PART 0 DESIGN STANDARDS

0.01 GENERAL DESIGN GUIDELINES

A. The intent of this standard is to describe the requirements of the telecommunications system infrastructure. Part of this system is the responsibility of Denver Public Schools (DPS) and the remaining is to be designed by the Architect/Engineer (A/E) and installed by the contractor. In order to understand the whole system, the responsibilities of DPS, the A/E, and the contractor are listed below.

B. The basic infrastructure of the system is covered in other Sections, such as conduit, outlet boxes, receptacles, grounding, etc. This section describes how they are to be put together as a telecommunications system, as well as the equipment necessary for a functioning system.

C. Obtain additional detailed requirements and equipment specifications from the DPS Project Manager for each project. The DPS Project Manager will coordinate with the Department of Technology Services (DoTS) Project Manager to determine scope of work, equipment lists, and other details specific to the project.

D. Furniture which will require power and/or data and telephone wiring must be reviewed and approved to ensure compatibility.

E. Audio enhancement systems are considered part of the telecommunications systems.

1. Each classroom shall be designed to include an audio enhancement system. The classroom Enhanced Audio System provides the teacher with the ability to broadcast their voice at an even level throughout the classroom. The major components of the system are the Enhanced Audio receiver/amplifier unit, a wireless handheld or headset microphone, a wireless infrared receiver or RF amplifier and a minimum of four to six broadcast speakers. Amplifiers, receivers and microphones will be Furniture, Fixtures & Equipment (FF&E) items.

2. The size of each classroom will determine whether an infrared or RF system is necessary for the audio enhancement system.

F. This specification states that DoTS will install all telephone sets. However, review this prior to bid in the event DoTS wants the contractor to take on this task.

G. Lockable blue cabinets shall be used in lieu of open racks where an MDF (Main Distribution Frame) or IDF (Intermediate Distribution Frame) location is in an unsecure location. Review this requirement prior to bid.

H. The term Telecommunications Closet (TC) is used to identify either an MDF or IDF room.

I. Standalone paging systems in auditoriums, gymnasiums, and cafeterias are not covered in this section. This section only covers the connection between them and the school paging system. A/E is responsible for specifying standalone paging systems in auditoriums, gymnasiums, and cafeterias.

J. The A/E is responsible for determining whether one or more amplifiers are required for the quantity of speakers necessary for the project.

K. A/E shall create a responsibility matrix to clearly identify work (furnish and/or install) by electrical contractor, general contractor, telecommunications contractor, DoTS/DPS, and other subcontractors that interface with the telecommunications systems.

0.02 WORK BY DPS

A. DPS DoTS will provide (furnish and install) the following:

1. Telephone system switch
2. Data equipment that is rack mounted (racks provided by Contractor)
3. Connect amplifiers for paging system (equipment furnished by Contractor)
4. Make final terminations to telephone switch and any rack mounted equipment as well as patch panel to patch panel connections. (Contractor shall provide patch cables.)

5. DoTS will assist the contractor in determining how many patch cables are required and the length of the patch cables.
6. Wide area network components that connect the facility to DPSNET
7. Local area network switches for data connectivity
8. Telephone System and Telephone Sets

0.03 CODES, STANDARDS, SPECIFICATIONS AND RECOMMENDATIONS

A. DoTS reserves the right to modify these specifications as needed or required by DoTS or by the Panduit Certification Plus^{SM} System Warranty Program. This statement does not apply to codes or regulations required by law. A/E shall list these in the project specification.

1. NFPA 70 National Electric Code (NEC)
2. IEEE C 2 National Electric Safety Code (NESC)
3. ANSI/IEEE 802.3 Information Technology–Local and metropolitan area Networks –Part 3: Carrier Sense multiple access with Collision detection (CSMA/CD) access method and Physical layer specifications
4. TIA/EIA–568–B Commercial Building Telecommunications Cabling Standard (Parts 1, 2, and 3)
5. TIA/EIA–569–A Commercial Building Standard for Telecommunications Pathways and Spaces
6. TIA/EIA–606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
7. TIA/EIA–607 Commercial Building Grounding and Bonding
8. TIA/EIA-758 Customer-Owned Outside Plant Telecommunications Cabling Standard
9. BICSI Telecommunications Distribution Methods Manual (TDMM), 9th Ed. Network Design Reference Manual, 4th Ed. and Customer-Owned Outside Plant Design Manual, 2nd Ed.
10. OSHA Standard 29 CFR 1910.268

0.04 WORK BY ELECTRICAL/TELECOM CONTRACTOR

A. Contractor shall provide conduits, sleeves, outlet boxes, and other raceways necessary to connect the telecommunications system.

B. Contractor shall provide all wire and cable necessary to connect the telecommunications system. This work must be performed by a Panduit Enhanced Certified Installer.

C. Contractor shall provide station, fiber, and coax terminations, wire management, frames/racks, surface mounted raceway, clocks, speakers , clock/speaker housing and paging system speakers.

D. Contractor supplies patch cords, but DoTS installs the patch cords.

E. The contractor will be responsible for fire caulking the interior and exterior of conduit sleeves.

F. Contractor shall install the audio enhancement system speakers and wiring.

G. Contractor shall provide and install the paging system amplifier.

0.05 DESIGN REQUIREMENTS

A. A/E shall refer to drawings that accompany this section. Not all drawings are specifically referenced in this section, but are to be considered part of the design requirements.

1. 17700-1 Communications Outlet Drops and Jacks
2. 17700-2 Typical Classroom
3. 17700-3 Typical Computer Lab
4. 17700-4 Typical Office

5. 17700-5 Typical Large Main Telecom MDF Room
6. 17700-6 Typical 0x32 or PBX MDF Wallfield
7. 17700-7 Typical Small Remote Telecom IDF Room
8. 17700-8 Typical IDF Wallfield
9. 17700-9 Typical Fourplex Receptacle Types
10. 17700-9B Typical 220V Dedicated Receptacle
11. 17700-10A Typical Enhanced Audio Connections with IR Receiver
12. 17700-10B Typical Enhanced Audio Connections with RF Receiver
13. 17700-11A Enhanced Audio IR Receiver One-Line Connections
14. 17700-11B Enhanced Audio RF Receiver One-Line Connections
15. 17700-11C Enhanced Audio Custom Adapter Assembly
16. 17700-12 Telecommunication Grounding
17. 17700-13 PBX (HD) Typical MDF Rack Layout
18. 17700-14 0x32 (HD) Typical MDF Rack Layout
19. 17700-15 Typical IDF Rack Layout (HD)
20. 17700-16 Typical Blue B-Line Cabinet Layout (HD)
21. 17700-17 PBX Patch Panel Miscellaneous Circuits
22. 17700-18 KSU Patch Panel Miscellaneous Circuits
23. 17700-19 MDF/IDF Paging Speaker Connections
24. 17700-20 Typical MDF NIU, KSU, and PBX Wallfield Tie to Patch Panel
25. 17700-21 Communication Outlet Labeling

B. Data/Telephone Outlets:

1. DoTS requires one 1” conduit for every 10’ section of surface mounted raceway containing terminations placed or any portion thereof. Reference drawing 17700-1.
2. Due to bend radius requirements, special sloped faceplates are required in surface mounted raceway. These faceplates will not fit above a duplex electrical outlet. Data outlets will have to be placed in a separate sloped faceplate positioned adjacent to the electrical outlet. Reference drawing 17700-1.
3. TV outlets in classrooms, office and conference room areas where a video cabinet is not provided can be combined with the communications outlet in that room at 18” A.F.F. See drawings 17700-1 through 17700-4.
4. Typical DPS classroom standard requires three outlet locations supplied with three RJ45 jacks per outlet for a total of nine jacks per classroom. If a fixed video location is not provided, two video outlets containing a coax are to be supplied making two locations on opposite ends of the room for teacher stations. If a fixed video location is provided, the fixed video location shall contain minimum one data and one coax outlet. See drawings 17700-2 and 17700-3.

C. Power Requirements:

1. In all classrooms where a video cabinet is supplied, increase the electrical receptacle behind the cabinet to a fourplex to support a TV, VCR and Enhanced Audio System.
2. One dedicated fourplex receptacle is required next to each data outlet.
3. MDF and IDF locations require dedicated circuits with lockouts on circuit breakers.
4. Reference drawings 17700-5, 17700-7 17700-9A and 17700-9B.

D. Conduits Required:

1. Provide a 1" conduit from the security alarm panel to the nearest TC.
2. Provide a 1" conduit from the gas meter to the nearest TC.
3. Provide a 1" conduit from the HVAC remote access panel to the nearest TC.
4. Provide a 1" conduit from the elevator control room to the nearest TC.
5. Provide a 1" conduit from the auditorium/stage/gymnasium/cafeteria sound system to the nearest TC.
6. Provide a 1" conduit from the master clock, typically located in the main office, to the nearest TC.
7. Provide a 1" conduit from the MDF to the roof for TV satellite dish feed. Dish must have unobstructed view to North-west horizon. Stub conduit minimum 6 feet from building edge. Provide weatherhead on conduit on roof. Sprint/WANT TV provides the dish. DoTS requests the dish, but Sprint installs the dish.
8. Provide two 4" conduits equipped with ¼" pull rope and a measured pull string to Qwest pedestal from MDF. Pedestal location to be coordinated with Qwest.
9. Provide one 4" conduit equipped with ¼" pull rope and a measure string to ComCast pedestal from MDF. Pedestal location to be coordinated with ComCast.
10. The Qwest and ComCast pedestals should be in the utility easement and separated by a minimum of two feet. Qwest charges additional monies for feed cable lengths in excess of 150', therefore locate MDF accordingly.
11. Provide sleeves of adequate size to route communications wiring through ***any*** floor and any wall that is floor to deck. The actual construction will dictate final size and locations of these sleeves. A typical sleeve will be 4". The Contractor will be responsible for fire caulking the interior and exterior of the sleeves.
12. Provide two 4" conduits between the MDF and each IDF room. These conduits must all be home run and not looped from room to room.
13. Paging speaker conduits may be ½".
14. Outlet boxes and associated conduits are not to be looped.
15. All conduits from outlets boxes to above accessible ceiling shall be 1".
16. All conduits shall be routed above grade except conduits from pedestals and main conduits between (MDF or IDF) TCs.
17. Reference drawings 17700-5 and 17700-7.

E. MDF and IDF Room Requirements:

1. This room is for the exclusive use of DoTS and shall not have other equipment located in this room.
2. This room shall not be a pass through for any other room.
3. This room shall not be used for pipe chase, clean outs, or any other object which reduces the useable interior dimension of the room.
4. This room shall not be used for roof or crawlspace access hatches.
5. If this room is equipped with a gyp board ceiling, a 24"x24" access hatch shall be provided and be located near the doorway to provide unobstructed access to the space above ceiling.
6. Provide ground buss bar on the plywood per drawing 17700-12 and connected to building ground with #6 stranded copper in conduit. Ground bar shall be ¼"x2"x6" copper with ¼" -20 (4 holes for ground wire attachment) with 3/8"x16x1.5" long standoff insulator studs.
7. Provide cooling for MDF and IDF rooms. Coordinate heat loads with mechanical A/E. MDF and IDF rooms shall be cooled to minimum 72 degrees. MDF and IDF rooms must be on separate zones or drops with thermostast control and not included with heating/cooling of adjacent rooms.

8. Provide dedicated circuits for TCs per drawings 17700-5,-7,-9A, and -9B.
9. Provide task level lighting for MDF and IDF rooms. Lighting fixtures shall be a minimum of 8'6" above finished floor to the bottom of the lighting fixture. If lighting fixtures are fluorescent type, they shall be mounted at right angles to cable ladder racks. Coordinate rack locations with DoTS.
10. No ceiling mounted fixture or equipment may extend below 9'0" A.F.F.
11. All conduits shall enter the MDF or IDF room above or below the plywood back boards as practicable. All conduits shall be located as tight to the walls as possible.
12. The door to the room shall swing out so as not to restrict useable space within the room. The door on this room shall be keyed to DPS/DoTS key #XGM-1.

F. MDF Room Requirements:

1. Reference drawing 17700-5 & 6.
2. Room interior dimensions shall be 12'x 6' minimum.
3. Three sheets of ¾"x 4'x8' fire rated plywood mounted to the MDF walls per drawing 17700-6.

G. IDF Room Requirements:

1. Reference drawing 17700-7 & 8.
2. Room interior dimensions shall be 8'x 6' minimum.
3. One sheet of ¾"x 4'x8' fire rated plywood mounted to the IDF wall per drawing 17700-8.

PART 1 GENERAL

1.01 SUBMITTALS

A. Product Data:

1. Component and accessories list.

B. Schedules and Certificates:

1. Schedule of when contractor needs DoTS supplied equipment or materials.
2. Schedule of when contractor needs FF&E items on site for installation by contractor.
3. Fluke calibration certificate.
4. Panduit installer certification per paragraph 1.05.B this section.

C. Project Record Documents:

1. Shop drawings: Wiring and termination drawings.
2. As-built drawings shall be provided by the contractor at the completion of project indicating changes to the contract drawings, including jack numbers. All components installed by the contractor will be noted on these drawings. This requirement pertains to telecommunications and is generally confined to the electrical drawings.
3. Record drawings shall be corrected and resubmitted to include any changes or corrections made to the system after system cutover.

1.02 CONTRACTOR QUALIFICATIONS

A. Denver Public Schools requires that the contractor have a BiCSI Certified Registered Communications Distribution Designer (RCDD) on staff for the duration of the project. Information regarding BiCSI and its services including RCDD Certification can be obtained by contacting BiCSI at 1-800-242-7405 or 1-813-979-1991 or fax 1-813-971-4311 or e-mail bicsi@bicsi.org or web site www.bicsi.org.

B. Contractor must submit certification from Panduit authorizing contractor to provide Panduit Enhanced Certifications Plus^{SM} System Warranty.

C. Contractor shall supply a detailed list of recently installed sites. Contractor must have successfully completed at least one site similar in drop count and configuration (including backbone) within the past year. Please submit the site name, contact, contact telephone number, date installed, and number of drops installed.

D. Contractor shall attend a mandatory pre-bid meeting at a location determined by DoTS and walkthrough at the school site.

1.03 WARRANTY

A. The telecom installer must provide the Panduit Certification Plus^{SM} System Warranty. This program offers a 25-year standards based performance warranty that applies to all registered links in an installation. This program guarantees that these links will meet minimum performance requirements as specified in the Commercial Building Telecommunications Cabling Standards. The warranty covers the repair or replacement of defective components and/or cable and the labor associated with this repair or replacement per the terms of the warranty.

B. Telecom installer must complete specific documentation to be eligible for warranty coverage. Telecom installer must coordinate and comply with the documentation required. The complete Panduit Warranty guide can be obtained from Panduit.

1.04 COMMISSIONING

A. Commissioning of the telecommunications systems is the responsibility of DoTS. Testing of the wiring infrastructure and any components installed by Contractor is the responsibility of the Contractor. Contractor is repsonsible for repairs and changes to correct deficiencies and nonfunctioning components or systems. DoTS will witness testing.

PART 2 PRODUCTS

2.01 MATERIALS

A. Conduit as specified in Section 16110, except:

1. Runs shall not contain more than 225° of bends.
2. Runs shall not exceed 100' in length between junction boxes.
3. All conduits for the communication outlets are 1” in diameter with no “looping” between outlets.
4. The conduits for clock/speakers are ½” and may be looped between as many as three clock/speakers.
5. All station cables shall be installed in conduit and junction boxes and shall be provided by the electrical contractor; or installed as plenum rated cables supported by appropriate hangers in the plenum.
6. A bushing is required to be placed at each end of any conduit that is used for placing communications wiring. The contractor will be required to insure these bushings are in place prior to pulling wire and not place them after the fact. If upon inspection by the DoTS Project Manager it is noted that the bushings are not in place or it appears that the bushings were placed after the cable was pulled (split bushing) the contractor will be directed to remove the wiring that was placed, destroy that wiring, and re-pull the wiring with the appropriate bushings in place. The electrical contractor will place bushings for the larger conduits. As a part of this labor component, the contractor shall fire seal both interior ends of conduits or sleeves that lead into the TCs and any conduit or sleeve that penetrates any wall. The Denver Building Department has recently started requiring fire seal in the ceiling end of conduits which stub up into the plenum ceiling area and as a result contractors must include this activity as part of their bid. The contractor is required to fire seal the interior and exterior of any conduits placed by the electrical subcontractor.
7. All cabling shall be placed and routed in Panduit or other surface raceways, false ceilings, conduit, trays, behind walls or any other suitable means approved by the Dots Project Manager, in order to conceal all cabling at all locations while maintaining the architectural integrity of the building and according to the approved drawings. Cabling placed in false ceilings, MDF, IDF’s shall be routed, self

supported and dressed neatly and in a quality workmanship like manner meeting all applicable State and Local Building Codes, ordinances, OSHA requirements and DPS specifications.

8. Some locations may utilize Wiremold raceway. The Wiremold type shall be 4000, gray in color. A 1" conduit will be supplied for each 10' of wiremold placed. The correct Wiremold faceplate to be used will be G4048R. The Panduit faceplate used in conjunction with the Wiremold is CFPHS2IG which is a 2 port sloped faceplate in gray. The Contractor will equip these faceplates with matching gray inserts.

B. Contractor to provide sleeves of adequate size to route communications wiring through ***any*** floor and any wall that is floor to deck. The actual construction will dictate final size and locations of these sleeves. A typical sleeve will be 4". The Contractor will be responsible for fire caulking the interior and exterior of the sleeves.

C. Outlet boxes as specified in Section 16130, except boxes shall be minimum 2-1/2" deep.

D. Provide single gang plaster ring for outlet boxes. Exception for audio infrared systems.

E. Electrical Identification as specified in Section 16195.

F. Grounding as specified in Section 16450.

G. Receptacles as specified in Section 16141.

H. Pull boxes need to be trough style, minimum 6" wide and 2' long.

I. Wire and cable as specified in Section 16120. Exceptions:

1. Data cable shall be category 6. Category 6 cables will be plenum rated (blue in color).
2. DoTS does not want "service loops" left on the cabling. When terminating the device end of the cabling, pull 12" of wire out of the outlet box, trim and terminate the cabling. After termination, push the cabling back up the conduit, leaving approximately 7" of wire in the box. Allow the remainder to remain slack as it exits the upper end of the conduit and caulk the conduit with fire caulking.
3. All Category 6 cables will be tested to Panduit and EIA/TIA 568B Category 6 specifications by the Contractor and documentation of these tests supplied as outlined in this document.
4. The Contractor shall test all coax cables and documentation of these tests supplied as outlined in this document.
5. Speaker wire shall be #18, 2 pair shielded, grounded at head end equipment only.
6. Cable layouts should be designed to avoid close proximity to flourescent lights, power sources, electrical motors, and motor controllers.

2.02 HORIZONTAL STATION CABLING

A. Contractor shall be responsible for all labor and material to complete the installation of all drops. The majority of the horizontal runs or drops are office, teacher and student workstations consisting of three (4 pair) Category 6 cables from the respective serving TC to the four port outlet sloped faceplate. All Category 6 cables shall be terminated with Panduit Category 6 hardware. Each drop shall be terminated compliant with Category 6 practices as defined by EIA/TIA 568B cable installation specifications and in accordance with the Panduit Enhanced Certifications Plus System Warranty procedures. Additional outlets for video service consisting of 1 coax and 1 Cat. 6 drop and other configurations may be placed. There will be additional cables placed for wireless data access points, paging speakers in clock housings and corridor paging speakers which are either wall hung or ceiling units.

B. Horizontal communication outlets and drops can be terminated in a variety of 1, 2, 4, 6, or 10 port sloped faceplates with a variety of sloped faceplate inserts supporting copper or coax wiring in several different configurations depending on their location and usage within the school.

C. All Category 6 cables will be terminated on Panduit high density (HD) patch panels.

D. All coax cables shall be terminated on Panduit patch panels attached to a Panduit swing out gate mounted to the backboard at a 6'6" height. All coax drops will enter the hinged side of the rack so as to allow the rack to be fully opened for maintenance. A front only wire management panel shall be provided for each

48-port patch panel placed. The contractor will supply 8-way splitters in sufficient quantity to connect all coax. The contractor shall place a 75-Ohm terminator cap on any unused output of the splitters. contractor will be responsible for fabricating and placement of coax "patch cables" to connect the splitters to the terminated coax drops routed through the hinged side of the front only management panel. The device end of the coax cable will be terminated in self-terminating inserts placed in a variety of sloped faceplates depending on the application. Most conduits supplied by the electrical sub-contractor for video locations are 1" in size. DoTS personnel will make the head end connection to the ComCast entrance termination.

E. All speaker cables shall be terminated on 66 type blocks located on the backboard in the serving TC. The speaker connection shall be at the 70-volt level, 2 watt for classrooms and 4 watt for corridors and large spaces (i.e. gymnasiums and lunchrooms). The contractor will be responsible for placing the speaker and speaker wiring. Gymnasium speakers require the grills specified in the attached materials list. All ceiling mounted speakers are to be installed by the contractor including tile or gypsum board cuts as required. All ceiling mounted speakers will use tile bridge supports and fire rated speaker and enclosure assemblies as specified in the materials list. Paging amplifier connections will be discussed later in this section.

F. The drops for Wireless Data Access Points (WAP's) shall be terminated at the serving TC end in the Panduit patch panels with the other Category 6 terminations and labeled in the same fashion as all other cables. The device end of the cable will be terminated with a Panduit RJ45 Category 6 minicom jack and 20' of cable coiled and left supported above the ceiling at a location determined by DoTS. Provide green nameplate on ceiling grid to indicate where device is installed for WAPs.

2.03 BUILDING BACKBONE AND RISER CABLES

A. Between the MDF and each IDF the Contractor will place one 100 pair 24 Ga. PVC or plenum tie cable, one 12 strand multi-mode PVC or plenum fiber optic armored cable, one RG11 PVC or plenum video coax tie, two #18, 2 pair shielded PVC or plenum paging speaker ties, two #18, 4 pair Category 6 PVC or plenum data backup ties and a new ¼" pull rope. All riser components will originate in the MDF and terminate in their respective IDF locations. The contractor will be responsible for all placements, testing, terminating, and labeling of all riser and horizontal cabling and providing the DoTS Project Manager with all electronic and written test results.

2.04 TELECOMMUNICATIONS CLOSET SETUP

A. All of the TCs will have hard deck ceilings. The general contractor will place all ¾" fire retardant plywood backboards installed vertically with fire brand showing. The contractor shall be responsible for placing and mounting of all equipment racks, wire management, terminating hardware (copper, coax and fiber), ladder rack (including waterfalls), grounding of the ladder racks and frames, and all labeling. This includes all MDFs and IDFs in the building.

2.05 MDF SETUP

A. Reference drawings 17700-13, -14, -17, -18, -19, and -20.

B. The MDF supports the feeds from various service contractors' into the building, it contains the telephone system, the master data networking equipment, the paging and video amplifiers, serves certain areas and systems of the building.

C. The feed from Qwest is terminated in this room by Qwest.

D. The feed from ComCast (AT&T Broadband) is terminated in this room by Comcast. The output of the reverse fed splitter will connect to the input of the Coax Amplifier. The contractor will connect the output of the Coax Amplifier to the input of an 8-way splitter. The contractor will connect seven of the outputs of this splitter to feed the first seven coax video drops terminated in the wall hung, Panduit hinged wall bracket, containing the video patch panel. The contractor will connect the eighth output of this splitter to feed the next 8-way video splitter. This process will continue until all coax drops have connection with one terminal on the 8-way splitter left vacant for growth. The contractor will connect the output of the Coax Amplifier to a splitter of sufficient size to feed all IDF TCs. The contractor will connect the feeds to all IDF TCs to this splitter. The contractor will provide all components, cables and connectors to accomplish this task.

E. The feed from Sprint TV (rooftop receiver) is terminated in this room by Sprint.

F. The contractor will place 9 – PVC or plenum 25 pair single ended female amphenal cables to support the telephone system. The raw ended majority of these cables will be terminated on patch panels in the Panduit Frame the remainder will terminate on the 66M150 block designated for trunks (see Attachment # 1) and located on the backboard. The amphenaled ends of the cable will be secured to the backboard in a position designated by DoTS for installation into the telephone system installed by DoTS.

G. The contractor will place and connect Bogen Paging Amplifier(s) (100 amp.) on the backboard and connect to the speaker multiple 66M125 block. The contractor will cross-connect from the speaker multiple block to the 66M150 speaker termination block. The contractor will connect speaker tie cables to the IDF's. The contractor will connect paging speaker wiring to the 66M150 speaker wire termination block. All pairs of the speaker wire will be terminated and additional 66M150 blocks may be required based on number of speakers. The contractor placed speaker cross-connect will be terminated on the green/red pair.

H. The contractor shall arrange all components on the backboards so that cross-connects are run across the tops of the connected components as shown. With the exception of the cables for the telephone system, all cables shall be routed in "D" rings around the extreme edges of the backboards and brought up into the components from below. The cables from the telephone system will be routed down from the cable tray to the left side of the telephone system.

I. The contractor shall place a 25 pair tie cable between the Panduit Frame and the 66M150 block on the backboard. 24 pair of this cable will be connected at the patch panel as shown on the drawings.

J. The contractor shall place and connect KSU Category 6 ties between the frame patch panel #3 and the backboard. At the backboard these cables will terminate in a 10 port faceplate connected to a double gang Panduit surface mount box.

K. The contractor shall place and connect NIU Category 6 ties between the frame patch panel #3 and the backboard. At the backboard these cables will terminate in a 2 port faceplate connected to a single gang Panduit surface mount box.

L. The contractor shall assemble all Panduit frames and permanently mount these frames using the specified concrete anchoring kit. The contractor will attach to the tops of each frame, using a Panduit cable tray bracket and specified wall angle supports, a section of cable tray (ladder rack) spanning wall to wall at right angles to the frame. This cable tray will be equipped with runway cross member radius drops, 1 from each direction, above the top entrance to the frame. In an effort to reduce labor costs these cable trays will be fitted by the contractor with 6"w x 4" h wiring duct to conceal wiring from the point of entry into the MDF to the point the wiring drops down into the frame. This does not mean that DoTS does not want a quality wiring job, rather, it is not as critical to provide the level of quality DoTS expects from the entrance into the frame down to the terminations in the patch panels. In this area of the process DoTS expects the very highest quality work, precision and attention to detail. The contractor shall permanently attach the wiring duct to the cable tray with the heads of the screws inside the duct and the threaded end of the screw not extending below the cable tray so as to prevent a hazard.

M. The contractor shall ground the frames and cable trays with a #6 green insulated ground wire routed to the grounding buss bar supplied by the electrical sub-contractor on the backboard. See drawing 17700-12.

N. The contractor shall equip and connect frames.

O. The contractor will place and terminate all copper and fiber optic tie cables.

P. The contractor shall install all labels for all terminating hardware with the exception of the patch panels designated for PBX Telephone System Termination. DoTS will label these patch panels.

2.06 IDF SETUP

A. Reference drawings 17700-15, -16, and -19.

B. The IDF supports the feeds from the MDF, the remote data networking equipment, and serves certain areas of the building.

C. A minimum 100 pair 24 ga. copper feed from the MDF terminated on patch panel, one 12-strand armored fiber cable, two-4 pair cat 6 cables terminated in patch panel, and two 2-pair shielded #18 speaker tie wire terminated on 66M150 wallfield

D. An RG-11 video feed from the MDF.

E. The contractor will connect the video feed to the input of an 8-way splitter. The contractor will connect seven of the outputs of this splitter to feed the first seven coax video drops terminated in the wall hung, Panduit hinged wall bracket, containing the video patch panel. The contractor will connect the eighth output of this splitter to feed the next 8-way video splitter. This process will continue until all coax drops have connection with one 8-way splitter left vacant for growth. The contractor will provide all components, cables and connectors to accomplish this task.

F. Connect the speaker ties from the MDF to 'page in' on the speaker multiple 66M125 block. The Contractor will cross-connect from the speaker multiple block to the 66M150 speaker termination block. All pairs of the speaker wire will be terminated and additional 66M150 blocks may be required based on number of speakers. The Contractor placed speaker cross-connect will be terminated on the green/red pair.

G. The contractor shall arrange all components on the backboards, so that cross-connects are run across the tops of the connected components as shown. All cables shall be routed in "D" rings around the extreme edges of the backboards and brought up into the components from below.

H. The contractor shall assemble the Panduit frame(s) and permanently mount this frame using the specified concrete anchoring kit. The contractor will attach to the top of the frame, using a Panduit cable tray bracket and specified wall angle supports, a section of cable tray (ladder rack) spanning wall to wall at right angles to the frame. This cable tray will be equipped with runway cross member radius drops, 1 from each direction, above the top entrance to the frame. In an effort to reduce labor costs these cable trays will be fitted by the contractor with 6"w x 4" h wiring duct to conceal wiring from the point of entry into the IDF to the point the wiring drops down into the frame. This does not mean that DoTS does not want a quality wiring job, rather, it is not as critical to provide the level of quality DoTS expects from the entrance into the frame down to the terminations in the patch panels. In this area of the process DoTS expects the very highest quality work, precision and attention to detail. The contractor shall permanently attach the wiring duct to the cable tray with the heads of the screws inside the duct and the threaded end of the screw not extending below the cable tray so as to prevent a hazard.

I. The contractor shall ground the frame and cable tray with a #6 green insulated ground wire routed to the grounding buss bar supplied by the electrical sub-contractor on the backboard. See drawing 17700-12.

J. The contractor shall equip and connect frames with components.

K. The contractor will place and terminate all copper and fiber optic tie cables.

L. The contractor shall install all labels for all terminating hardware.

2.07 OTHER SERVICES/FEEDS TO MDF/IDF ROOMS

A. The Category 6 PVC or plenum link (Ethernet) from the HVAC Access panel will be terminated in the nearest TC by the Contractor on the Panduit patch panel along with the rest of the Category 6 drops. The HVAC Access panel location shall have a 1" conduit homerun to the nearest MDF or IDF.

B. The Category 6 PVC or plenum elevator telephone line routed in 1" conduit will be terminated to the nearest TC by the Contractor on the patch panel.

C. The Category 6 PVC or plenum security panel telephone line routed in 1" conduit will be terminated to the nearest TC by the Contractor on the patch panel.

D. The Category 6 PVC or plenum master clock link routed in 1" conduit will be terminated to the nearest TC by the Contractor on the patch panel.

E. The Category 6 PVC or plenum Excel Energy gas meter routed in 1" conduit will be terminated to the nearest TC by the contractor on the patch panel. The contractor needs to coordinate location of gas meter and outlet location.

F. The Category 6 PVC or plenum power failure telephone drop will be terminated in the nearest TC by the Contractor on the Panduit patch panel along with the rest of the Category 6 drops. Coordinate location with DoTS.

2.08 CLASSROOM AUDIO ENHANCEMENT SYSTEM

A. The Enhancement Audio Equipment Supplier will provide the following components as FF&E items:

1. Enhanced Audio Unit ULT2000 Infrared (IR) Receiver/Amplifier or equivalent RF unit
2. Power transformer for above unit
3. Ceiling mounted 360 degree domed infrared sensor for IR systems
4. Wireless Microphone or Headset

B. The Contractor will provide labor and material for the following IR system components, if IR is used:

1. Installation of the ceiling mounted 360 degree domed infrared sensor provided by the Enhancement Audio Equipment Supplier.
2. Installation of the RG6 coax and snap and seal connectors to connect the ceiling sensor above.
3. Installation of 4 ceiling mounted speakers and supporting hardware.
4. Installation of 2 Category 6 drops to connect speakers (note pair assignments).
5. Installation of 2 RJ45 Cat 6 inserts and 1 coax insert into the existing 6 port video outlet in the classroom.
6. Installation of 2 white Category 5 patch cords and fabrication and installation of 1 coax “patch cord”.
7. Connection of the two RJ45 patch cords above into a custom RJ45 to 2-1/4” phono plug adapter.
8. The custom adapter above is supplied by the contractor and is part of the material list provided.
9. Reference drawings 17700-10A, 17700-11A, and 17700-11C.

C. The contractor will provide labor and material for the following RF system components, if RF is used:

1. Installation of 6 ceiling or wall mounted speakers and supporting hardware.
2. Installation of 3 Category 6 drops to connect speakers (note pair assignments).
3. Installation of 3 RJ45 Cat 6 inserts into the existing 6 port video outlet in the classroom.
4. Installation of 3 white Category 5 patch cords.
5. Connection of the three RJ45 patch cords above into 3 custom RJ45 to 2-1/4” phono plug adapters.
6. The custom adapter above is supplied by the contractor and is part of the material list provided.
7. Reference drawings 17700-10B, 17700-11B, and 17700-11C.

PART 3 EXECUTION

3.01 INSTALLATION

A. The contractor shall not install fire caulking until after all testing has been completed and final acceptance has been given for the telecommunications system.

B. Labeling:

1. All telecommunications equipment and terminations furnished and installed by the contractor shall be equipped with a permanent numbering identification indicating its individual location within the school. Label numbers shall be comprised of the alpha terminal location followed by a three-digit number specific to the drop location within the school, i.e. A001. Equipment to be identified shall include, but not limited to, all wiring, faceplates, jacks, patch panels, 66 blocks, paging amplifiers and coax amplifiers.

2. All faceplates will be identified with a alpha terminal location followed by a three-digit number specific to the drop location. The first labeling will be handwritten using a permanent Permanent marker in the recess beneath the clear plastic label cover. The second label will be a Panduit machine printed label placed over the top and corresponding to the hand printed labeling. The clear plastic label cover will then be installed. Hand lettering will not be permitted on the outside of the faceplates except under the machine printed Panduit label.
3. All jacks at both the device and patch panel locations will be identified with a permanent Permanent marker, handwritten alpha terminal location followed by a three-digit number specific to the drop location on the side of the jack. This labeling shall not be visible from the exterior face of the jack.
4. All patch panels located in the MDF and IDF's will be identified by either a two, three or six digit number specific to the drop location, tie cables and fiber termination, coax and paging equipment by using Panduit printed labels on the face of the patch panel. Hand lettering will not be acceptable on patch panels.
5. All station wiring will be identified on both ends with a permanent Permanent marker, handwritten alpha terminal location followed by a three-digit number specific to the drop location on white tape approximately 3 inches below the cut end of the wire. The label shall include TC and Station Run Number (i.e., "A001", A = TC, 001 = Run).
6. Reference drawing 17700-21.

3.02 FIELD QUALITY CONTROL

A. Testing:

1. All cables and terminations shall be 100% tested for defects in installation and to verify cable performance under installed conditions. The contractor, prior to system acceptance, shall verify all conductors of each installed cable. Any defect in the cabling system installation including but not limited to cable, connectors, feed-through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% usuable conductors in all cables installed prior to final acceptance of the telecommunications system.
2. Testing results documentation (print copy and on CD-ROM) must be provided on all installed cabling. Contractor shall use a Fluke Model DSP4300 in-house for testing both fiber optic and copper media Contractor to provide calibration certificate.
3. Fiber testing shall be done using an approved tester as outlined above to achieve bi-directional testing for all links. Test results documentation shall be furnished to DoTS upon completion of testing. Printed documentation is required and electronic documentation from the tester shall be included in the final submittal. Tests will be performed to the TIA/EIA – 568B.3 Standards. Terminated fibers shall not exceed 1.5-db loss from connector to connector.
4. Copper cable testing will require Permanent Link testing using the Fluke DSP4300 and PM-06 personality modules. Printed documentation is required and electronic documentation from the tester shall be included in the final submittal.

B. Inspection:

1. DoTS Project Manager shall inspect wiring installation after wire is installed and before closing the ceiling.
2. DoTS Project Manager shall inspect quality and workmanship of terminations on an on-going basis.
3. The owner and the owner's representatives shall at all times have access to the work and the contractor shall provide proper facilities for such access and for their inspection of the work. If any work should be covered up without the approval or consent of the owner, it must, if required by the owner, be uncovered for examination, at the Contractor's expense.
4. The owner shall have the authority to reject materials or to suspend the work, or both, for any violation by the contractor of any provisions of the contract documents.

END OF SECTION 17700