



Structured Cabling & Infrastructure Standards



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Information Technology

Houston Community College – Information Technology (HCC-IT) has established the structured cabling standard to ensure consistently high quality voice, data and video services at all HCC locations.

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Structured Cabling & Infrastructure Standards

INFORMATION TECHNOLOGY

PART 1 GENERAL

1.01 Description

A. Structured Cabling Standard Summary:

Houston Community College – Information Technology (HCC-IT) has established the structured cabling standard to ensure consistently high quality voice, data and video services at all HCC locations. The structured cabling standard is a complete and tested Systemax, category 6, cable distribution system for video, voice and data local area network (LAN) interconnections. The voice and data distribution system shall include fully terminated unshielded twisted pair cables, raceway, conduit, IDC termination devices, voice and data communications outlets, patch panels, patch cables, racks, and other incidental and miscellaneous wiring system hardware as required for a complete and usable video, voice & data network system.

Each Telecommunications Room (TR or IDF) will connect to the Main Equipment Room (MER or MDF) via 24-strand Multimode OM4 (MM) fiber optic cable for data/VoIP, and 25 pair Cat 3 copper (plenum rated) riser cable for voice as indicated in the project RFP/RFQ or as specified by and authorized Houston Community College-Information Technology (HCC-IT) representative.

Inter-building connections will be via Singlemode (SM) fiber optic cable. The SM fiber cable specifications will be as indicated in the project RFP/RFQ or as specified by and authorized HCC-IT representative.

The installation of all cable shall comply with all applicable local, state, NEC, EIA/TIA and BICSI codes & standards and as indicated by project drawings and specifications.

1.02 Quality Assurance

A. Installer Qualification

The Video, Voice and Data (LAN) System installer shall be licensed and shall meet all applicable regulations of the State of Texas and Department of Labor as they apply to this type of cable system installation. The installer shall be a firm normally employed in the low voltage - video, voice and data cabling industry and shall provide a reference list of at least ten (10) large-scale projects and contact names confirming successful video, voice and/or Category 6 or higher data (LAN) cable system installations. Large-scale projects shall be defined as projects involving at least 100, Category 6 or higher, cabling runs per site.

B. Pre-Construction Meeting

The installer shall attend a mandatory pre-construction meetings with individuals deemed necessary by the HCC representative prior to the start of the work.

C. Acceptance

The HCC representative reserves the right to reject all or a portion of the work performed, either on technical or aesthetic grounds.

D. Warranty

The selected cable system installer shall be a factory certified SYSTIMAX Value Added Reseller (VAR) and shall provide a SYSTIMAX end-to-end performance warranty of not less than twenty (20) years. The cable system installer must provide Systimax certification documentation prior to the start of work. The performance warranty shall be issued by the manufacturer, and a workmanship warranty shall be issued by the cable installer which shall warrant that ALL voice and/or data Category 6 links have been bi-directionally (end to end) tested using a Level 2 tester, per TSB-67, and that all test results conform to the most current EIA/TIA-568-B and TSB-67 Link standards.

The warranty will also cover Singlemode and Multimode fiber optic cabling. Performance testing shall be conducted in accordance with EIA/TIA-526-14 standards.

The warranty will stipulate that all products used in this installation meet the prescribed mechanical and transmission specifications for such products as described in ISO/IEC

11801, EIA/TIA-568-B. Quality and workmanship evaluation shall be solely by HCC designated representatives and SYSTIMAX.

1.03 Regulatory Requirements

A. Standards:

All work shall be performed in accordance with the *latest revisions* of the following standards and codes:

1. Latest Local Codes and Amendments
2. ANSI/NFPA70

B. Other References

Item#	Standard	Description
1.	EIA/TIA-568	Commercial Building Telecommunications Cabling Standard

2.	EIA/TIA-569	Commercial Building Standard for Telecommunication pathways and spaces.
3.	EIA/TIA-606	Administration Standard for the Telecommunications Infrastructure of commercial buildings.
4.	EIA/TIA-607	Commercial Building Grounding and Bonding for Requirements for Telecommunications.
5.	EIA/TIA-455	Standard test procedure for fiber optic cables, Transducers, sensors, connecting and terminating devices and other fiber optic components.
6.	EIA/TIA TSB-67	Transmission performance specification for field testing of unshielded twisted pair cabling systems.
7.	EIA/TIA TSB-72	Centralized Optical Fiber guidelines.
8.	ISO/IEC 11801	Generic Cabling standard.
9.	EIA/TIA 526-14-	Optical power loss measurements of installed Multimode fiber cable plan.
10.	EIA/TIA 598	Optical Fiber Cable color coding
11	EIA/ TIA 1152	Requirements for field Test Instruments and Measurements for Balance Twisted Pair Cabling

C. Governing Codes and Conflicts:

If the requirements of these specifications or the project drawings exceed those of the governing codes and regulations, then the requirements of these specifications and the drawings shall govern. However, nothing in the drawings or specifications shall be construed to permit work not conforming to all governing codes and regulations.

D. Telecommunication Consultant:

The Information and Communication Technology (ICT) distribution designer must be aware of codes, standards and regulations related to design and installation of telecommunication cabling and customer-provided equipment connected to the regulated public networks. In the US, the Federal Communications Commission (FCC) part 68 rule provides regulation for connecting cabling and customer-provided equipment to the regulated networks.

Must be RCDD certified.

1.04 Abbreviations

A. Document abbreviations used:

- a) ICT Information and Communication Technology
- b) DC Direct Current
- c) TR or IDF Telecommunications Room

d) MER or MDF	Main Equipment Room PBX Private Branch Exchange
e) UTP	Unshielded Twisted Pair
f) IDC	Insulation Displacement Connection
g) I/O	Information Outlet(s)
h) CAM	Video Surveillance Camera
i) GW	Physical Access Gateway
j) ENC	Analog to Digital Video Encoder

1.05 Submittals

A. Project Initiation:

Within ten (10) working days of Notice to Proceed, the cable system installer shall furnish the following in a single consolidated submittal to HCC-IT:

1. Construction Schedule: A time-scaled Construction Schedule, using PERT/CPM, Microsoft Project or equivalent indicating general project deadlines/milestones and specific dates relating to the installation of the cable distribution system.
2. Permits: The cable system installer shall obtain all required permits, if required by state and local law.
3. Product Literature: Complete manufacturer's product literature for all cable, patch panels, cross-connect blocks, cable supports, cable labels, outlet devices, and other products to be used in the installation. In addition, whenever substitutions (when requested by the HCC-IT/Designer) for recommended products are made, samples and the manufacturer's supporting documentation demonstrating compatibility with other related products must be included.

B. Installation Plan:

Submit the following items, for HCC-IT review and approval, within ten (10) working days of notice to proceed:

1. Cable Routing:

Proposed cable routing and cable grouping plan prepared by a BICSI certified RCDD (Registered Communications Distribution Designer). The RCDD certification must be current.

2. Conformance:

For items that are not as specified, provide standard manufacturer's cut sheets or other descriptive information and a written description detailing the reason for the substitution. Substitutions are subject to HCC-IT approval.

3. Working "as -built" Drawings:

Provide HCC-IT a preliminary "as-built" drawing set via email, disk, flash memory or two (2) Mylar plots of each drawing. The preliminary "as- built" drawings will include cable pathways, voice & data outlets, room numbers, and MDF/IDF locations with correct labeling. This "as-built" drawing will be utilized by HCC- IT to configure network & telephony equipment.

4. Provide a completed set of Technical series (**T Series**) drawings typically include as a minimum:

T0 – **Campus or site plans** which show extension pathways and interior-building systems.

T1 – **Layout of complete building** per floor serving zone boundaries backbone systems and horizontal systems.

T2 – **Serving zones** – Drop locations & cable ID's

T3 – **Communication equipment rooms** – plan views – Tech and Architectural, electrical, mechanical and Plumbing (AMEP) Elevations Racks and walls- elevations.

Note: Specially add path elevations for long pathways across building.

T4 - **Typical detail drawings** – Faceplate labeling, firestopping, ADA, Safety and DOT.

T5 – **Schedules** (cabling and equipment spreadsheets) for cutovers.

C. Project Completion:

As a condition for project acceptance, the cable system installer shall submit the following for review and approval:

1. Samples:

Complete manufacturer's product literature and samples (if requested) for all pre-approved substitutions to the recommended products made during the course of the Project.

2. Inspection and Test Reports:

During the course of the project, the cable system installer shall maintain an adequate inspection system to insure that the materials supplied and the work

performed conforms to contract requirements. The cable system installer shall provide written documentation that indicates materials acceptance testing was conducted as specified. The cable system installer shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion. Test data will be provided on disk and/or hardcopy.

3. Operating and Maintenance Instructions:

Operating and maintenance instructions for all devices within the system. These instructions shall reflect any changes made during the course of construction, and shall be provided to the HCC-IT for their use in a three-ring binder labeled with the project name and description (1 copy unless otherwise specified by HCC-IT).

4. Final “as-built” Drawings:

As-built drawings will include cable pathways, data outlet locations with correct labeling, room numbers, and MDF/IDF locations. All manholes sizes and conduit penetrations (butterfly diagram shall be provided for each manhole). The as-built drawings will be prepared using AutoCAD latest version. **Provide HCC-IT with electronic versions of the as-built drawings via email, CD, DVD or flash drive.**

5. All manufacturer’s product data and warranties including specifications and manuals will be provided to the Owner upon acceptance of the system by the Owner.

PART 2 PRODUCTS

2.01 General

A. Installation:

The cabling system shall be installed per requirements of BICSI standards, recommendations of the manufacturer and the project documents, utilizing materials that meet all applicable EIA/TIA standards. The cable system installer shall also be responsible for meeting all city and state codes. The cable system installer is responsible for providing all incidental and /or miscellaneous hardware not explicitly specified as required for a complete operating system.

B. Materials:

Materials shall be as listed or shall be approved equivalent products of other manufacturers meeting the intent and quality level of the EIA/TIA standards. All approved equivalent products will be published by addendum for approval ten (10) days prior to installation for HCC-IT.

C. Testing:

All installed cabling shall be tested 100% good, via Level II test equipment, after installation and prior to job completion by the cable system installer.

D. Ratings:

All products shall be new and brought to the job site in the original manufacturer's packaging. Electrical components (including inner duct) shall bear the Underwriter's Laboratories (UL) label. All communications systems cable shall bear flammability testing ratings as follows:

1. CM Communications Cable
2. CMP Plenum Rated Communications Cable
3. CMR Riser-Rated Communications Cable

E. Initial Cable Inspection:

The cable system installer shall inspect all cable prior to installation to verify that it has been identified properly on the reel identification label; it is of the proper gauge containing the correct number of pairs, etc. and is ready for installation. Damaged cable or any other components failing to meet specifications shall not be used in the installation.

F. Cable Lubricants:

Lubricants specifically designed for installing communications cable may be used to reduce pulling tension as necessary when pulling cable through conduit.

1. Approved Products for twisted-pair cable:
 - 3M
 - Green Lee
 - HCC-IT Pre-approved equivalent

G. Fire Wall Sealant:

Any penetration through MDF/IDF and fire rated walls will be sleeved and sealed with an Underwriter Laboratories (UL) approved sealant and/or mechanical fire-proofing solution.

1. Approved Products:

- 3M
- Hilti System
- Fire Safe
- HCC-IT Pre-approved equivalent

2.02 Telecomm and Main Equipment Room (MDF/IDF) cabling Termination Hardware

A. Equipment and Distribution Racks:

Provide and install equipment and distribution racks in locations indicated on telecommunications room design drawings or as indicated by HCC-IT. All racks shall be floor mounted, type 19" x 84" unless otherwise approved by HCC-IT.

1. Approved Products - Floor Mount Racks:
 - Chatsworth Products, Inc. (CPI) #55053-703
 - Hoffman or equivalent
 - HCC-IT Pre-approved equivalent
2. Approved Products - Wall Mount Enclosures:
 - Hubbell Premise Wiring #HSQ3636
 - Hoffman or equivalent
 - HCC-IT Pre-approved equivalent
3. Approved Products – Equipment Shelf for Two-Post Rack:
 - Rack Solutions rack shelf 3-RU compatible with Hoffman rack
 - HCC-IT Pre-approved equivalent

A two (2) RU horizontal wire management product will be installed in between each patch panel on the equipment racks. Additional horizontal wire managers will be provided for placement between network equipment, adjacent to patch panel racks, per HCC-IT Network and project requirements for patch cable management. Vertical cable managers should be 12" between racks, and 6" on rack ends.

1. Approved Products:
 - Chatsworth Products, Inc. (CPI) #35441-702
 - Hoffman or equivalent
 - HCC-IT Pre-approved equivalent

B. Equipment and Distribution Rack Grounding:

Equipment and distribution racks shall be grounded using a stranded #6 AWG insulated copper conductor. Ground wire will connect to the Telecommunications grounding bus bar in each respective MDF or IDF. The cable system installer shall

E. Cable Management Panels:

Provide horizontal and vertical cable management (12" between racks and 6" on racks ends) as specified by HCC-IT representative for cables terminated in equipment racks.

1. Approved Products:

- 12" Vertical - Chatsworth Products, Inc. (CPI) #35574-703
- 6" Vertical - Chatsworth Products, Inc. (CPI) #35571-703
- HCC-IT Pre-approved equivalent

F. Conduit

No section shall be greater than 30m (100ft) between pull points. If distance to be covering is greater, pull boxes or other form of pulling access must be included every 30m (100ft). No more than two 90 degree bands.

2.03 CABLE ROUTING/PATHWAY

A. Cable Tray:

Metal cable tray shall be provided and affixed to the top of all floor-mounted racks as indicated in MDF/IDF layout drawings. Cable tray shall be used to brace racks to walls and to support cable routing from either ceilings or walls to the rack in the MDF/IDF rooms.

1. Approved Products:

- Chatsworth Products, Inc. (CPI) 11252-712
- Chatsworth Products, Inc. (CPI) 10822-712
- And all applicable installation accessories
- HCC-IT Pre-approved equivalent

B. Cable Support System:

Cables not in conduit or cable tray shall be supported by BICSI/EIA/TIA approved supports. The Contractor shall provide and install the necessary quantity and size of CADDY Fastener "Cable CAT" hangers and support hardware necessary for routing all station cable bundles outside of cable tray systems.

At a minimum, there shall be one "Cable CAT" hanger every 4 to 5 feet. Exact placement shall be dictated by Manufacturer's installation guidelines and site

conditions. Caddy-bags will be used for the larger trunks. Bridal rings are not to be used.

Note: Cables for physical security and life safety must not be exposed.

1. Approved Products:
 - Caddy Fasteners® or
 - HCC-IT Pre-approved equivalent

Cable dressing will be required every two (2) to three (3) feet. Cables will be secured with **Velcro® type wire wrap**.

Note: Plastic tie/wire wraps are not permitted.

C. Outside Plant Pathways:

MaxCell OSP Mesh shall be installed in exterior conduit pathways for building-to-building communications tie cables.

Intra-building backbone pathway will use four (plus one) additional 100mm (4" trade size) conduits per 4000 sqm (40,000 sqft) of usable floor space.

Maintenance Hole (MH) will be installed for conduit systems that require more than three 100mm (4" trade size) ducts.

1. Approved Products:
 - MaxCell OSP Mesh
 - HCC-IT Pre-approved equivalent

2.04 Station Wiring

A. Wire-Copper:

The wire provided for all outlets shall be Category 6 (Category 6A where indicated), Unshielded Twisted Pair (UTP), four- pair, 24 AWG solid copper conductor, meeting the intent and quality level of the EIA/ TIA -568-B Commercial Building Wire Standard.

All Wireless Access Point (AP) wiring should consist of two Category 6A cables per designated AP location. Cable count to be confirmed with HCC-IT, per project plans.

Approved Products:

- Systemax 2071E LAN Cable Giga Speed CAT6 (**Blue**)

Product Code 2071004ELB

- Systimax 2091B LAN Cable Giga Speed CAT 6A **(Blue)**
Product Code 760105965

B. Life Safety/Physical Security

All Life Safety lines to be installed will be using **red** category 6 Systimax cabling. Labeling on each end of the cable will be machine generated Panduit 'PLF1MA-C3' cable labels. Red cross-connect wire will be used at the Telco Demarc to indicate Life Safety lines are present.

Life Safety lines include- Fire Alarm lines, Elevator lines, and Physical Security (video surveillance and physical access control). Ensure all life safety cables are bundled neat and orderly. Life safety cables must not be bundled with voice/data type cabling.

Approved Products:

- Systimax 2071E LAN Cable Giga Speed **(Red)**
Product Code 2071004ERD
- Systimax 2091B LAN Cable Giga Speed CAT 6A **(Red)**
Product Code 760105924

C. Testing:

The Category 6 (Category 6A where indicated), UTP cable must be UL Performance Level tested. Each spool must be individually tested with test results affixed to the spool.

D. Rating:

All cabling will be rated for the environment in which it will reside. All interior cable must be plenum rated.

2.05 Station Hardware

A. Flush Mount Jacks:

Flush mount jack inserts shall be high quality Category 6 (Category 6A where indicated), using RJ-45 modular jacks with circuit board construction and IDC or

110-style, with T568B type terminations. Jacks shall meet EIA/TIA 568-A recommendations for Cat-6 connecting hardware.

1. Approved Products - Outlet Jacks:

- Systimax Voice & Data Jacks Giga Speed Cat6 **(blue color)**
Product Code MGS400-318-Blue
- Systimax Voice & Data Jacks Giga Speed X10D CAT 6A **(green color)**
Product Code MGS600-226-Green

2. Jacks should be arranged in accordance with the HCC/ Information Technology standards that follow. Also reference DOCUMENTATION section 3.02-A.

i. Quad faceplate, four jacks: In the case of a quad plate with quad jacks, outlet jacks **(blue)** are to be installed in all four ports of the faceplate.

ii. Quad faceplate, two jacks: In the case of a quad plate with dual jacks, outlet jacks **(blue)** are to be installed on the top ports of the faceplate.

B. Faceplates:

Faceplates shall be Systimax equipment. Color to be determined by HCC project manager or HCC-IT representative.

1. Approved Products:

- 4-Port Single Gang, Prod. Code M14L-262, Com. Code #108 168 543-**electric white**
- 4-Port Single Gang, Prod. Code M14L-270, Com. Code #108 168 535-**electric gray**
- 3-Port Cubicle Faceplate M13C-003 Com Code # 106650864- **Black**

*** Note: Com. Code may change depending on color.**

C. Camera Jacks:

Category 6 cables for video surveillance cameras shall be terminated on **RJ45** jacks with adequate slack of not less than **10 feet**.

2.06 Fiber Optic Products

A. Fiber Cable:

Fiber Optic Cable shall be armored UL listed type OFNP; twenty four strand, 50/125, multimode fiber and 8.3/125 singlemode fiber, each with a color-coded PVC buffer. Maximum attenuation shall be 3.75 dB/km at 850 nm and 1.5 dB/km at 1300 nm. Minimum bandwidth shall be 160 MHz/km at 850 nm and 500 MHz/km at 1300 nm. Fiber should contain no metallic elements.

1 . Approved Products:

- Systimax 24 Strand Multi-Mode -Aqua
Product Code P-024-DS-5K-FSUAQ-LazrSPEED 550 OM4
- Systimax 24 Strand Single-Mode - yellow
Product Code P-024-DS-8W-FSUYL
- HCC-IT Pre-approved equivalent

B. Connectors:

Optical Fiber Connectors shall be duplex SC type connectors.

1 . Approved Products:

Systimax	Multi-Mode Connector	Single-Mode Connector
Product Code	P6200A-Z_125	P6000A-Z-125
Color	Aqua	Beige

C. Patch Cables:

Fiber patch cables, including connector type and length, to be determined by HCC-IT. Patch cable count per project requirements.

PART 3 EXECUTION

3.01 General

A. Wall Penetrations:

The cable system installer shall avoid penetration of fire-rated walls and floors wherever possible. Where penetrations are necessary, they shall be sleeved with metallic conduit, bushings installed on both ends, and resealed with a UL approved fire rated sealant and/or mechanical fire-proofing solution. Cable system installer shall also seal all floor, ceiling and wall penetrations in fire or smoke barriers and in wiring telecommunication and equipment rooms (IDF/MDF).

B. Allowable Cable Bend Radius and Pull Tension:

In general, communications cable cannot tolerate sharp bends or excessive pull tension during installation. Refer to the Systimax's bend radius recommendations for the maximum allowable limits.

C. Cable Lubricants:

After installation, exposed cable and other surfaces must be cleaned free of lubricant residue.

D. Pull Strings:

Provide pull strings (approved jet-line or mule-line) in all new conduits, including all conduits with cable installed as part of this contract.

E. Conduit Fill:

Conduit fill shall not exceed 40%. Reference the TIA/EIA Design and Installation Guidelines.

F. Damage:

1. The cable system installer shall replace or rework cables showing evidence of improper handling including stretches, kinks, short radius bends, over-tightened bindings, loosely twisted and over-twisted pairs at terminals and cable sheath removed too far (greater than 1/2 inch).
2. The cable system installer shall be responsible for any damage to the network, equipment and or facility that occurred during the cable system installation.

G. Clean Up:

All clean up activity related to work performed will be the responsibility of the cable system installer and must be completed daily before leaving the facility.

3.02 Documentation

A. Labels and Outlet Jack Placement:

The cable system installer will label all information outlets using permanent machine generated labels approved by the HCC-IT representative.

Handwritten labels are not permitted. Label all patch panels in the telecommunication and equipment room(s) to match those on the corresponding voice and data outlets.

The font shall be at least one-eighth inch (1/8") in height, block. All labels shall correspond to as-built drawing and to final test reports. Each cable shall be labeled at the work station within 1" of termination with machine generated labels. This is an addition to the labeling of the wall plate.

All wireless access point (WAP) drops hidden behind ceiling tiles shall be labeled on the corresponding ceiling grid with clear labels.

To meet HCC standards, telecommunication outlet faceplates should be labeled and constructed as follows:

1. In the case of a QUAD plate with QUAD jacks; outlet jacks will be installed in all four ports.

See Figure 1 below, section 3.02-A-8.

2. General jack placement in quad faceplate is shown in figure 1 under the face plate port layout section.

3. In the case of a single network jack, utilize the upper left side port and insert blanks into unused outlets.

4. Labels should be self-adhesive. Outlets should have non-embossed area for label placement to ensure label will adhere properly.

5. Labels are to be machine generated. Handwritten labels are unacceptable and will not be used.

6. **Do not duplicate existing cable number identifications.** New patch panel jack numbers shall be numbered in continuation to any existing identification numbers and must be coordinated with HCC-IT.

- **Example:** If existing numbers are 1-40, new identification numbers should start at 41.

7. The following label nomenclature should be used. Identification labels must be coordinated with HCC-IT prior to printing and placement:

- Telecom Room Example:

T2B-001

T - Telecommunication Room (TR or IDF)
2 - Floor Identifier - 2nd floor
B - IDF room B on floor level (A, B, C, etc.)
001 - Cable Number

• Main Equipment Room Example: **M2-025**

- M - Main Equipment Room (MER or MDF)
- 2 - Floor Identifier – 2nd floor
- 025 - Cable Number

8. Faceplate Port Layout:

Legend

- J – Outlet Jack
- B – Blank Insert

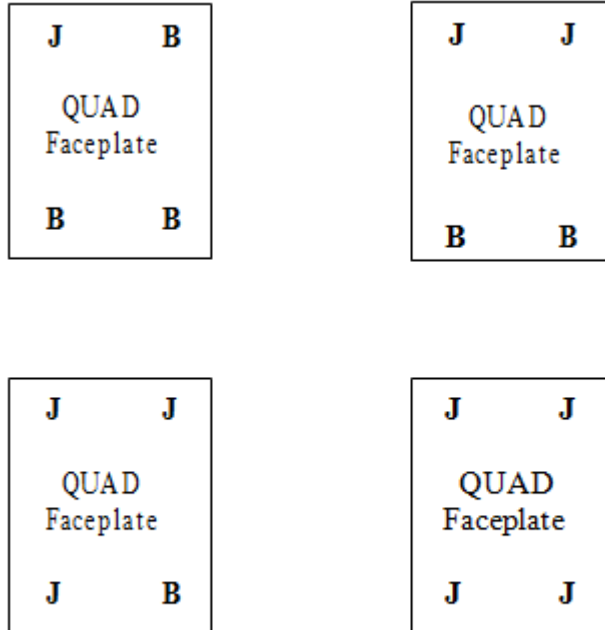


Figure 1

B. Labeling of Life Safety Cables at Patch Panel and Jack

The cable system installer will label all life safety outlets using permanent machine generated labels approved by the HCC-IT representative.

Handwritten labels are not permitted. Label all patch panels in the telecommunication and equipment room(s) to match those on the corresponding camera jacks. The font shall be at least one-eighth inch (1/8") in height, block.

All labels shall correspond to as-built drawing and to final test reports. Each cable shall be labeled on the jack at the camera end with machine generated labels.

The following label nomenclature should be used. Identification labels must be coordinated with HCC-IT prior to printing and placement:

Example: CAM-101

CAM - Camera
1 - Floor Identifier – 1st floor
01 - Camera Number

Example: GW-201

GW – Physical Access Control Gateway
2- Floor Identifier – 2nd floor
B- IDF room B on floor level (A, B, C, etc.)
01 – Gateway Number

C. Floor Plan Drawing:

A floor plan drawing, clearly labeled with all outlet jack numbers shall be included in the as-built plans. See section 1.05, C-4.

3.03 Equipment Rack Configuration

A. Equipment Racks

Equipment racks shall be assembled and mounted in locations shown on project drawings and verified with HCC-IT prior to installation. Each rack shall be securely mounted to the floor and braced to the wall with cable tray in accordance with the manufacturer's instructions and recommendations.

Racks shall be mounted such that the side rails are plumb with vertical cable management panels. Racks are to be located so that future expansion can occur without relocating existing racks.

Racks shall be grounded in accordance with BICSI, EIA/TIA and NEC requirements.

B. Wire Management Components:

Horizontal cable management panels shall be installed directly above and below each patch panel. Vertical cable management panels shall be installed on each side of the rack or as specified by HCC-IT.

C. Cable Placement:

Cable installation in the wiring telecommunications room(s) and main equipment room must conform to the Project Drawings.

Avoid potential sources of electromagnetic interference (e.g., motors and transformers that share distribution space, copiers used in work areas, etc.) when designing and installing the horizontal pathways. At a minimum, the Contractor shall provide clearances of at least:

- 1.2 m (4 ft.) from motors or transformers.
- 0.3 m (1 ft.) from conduit and cables used for electrical power distribution.
- 0.3 m (1 ft.) from fluorescent lighting. Pathways should cross perpendicular to fluorescent lighting and electrical power cables or conduits.

All cabling shall be routed so as to avoid interference with any other service or system, operation, or maintenance location. Avoid crossing area horizontally just above or below any riser conduit. Lay and dress cables to allow other cables to enter the conduit/riser without difficulty at a later time by maintaining a working distance from these openings.

D. Cable Routing:

Cable shall be routed as close as possible to the ceiling, floor or corners to ensure that adequate wall or backboard space is available for current and future equipment. All cable runs within the wiring telecommunications and equipment room(s) shall be horizontal or vertical within the constraints of minimum cable bending radius. Minimum bend radius shall be observed. Cables shall not be tie-wrapped to electrical conduit or other equipment.

Cables will be wrapped with Velcro® type tie wraps. Plastic tie wraps are not permitted.

E. Installation:

All incoming cables shall be routed on the cable tray and secured with Velcro® type wire wrap. Unless otherwise indicated by the HCC-IT.

F. Hardware:

Provide all miscellaneous rack, jack and panel hardware as required for all station wiring.

G. MDF/ IDF Room Specifications:

- A. Room size: A minimum of nine feet by twelve feet or 0.75 sq. ft. of equipment room space for every 100 square feet of work area space, whichever is greater.
- B. Ceiling Height: Minimum ceiling height shall be eight feet six inches. Communications and equipment rooms shall generally be provided without a finished ceiling. Data centers and computer rooms shall have a finished ceiling.
- C. Plywood backboard: All walls in communication room drawings, shall be covered with eight-foot $\frac{3}{4}$ inch AC-grade or better plywood, with C-grade facing the wall. Plywood shall be fire-rated or covered with two coats of fire-retardant paint. Fire-rated certificate shall be visible

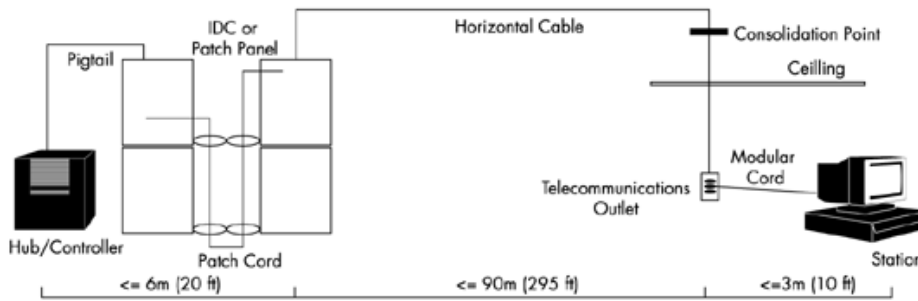
3.04 Station Wiring Installation**A. General:**

Cabling between telecommunications/equipment room(s) and workstation locations shall be made as individual “home runs”. No intermediate punch down blocks or splices may be installed or utilized between the Telecommunications/equipment room(s) and the information outlets at the workstation location.

All cable must be handled with care during installation so as not to change performance specifications. Factory twists of each individual pair must be maintained up to the connection points at both ends of the cable. There shall never be more than one-half inches (1/2”) of unsheathed enhanced Category 6 UTP cable at either the telecommunications/equipment room or the workstation termination locations.

Provide a **service loop** for horizontal cable (CAT6a) at each end of the 295 ft Horizontal cable length. 10ft at MDF/IDF and 5’ at station end in a figure 8 configuration. See figure

Horizontal Cable Length Refer to TIA/ EIA 568.



B. Exposed Cable:

Exposed station cable will only be run in conduit or approved cabling duct system and will require HCC-IT pre-approval, and will only be allowed when no other options exist.

C. Placement:

All cabling and associated hardware shall be placed so as to make efficient use of available space. All cabling and associated hardware shall be placed so as not to impair HCC-IT's efficient use of the space.

D. Cable Routes:

All cabling placed above drop ceilings must be supported by cable tray, j-hooks, and caddy bags or in conduit. Cable supports shall be permanently affixed to the building structure or substrates and no more than four (4) to five (5) feet apart.

Provide attachment hardware and anchors designed for the structure to which it is to be attached, and are suitably sized to sustain the weight of the cables to be supported. Attaching cable to pipes or other mechanical items is not permitted. Communication cables shall be routed so as to provide a minimum of 12 inches spacing whenever possible from light fixtures, sources of heat and EMI sources. Cabling shall not be attached directly to ceiling grid wires, refer to section 2.03 for approved cabling support systems.

3.05 Station Hardware

A. Flush Mount Jacks:

Flush mount jacks shall be mounted in a faceplate with back box support.

B. Placement:

Where possible, the information outlets shall be located so that its centerline is 18 inches above finished floor level or 12 inches above permanent bench surfaces. Outlets shall not be mounted on temporary, movable, or removable surfaces, doors, or access hatches unless specified by HCC-IT representative.

C. RJ-45 Jack Pin Assignments:

1. Pin connections for voice and data information outlets and patch panels shall match T568B termination standard under the EIA/TIA 568-B code.
2. Pin assignments at all panels or connecting blocks shall match pin assignments at the information outlets. i.e. (straight through wiring).

3.06 Fiber Optic Cable Installation

A. Placement:

Fiber Optic Cable, unless armored, shall be installed in innerduct from near end termination point to far end termination point.

Only UL approved plenum rated innerduct shall be installed in all plenum areas. Metallic conduit may be used in lieu of innerduct in plenum rated ceilings. All interior fiber optic cable should be armored.

B. Terminations:

Manufacturer-trained and certified (Systimax VAR) technicians shall perform terminations.

Terminations shall be made in a controlled environment. Cables may be assembled off -site, although testing must be completed with the cable in its final installed condition.

C. Warning Tags:

At each location where fiber cable is exposed to human intrusion, it shall be marked with warning tags. These tags shall be yellow or orange in color, and shall contain the warning "CAUTION FIBER OPTIC CABLE".

The text shall be permanent, black, block characters, and at least 3/16" high. A warning tag shall be permanently affixed to each exposed cable or bundle of cables, at intervals of not less than five (5) feet. Any section of exposed cable that is less than five (5) feet in length shall have at least one warning tag affixed to it.

3.07 Cable Testing Requirements

A. Notification:

The HCC-IT shall be notified at least one (1) week prior to any testing so that the testing may be witnessed.

B. Inspection:

Before requesting a final inspection, the cable system installer shall perform a series of end- to-end installation performance tests. The cable system installer shall submit for approval, a proposal describing the test procedures, test result forms and timetable for testing all copper and fiber optic cabling.

C. Procedures:

Trained personnel shall perform all testing. Acceptance of the test procedures discussed below is predicated on the cable system installer's use of recommended products and adherence to the inspection requirements and practices set forth by NEC and Systimax.

Acceptance of the completed installation will be evaluated in the context of each of the NEC and Systimax factors.

D. Errors:

When errors are found, the source of each shall be determined, corrected and the cable re- tested.

All defective components shall be replaced and re-tested. Re-test results must be provided on HCC-IT approved forms and witnessed by HCC-IT.

E. Twisted Pair Cable Testing:

1. At a minimum, the cable system installer shall test all station I/O's cable pairs from MDF/IDF termination patch panels to RJ45 station outlet jacks. Category 6 products shall be tested for compliance to EIA/TIA 568-B and ISO/IES 11801 for Category 6 rated installation.

Test equipment shall meet EIA/TIA TSB-67, Level 2 accuracy. Furthermore, the cable system installer shall have a copy in their possession and be familiar with its contents.

2. Each wire/pair shall be tested at both ends for the following:

- a. Wire map (pin to pin connectivity)
- b. Length (in feet)
- c. Attenuation
- d. Near end cross talk (NEXT)

- e. Far end cross talk (FEXT)
 - f. Power Sum
3. Test equipment shall provide an electronic and printed record of these tests.
 4. Test results for each Category 6 UTP cable must be submitted with identification to match labels on all patch panel ports and RJ45 jacks and must match as-built drawing associated with that cable.

F. Testing:

All cabling will be tested for continuity, shorts and grounds after installation.

1. Cabling
 - a. Continuity - **100% continuity testing** is required and will be tested from the input of the backbone to each drop. A checklist of each cable and test performed on that cable will be submitted once the testing has been completed.
 - b. Shorts - **No cable shorts will be permitted** on the system. If a short is detected, the connector or cable will be repaired or replaced.
 - c. Grounds - **No direct ground on the center conductor of the AVDN cables is permitted.**

3.08 Inspection

A. General:

1. Conformances to installation practices covered above are to be verified when completed.
2. On large projects (100+ cable runs), the cable system installer will setup and coordinate a cable system inspection walk through with a Systimax inspector and HCC-IT.
3. HCC-IT will inspect the cabling system before acceptance.

PART 4 APPENDIX A

4.01 IDF/ MDF Standards:

B. MDF/ IDF Room Specifications:

Room size: MDF shall be a minimum of fifteen feet by eighteen feet (270 sq. ft.), and an IDF shall be a minimum of ten feet by twelve feet (120 sq. ft.).

Ceiling Height: Minimum ceiling height shall be eight feet six inches. Communications and equipment rooms shall generally be provided without a finished ceiling. Data centers and computer rooms shall have a finished ceiling.

Plywood backboard: All walls in communication rooms shall be covered with eight-foot by four foot by $\frac{3}{4}$ inch A through C-grade rating or better plywood with clean side facing out. Plywood shall be fire-rated and covered with two coats of white paint. Fire-rated stamp on plywood backboard shall be visible.

B. Doors

Doors of the Telecom/Data room shall be a minimum 1M(3ft) wide and 2.13M (7ft) high, without door sill, hinged to open outward (code permitting) or slide side to side, or be removable. Door shall be fitted with a lock and have either no center post or removable center post to facilitate access for large equipment.

C. Power:

Both standard building power and emergency-generator based power feeds should be available within each respective IDF/MDF. Power circuits shall be provisioned based upon a distributed power bus system (60 AMP, 4 POLE, 'STARLINE' TRACK BUSWAY SYSTEM) with both bus bar taps mounted parallel to and above the equipment/cable racks (see figure 2).

Minimum two (2) L6-30R receptacles & one (1) L6-20R taps per power feed shall be provisioned. Minimum one (1) L5-15R 120V quad receptacle power should be available in room, with preference on bus bar tap. All power requirements and quantity of circuits will be verified with HCC-IT/Networks prior to installation.

D. Uninterruptable Power Supply (UPS):

All network, voice, and server systems located within the IDF/MDF are required to be powered by HCC-IT provided Uninterruptable Power Supplies/battery back-ups. Minimum one (1) APC SAU5000RMT5U (5KVA) Smart UPS and one (1) APC AP7811 Power Distribution Unit is required per 196 Data Drops, Qty. one (1) Chassis-based switch, or Qty. four (4) stack-based switches; whichever is greater. Minimum one (1) APC AP9626 Step down transformer is required per every two (2) APC 5KVA UPS.

E. HVAC:

All IDF/MDF rooms shall be on autonomous HVAC systems, separate from the general HVAC system and cooling, with thermostats and air handlers specific to each IDF.

F. Equipment Rack Placement:

Each IDF shall have a minimum of four (4) equipment racks (per standards above). The first rack shall be mounted on the wall farthest from the entry door, and house copper patch panels. The second rack shall be reserved for the fiber patch panel (top of rack), network equipment installation (router/switches), and UPS/PDU systems at bottom of rack. The third rack will be reserved for expansion, with the fourth rack allocated for building automation and security.

[See figure2](#): for sample layout elevation.

G. Security:

All IDF/MDF rooms shall have card readers and door locks integrated into HCC's Access Control system for restricted access.

H. Demarc Provisions

MDF rooms that are the **designated demarc** for the respective building/campus location should have basic provisions relative to WAN vendor and remote connectivity (i.e. AT&T, Verizon, and Level 3 Communications).

These requirements shall be reviewed with HCC-IT/Networks to ensure compliance. Examples of these provisions include dedicated plywood backboards, copper grounding, fiber raceways/ladder racks, and 120V power at the fiber/equipment termination point.

4.02 Wireless Access Points (AP/ WAP's)

A. Placement & Mounting

To ensure proper placement, coverage, and density; a pre-planning site survey based upon building plans conducted by HCC-IT/Networks is required.

Once locations are identified, each wireless access point (AP) is required to have a **total of two Category 6A drops**.

Drops will be terminated into surface mount boxes with corresponding **green (CAT 6A)** keystone jacks, per section 2.05 A-1. Access points will be mounted on suspended ceiling grid via HCC supplied Cisco mounting brackets. Cabling vendor will coordinate installation of bracket and wireless Access Point with HCC-IT/Networks.

4.03 Voiceover IP (VoIP) Phones

A. Placement & Mounting

In plan locations identifying wall phone mounts, vendor will install HCC provided Cisco IP Phone mount, product number CP-WALLMOUNTKIT. Data jack should be placed appropriately, with adequate spacing (per wall mount specifications) to accommodate mount and not interfere with BAS switches, lighting or other wall mount building devices. Wall phone locations and mounting bracket type shall be confirmed with HCC-IT/Telecom prior to installation.

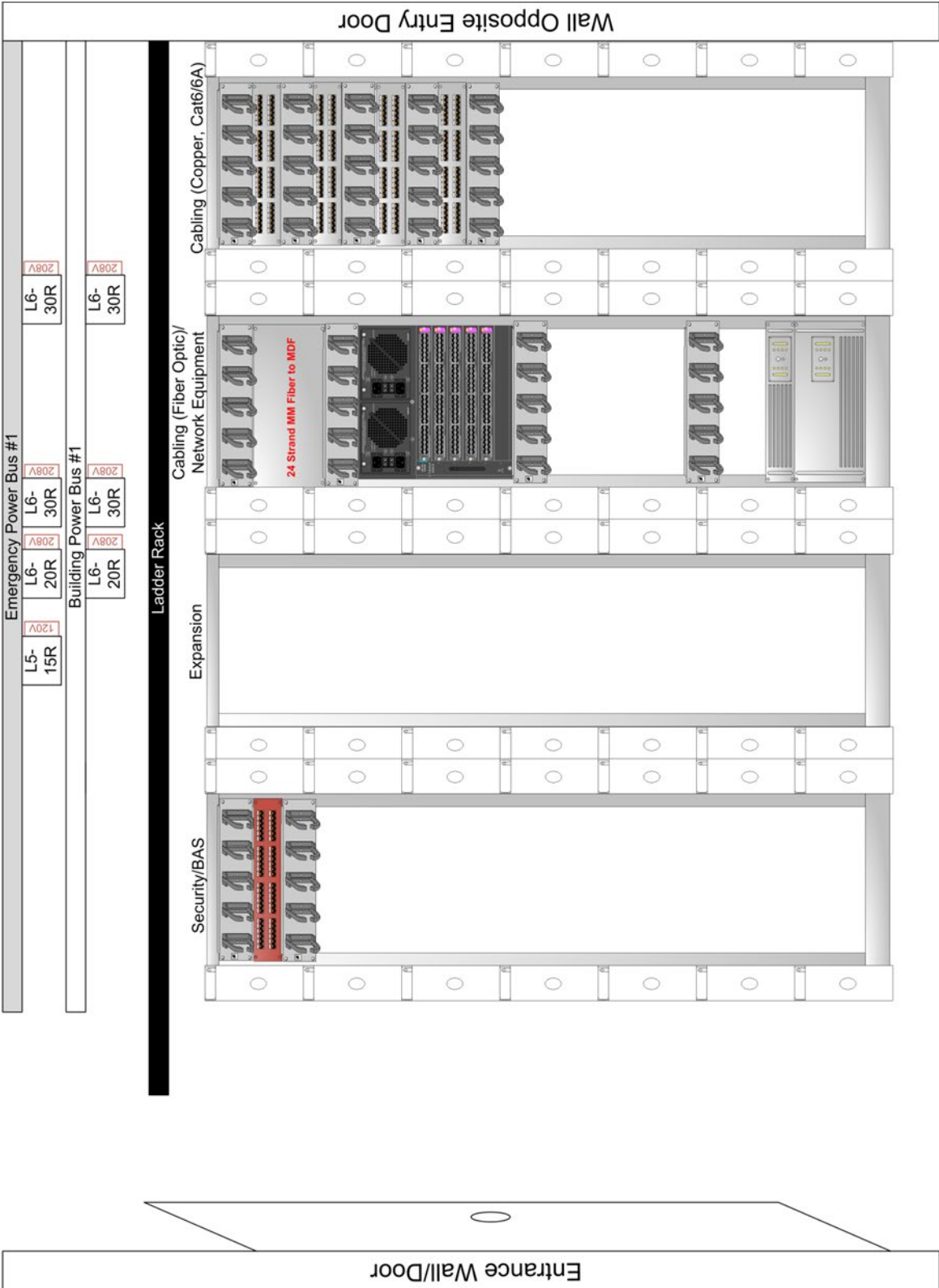
Current phone unit standards are listed below.

• Wall Phone	CISCO	CP-7821-K9=	Cisco UC Phone 7821
• Desk Phone	CISCO	CP-8851-K9=	Cisco IP Phone 8851
• Conference Room	CISCO	CP-8831-K9=	Cisco 8831 Base/Control Panel for North America
• Video Phone	CISCO	CP-8865-K9=	Cisco IP Phone 8865, Charcoal, Camera, USB, WiFi, Expansion Port
• Analog - 4 devices	CISCO	VG204XM	Cisco VG204XM Analog Voice Gateway
• Analog - 24 devices	CISCO	VG310	Cisco VG310 - Modular 24 FXS Port Voice over IP Gateway

PART 5 APENDIX B

Rack Elevation

Figure 2: Sample IDF Rack Layout



Power Busbar

INSTALLATION INSTRUCTION B60 PLUG-IN UNITS

DC60 Drop Cord Units
The units are completely removed to the designated phase and are ready to be installed on the busway. System kits include six units, arranged as 2 line phase, 2 load phase and 2 red phase. The phase wire can be easily reconnected to meet your specific electrical load requirements. After checking for proper wire configuration, the unit is ready to be installed on the busway. The DC60-X-5200-4 unit uses a class CC 20A fuse.

WARNING: All Plug-in Units are polarized to inhibit reverse installation. It is essential that the unit be installed in the proper direction. NEVER force a Plug-in Unit into position. If the Plug-in Unit is inserted BACKWARD IT WILL NOT ROTATE.

Installation into Track Busway
To install the Plug-in Unit into the busway, insert the black plug-head into the open slot of the busway so that it is centered according to the diagram below. Making sure that the box rests flush against the bottom of the busway housing, rotate the unit 90 degrees.

IMPORTANT: With the 3/32 Allen wrench, tighten the 2 set screws on the bottom of the Connector Head to secure the electrical connection.
For incoming wiring, knock out the appropriate size hole for the wire you are using into the end or side of the End Feed Box. A terminal block is mounted inside the End Feed Box for field wiring. The terminal block is wired to the busbar. Check the wiring to be sure that all electrical connections are secure before you close the lid on the End Feed unit.

THE HOME DEPOT

UNIVERSAL ELECTRIC CORPORATION
200 WILSONVILLE PIKE, ANDOVER, MA 01817
802-525-6787 FAX 802-525-1058 WWW.UEC.COM

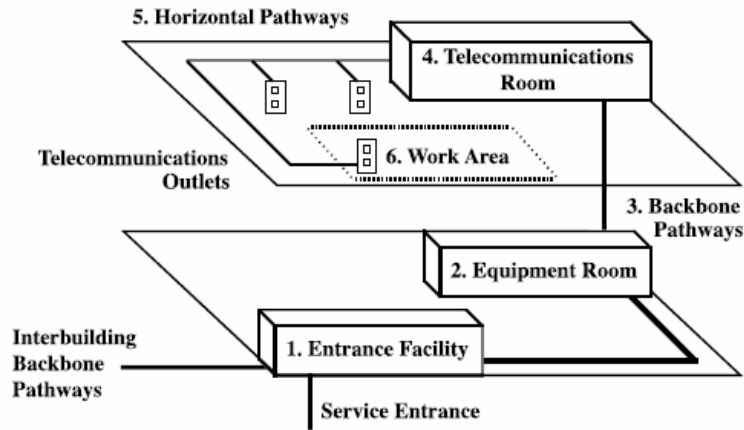
B60 ASSEMBLY INSTRUCTION

DATE: 10/28/02 DWS: MO
REV: A

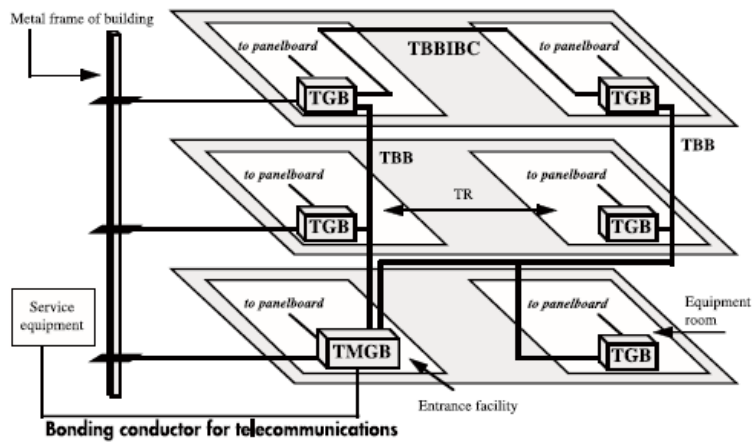
SCALE: NTS SHEET: 1

179-0059-0

Basic Schematic design ANSI/TIA/EIA- 569



Bonding and Grounding ANSI/TIA/EIA- 607



PART 6 GLOSSARY

DEFINITIONS FROM BICSI INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) HANDBOOK 2015

A

Access provider (AP) – 1. A company (e.g., Telephone Company) that provides a circuit path between a service provider (SP) and the client user. An AP also can be the SP. **2.** The operator of any facility that is used to convey telecommunications signals to and from a customer premises. (TIA) See service provider (SP).

American wire gauge (AWG) A system used to specify wire size. The greater the wire diameter, the smaller the AWG value.

as-built The documentation of measurements, location, and quantities of material work performed. May be in the form of marked up documents or other work order forms.

B

back end equipment The equipment component of a distributed antenna system (DAS) that is located in an area of coverage and receives and transmits signals to the headend.

Backboard – A panel (e.g., wood, metal) used for mounting connecting hardware and equipment.

Backbone – A facility (e.g., pathway, cable, conductors, optical fibers) between any of the following spaces: telecommunications rooms (TRs), telecommunications enclosures (TEs), common TRs, floor-serving terminals, entrance facilities (EFs), equipment rooms (ERs), and common ERs.

Backbone (Riser) Cabling – The cabling that connects multiple Telecommunications Rooms to each other, to the Equipment Room and/or to the Entrance Facility.

BICSI® A professional association supporting the information and communications technology (ICT) community. ICT covers the spectrum of voice, data, electronic safety and security, project management, and audio and video technologies. It encompasses the design, project management, and installation of pathways, spaces, optical fiber- and copper-based distribution systems, wireless-based systems, and infrastructure that support the transportation of information and associated signaling between and among communications and information gathering devices. BICSI provides information, education, and knowledge assessment for individuals and companies in the ICT community.

bonding The effective joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to safely conduct any current likely to be imposed.

bonding conductor (BC) A conductor used specifically for the purpose of bonding.

bonding conductor for telecommunications (BCT) A conductor that interconnects the telecommunications bonding infrastructure to the building's service equipment (power) ground. (TIA).

bridge The hardware used to connect multiple devices or optical fiber cables to a single appearance of a signal.

building automation system (BAS) A control system consisting of hardware (e.g., controllers, optical fiber cabling, input/output devices) and a software application or suite of software applications that automate the electrical, mechanical, or other building and facility subsystems.

building automation system (BAS) outlet A connecting device between a horizontal cable and a coverage area device. (TIA)

building grounding electrode system A network of grounded building components (e.g., metal underground piping, metal building frame, concrete-encased electrode, ground ring and rod, pipe electrodes).

C

cabling infrastructure – The optical fiber cable, connecting hardware, cabling pathways, vaults, junction/pull boxes, racks, cabinets, enclosures, equipment, patch bays/ blocks, and other infrastructure required to provide physical, electrical, or optical connectivity within and between buildings of the owner or between buildings on the owner's property.

Cable termination 1. The act of applying a connector to the end of an optical fiber cable for the purpose of facilitating connection to active or passive transmission equipment. **2.** The act of attaching a connectorless conductor to active or passive transmission equipment. **3.** Hardware applied to the end of an optical fiber cable for the purpose of facilitating connection to active or passive transmission equipment.

Communications Pathways – Conduits, cable trays or other supports with the sole purpose of carrying communications cabling. Communications pathways shall not be used by other low-voltage systems, including but not limited to: fire alarm, security systems, and or building automation wiring or air/vacuum tubes.

Conduit -- **1.** A raceway of circular cross section. **2.** A structure containing one or more ducts.

Construction document/drawing (CD) (TIA) A written and graphic document prepared or assembled by the architect or engineer for communicating the design of the project.

D

Demarcation point 1. A point where the operational control or ownership changes. (TIA) **2.** The (**demarc**) point of interface between service providers (SPs) and customer facilities. Also referred to as minimum point of entry (MPOE).

Design development (DD) -- A design phase that follows a schematic design and is prior to construction documents.

E

Entrance Facility (telecommunications, EF) – An entrance to a building for both public and private network service cables (including wireless) including the entrance point of the building and continuing to the entrance room or space. The location where the main telecommunications service enters a building from the outside; where the demarcation between the inter-building and intra-building cabling system occurs.

Entrance point (EP) The point of emergence for telecommunications cabling through an exterior wall, a floor, or from a conduit. (TIA)

Equipment Room (telecommunications, ER) – An environmentally controlled centralized space for telecommunications equipment that usually houses a main or intermediate crossconnect. The location which provides space and maintains a suitable operating environment for large telecommunications equipment. This space may be co-located with the Entrance Facility and/or Telecommunications Room, provided the room is sized for all functions.

F

Faceplate A protective (often decorative) outlet plate.

Firestopping The process of installing nationally recognized testing laboratory (NRTL) listed fire-rated materials into penetrations in fire-rated barriers to reestablish the fire-resistance rating of the barrier. (TIA).

G

Gateway 1. An internetworking service used to connect dissimilar applications running on different networks with different telecommunication protocols. Gateways normally operate at one or more of the top four layers of the Open Systems Interconnection (OSI) Reference Model. **2.** As it relates specifically to fire alarm control units, a gateway is a device that is used in the transmission of serial data (digital or analog) from the fire alarm control unit to other building system control units, equipment, or networks and/or from other building system control units to the fire alarm control unit.

Ground A conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of earth. (TIA)

grounding conductor A conductor used to connect the grounding electrode to the building's main grounding busbar. (TIA)

grounding equalizer (GE) A conductor that interconnects elements of the telecommunications grounding infrastructure. Used in multi-story buildings.

H

Handhole (HH) A structure similar to a small maintenance hole (MH) in which cable can be pulled, but not large enough for a person to fully enter to perform work.

home run-- A cabling pathway or cable installed without a splice or intermediate termination point between active electronics (e.g., switching, routing, data processing equipment) in a telecommunications space (e.g., equipment room [ER], telecommunications room [TR]) and an end user telecommunications outlet/connector in a work area.

horizontal cabling The part of the cabling system that extends from (and includes) the work area telecommunications outlet/connector to the horizontal cross-connect (HC [floor distributor (FD)]) in the telecommunications room (TR).

I

Innerduct -- A nonmetallic duct, either circular or fabric mesh, placed within a larger pathway. (TIA)

inside plant (ISP) -- Infrastructure (telecommunications) systems (e.g., balanced twisted-pair cabling, optical fiber cabling, coaxial cabling, racks, cabinets, cabling pathways, information outlets) inside a building. Telecommunications companies refer to this as inside wire (IW) or intrafacility cabling (IFC).

interbuilding backbone cable **1.** Cable that runs between buildings in a campus environment. **2.** Customer owned outside plant (OSP) cabling.

J

Junction box A location in the pathway system that allows transition of pathways and access to cables. (TIA)

L

Labeling system See ANSI/TIA-606-B, Administration Standard for Commercial Telecommunications Infrastructure.

M

maintenance hole (MH [telecommunications]) A vault located in the ground or earth as part of an underground duct system and used to facilitate placing, splicing, and maintenance of cables, as well as the placing of associated equipment, in which it is expected that a person will enter to perform work. Formerly called manhole.

O

outside plant (OSP) Telecommunications infrastructure designed for installation exterior to buildings and is typically routed into the entrance facility. (TIA)

P

Pair count -- Indicates how many pairs of wires are in a cable.

Patch cord -- A length of cable with a plug on one or both ends. (TIA) Patch cords are used for connections between two passive cross-connect terminations.

Patch panel -- A connecting hardware system that facilitates cable termination and cabling administration using patch cords or equipment cords. (TIA)

Pathway -- **1.** Physical infrastructure (e.g., conduit, cable tray, raceway) used to facilitate the placement of information and communications technology (ICT) or electronic safety and security (ESS) cabling media. **2.** A term used within the United States to denote any method of connecting elements of the fire alarm system (e.g., electrical, optical, radio frequency [RF]).

point of sale (POS) A location where credit card transactions are performed with the cardholder present, such as a retail establishment. The card is read magnetically.

pull box (PB) A device to access a closed raceway used to facilitate placing of wire or cables.

punch list A short list of tasks that are required to be completed in order to close out a work order or project.

R

Raceway Any enclosed channel designed for holding electrical wires or telecommunications cabling. Raceways include multiple types of conduit and tubing, as well as other types of channels built into the architectural materials, such as floor ducts, wireways, and busways. Cable tray is not considered a type of raceway.

rack grounding busbar A busbar that is vertically or horizontally mounted on an rack or cabinet and **(RGB)** connected directly to the telecommunications main grounding busbar (TMGB) or telecommunications grounding busbar (TGB) via a rack bonding conductor (RBC). Equipment within the rack is grounded to the RGB.

record drawing (as built) A plan that graphically documents and illustrates the installed telecommunications infrastructure, including devices, appliances, cabling sequences, cabling methods, connections of components, cabling pathways, and telecommunications spaces in a building or portion thereof. (TIA)

redundancy Providing secondary components that either become instantly operational or are continuously operational so that the failure of a primary component will not result in mission failure. *See also* N + 1 redundancy, N + 2 redundancy, 2N redundancy, 2(N + 1) redundancy, and Multi-N redundancy (xN).

Registered Communications Distribution Designer (RCDD®) A certification awarded by BICSI to individuals who, by meeting specified criteria, have demonstrated their expertise in the design, integration, and implementation of telecommunications (voice, data, video, audio, and other low-voltage control) technology systems and their related infrastructure components.

repeater In data networks, a device that repeats and regenerates a signal. A repeater receives a signal from one source, reads it, generates a completely new signal identical to the original, and transmits it to the next

destination. Repeaters can be separate devices to boost long-haul transmissions or can be incorporated into other devices such as switches and routers.

riser 1. Vertical sections of cable (e.g., changing from underground or directburied plant to aerial plant or from one floor of a building to another). **2.** The space used for cable access between floors. *See backbone.*

S

Scalability -- An existing system's capability of growing to meet the customer's needs over time. Most legacy systems are not scalable, resulting in obsolescence of components or entire systems and requiring regular software and hardware replacements.

Schematic design -- A design phase that follows preliminary planning and scope development and occurs prior to design development. This phase typically takes the design to about 30 percent.

service provider (SP) -- The operator of any service that furnishes telecommunications content (transmissions) delivered over access provider facilities. (TIA)

site survey A process used to identify the physical and electromagnetic characteristics of an environment impacting the installation of cable or wireless network components. Required for the design of any network.

standard A collection of specifications that encompass properties of components, systems, and practices intended to ensure an accepted minimum degree of functionality and longevity (performance). Standards are intended to reflect accepted norms as typically determined either through a balloting process conducted by a nationally or internationally accredited organization or as developed by businesses, industry groups, or governments for their use.

T

T0, T1, T2, T3, T4, and T5 drawings -- Telecommunications drawings that show site information (T0), building information (T1), serving zone information (T2), telecommunications rooms (T3), details (T4), and schedule/spreadsheets (T5). A part of the National CAD Standard (NCS), a collaborative effort in the United States between the National Institute of Building Sciences, the American Institute of Architects, and the Construction Specifications Institute.

telecommunications bonding backbone (TBB) -- A conductor that interconnects the telecommunications main grounding busbar (TMGB) to the telecommunications grounding busbar (TGB). (TIA)

telecommunications equipment bonding conductor (TEBC) -- A bonding conductor that should be installed from each piece of equipment in the telecommunications room (TR) or equipment room (ER) to the telecommunications grounding busbar (TGB) or telecommunications main grounding busbar (TMGB). TEBCs may also be connected to the rack grounding busbar (RGB), if the rack or cabinet has one.

telecommunications grounding busbar (TGB) -- A common point of connection for telecommunications systems and equipment bonding to ground, and located in the telecommunications room (TR) or equipment room (ER). (TIA)

Telecommunications Industry Association (TIA) -- An association that publishes telecommunications standards and other documents. (TIA)

telecommunications main grounding busbar (TMGB) -- A busbar placed in a convenient and accessible location and bonded, by means of the bonding conductor for telecommunications (BCT), to the building service equipment (power) ground. (TIA)

Telephony. **1.** Speech transmission by radio sets or telephony sets. **2.** Telephone technology

V

vault A telecommunications space, typically subterranean, located within or between buildings and used for the distribution, splicing, and termination of optical fiber cabling. These spaces may be established as a maintenance hole (MH) in campus environments or may include active equipment in addition to passive cabling such as in a controlled environment vault (CEV).

W

wireless access point (WAP) A wireless transceiver that connects WLAN clients to the wired LAN. Also used to bridge to other access points.

work area A building space where the occupants interact with telecommunications terminal equipment (e.g., an individual office or cubicle, printer/copier room). Typical area 100 sqft (TIA)