FORM 470, BID NO. 15-DD

ALBUQUERQUE PUBLIC SCHOOLS
PROCUREMENT DEPARTMENT
ADDENDUM # 1 FOR FORM 470 BID NO. 15-DD
NETWORK EQUIPMENT AND INSTALLATION SERVICES
FEBRUARY 27, 2015 – 3:00 PM MDT

February 20, 2015

Please note the following changes/corrections/additions:

- See answers to response to technical questions on the following page.
- Replace Scope of Work on original Form 470 with the enclosed revised Scope of Work – Rev. 1 (includes: answers to all questions submitted, revised Scope of Work, list of schools and equipment requirements, controllers and licenses requirements, and APS design Guidelines)

Addenda not returned and signed will deem the Bid submission as non-responsive and will be rejected.

Thank you for your interest in Albuquerque Public Schools

ACKNOWLEDGE ADDENDUM # 1 WITH YOUR BID SUBMISSION:

_____
COMPANY/FIRM NAME

_____
SIGNATURE

_____
DATE

Gustavo Rossell

_____
Gustavo Rossell, Senior Buyer

ALBUQUERQUE PUBLIC SCHOOLS
e-RATE FORM 470 - BID NO. 15-DD
NETWORK EQUIPMENT AND INSTALLATION SERVICES

RESPONSE TO TECHNICAL QUESTIONS SUBMITTED

1) Page 8/9 Wireless Access Points lists two part numbers J9590a HP MSM 460 Dual Radio 802.11nAP and J9845A HP 560 Wireless 802.11ac (AM) AP

   ANSWER: J9845A HP 560 Wireless 802.11ac (AM) AP (pg. 7)

2) Evaluation Point Summary pages 10 and 11
   a. 1.6 Material and Labor 45 points
   b. 1.19 Ineligible Cost Material and Labor 10 points

   Can you provide more information or matrix sheet we are to use for these sections. Pages 13 and 14 Pricing Format only have unit pricing for five individual tasks but during the walkthrough on Wednesday it was discussed that we had to provide a detailed scope of work labor and parts for the four school listed on page 9 & 10 as well as the format for the remaining schools listed on 15&16. However in the Pricing Format sheets there is no format for these.

   ANSWER: This addendum includes Appendix I and II for such purposes.

3) Are the contractors responsible for configuring the WAPs and switches or is APS networking? If yes can those services be provided by a subcontractor?

   ANSWER: APS - Technology Department will configure the WAPs.

4) There is reference to Item 21 attachment (21a-21d) for USAC and the FCC throughout the document. This does not apply to this contract since we are not "service" providers we are an installer is this correct? (An example: form 21a is asking for bandwidth download speeds etc, 21b is asking for recurring eligible costs, etc)

   ANSWER: The successful contractor will not be considered a "service" provider like a Century Link, for example.

5) Please confirm APS District will supply all direct connect cables and inline power supplies needed on this project.

   ANSWER: The successful contractor will provide all cabling and components from WAP to switch; APS will provide connecting cables from existing switch to new switch.

6) What is the quantity of cables we are installing per each AP?

   ANSWER: (1) One Cat5e Plenum Cables

7) Are we installing Category 5e or Category 6?

   ANSWER: Cat5e Plenum Cables

8) What type of faceplates are we installing – plastic or stainless steel?

ANSWER: *Stainless Steel- no window*

9) In some cases, we need to install conduit raceway. The bid does not say that the contractor needs an EE-98, however to install raceway in NM, the contractor must have an EE-98 license. Is this a requirement?

ANSWER: *Yes. The contractor has to have a NM EE89 License*

10) What type of faceplates are we installing – plastic or stainless steel?

ANSWER: *Licenses and Controller part numbers attached on Appendix II*

NOTE TO THE PUBLIC

The following project overview and statement of work for Albuquerque Public Schools E-Rate projects has been posted officially on USAC's website. You may access the 470 Form utilizing the following link:

http://www.slforms.universalservice.org/Form470Expert/6/PrintPreview.aspx?appl_id=1258388&fy=2015&src=search

As stated below, for procurement-related questions, please contact in writing (email), this procurement's manager:

Name: Gustavo Rossell, CPPB
Title: Senior Buyer
Albuquerque Public Schools
PO Box 25704
Albuquerque, NM 87125
Telephone: (505)878-6125
Fax Number: (505)830-1161
Email: rossell@aps.edu

To respond with your offer, follow USAC's prescribed instructions.

BID# 15-DD Network Equipment and Installation Services

PROJECT OVERVIEW E-RATE – REV. 1

Background:

The District is seeking bids for network electronics, associated hardware, wiring, and installation services. The District may decide to award the electronics portion of the contract to one vendor and the wiring and installation services to another vendor. All bids submitted must be based on master purchasing agreement pricing such as WSCA, CES, New Mexico State contracts, etc. Bids not referencing a valid (usable by APS) master purchasing agreements will be rejected.

During the upcoming E-Rate funding year the District expects to complete infrastructure upgrades at approximately 53 schools. In the event that the given scope of work cannot be completed in the next funding year, the District reserves the right to extend the agreement one year at a time for a maximum total term not to exceed five years. Because this project is being partially funded through the E-rate program, which is unlikely to cover the majority of the costs, the District reserves the right to limit or modify the scope of work based on budgetary limitations. Any contracts signed as a result of this procurement are contingent upon successful E-rate funding.

The District standard for wiring is CommScope and the District has a strong preference for CommScope Certified Partners for warranty purposes. While the E-rate rules do not allow the District to only consider bids for CommScope wiring strong consideration will be given to bids that do include CommScope wiring from a CommScope Certified Partner.

Given the complexity of the District's infrastructure the District requires that potential Offerors have at least two (2) Registered Communications Distribution Designers (RCDD's) on staff and that each RCDD has held the credential for at least the last five (5) years. Bids from vendors not meeting this requirement will not be considered. The RCDD's must currently be based in the Albuquerque Metropolitan Area or commit to relocating to the Albuquerque Metropolitan Area prior to July 1, 2015.

Given the timing of the procurement the District will be unable to perform a walk through at every site and will only be conducting a walk through at the following locations listed below. Directly prior to the walk through there will be a mandatory pre-bid meeting.

Walk Through Schools:
Bandelier Elementary School
Eisenhower Middle School
Madison Middle School
Eldorado High School

The walk through will be mandatory and bids will not be accepted from vendors that do not attend the all walk through at all four (4) schools. Prospective Offerors interested in attending the pre-bid meeting and walk through should arrive at the District Data Center, located at 930 Oak Street, at 8:30 am MT on February 11th. If for some reason not all four (4) site visits can be completed on the 11th the District (and the prospective Offerors in attendance on the 11th) will complete the visits the following day beginning at 8:30 MT. The deadline forsubmitting questions relating to this Form 470 bid is 10:00 am on February 16th. All bids in response to this procurement must be received by 3:00 pm MT on February 27, 2015.

The schools selected for the walk through are representative of the other schools where the work will be completed and will be used as the basis for vendors to bid on the work for the other schools. Vendors should formulate their bids for the other schools using the quantities of equipment listed in Appendix A and then a reasonable estimate of the wiring, other electronics, and labor needs for each school. Prior to work being conducted at any school a formal walk through will be conducted and the vendor will have the opportunity to adjust their pricing based on information gathered during

the walk through. However, the pricing methodology must remain consistent to the methodology that was used in the four (4) schools that were walked during the 470-bid process.

Vendors are reminded that as required by Section 54.500(f) of Part 47 of the Code of Federal Regulation all bids in response to this Form 470 must offer the lowest corresponding price (LCP) which is defined as the lowest price that a service provider charges to nonresidential customers who are similarly situated to a particular E-rate applicant (school, library, or consortium) for similar services. See http://www.usac.org/sl/service-providers/step02/lowest-corresponding-price.aspx for more information on the requirements relating to LCP. This includes passing on any manufacturer discounts to the District and USAC. Additionally, once the actual walkthrough is conducted for a given school the vendor is still required to offer the District the LCP.

The District expects service providers will provide an Excel version of the Item 21 Attachments in the format approved by USAC and the FCC. Offerors must ensure they provide the current approved Item 21 Attachment from USAC in an excel format that can easily be uploaded into USAC's online system. The approved templates are available at http://www.usac.org/sl/tools/forms/471-templates.aspx.
The agency has designated a Procurement Manager who is responsible for the conduct of this procurement. The Procurement Manager's name, address, and telephone number are listed below:

Name: Gustavo Rossell, CPPB
Title: Senior Buyer
Albuquerque Public Schools
PO Box 25704
Albuquerque, NM 87125
Telephone: 505-878-6125
Fax Number: 505-830-1161
Email: rossell@aps.edu

Special Instructions: Complete the bid documents as required. Your response must be received in the APS Procurement Department prior to the specified date and time regardless of above delivery option selected. Late RFPs are not accepted and will be returned unopened. To ensure proper identification and handling, clearly indicate the bid number and the response due date on the outside of the sealed package.

Any inquiries or requests regarding this procurement should be submitted, in writing, to the Procurement Manager. Offerors may contact ONLY the Procurement Manager regarding the procurement. Other Albuquerque Public Schools employees do not have the authority to respond on behalf of APS.

SCOPE of WORK:

Technical Specifications:

Horizontal Cabling:

- Contractor shall supply horizontal cables to connect each data communication Telecommunication outlet.
- Unless otherwise noted on the floor plans or within this document, the type of horizontal cables used work location shall be rated Category 5e/6 UTP. Per APS Standards.
- Network Cable jacket and Wall jacks shall be BLUE in color.
- The Category 5e/6 UTP cables shall be run using a star topology format from Telecommunications Room on each floor to every individual Telecommunication Outlet.
- All cable routes to be approved by APS project manager prior to installation of the cabling.
- The length of each individual run of horizontal cable from the Telecommunication Closet on each floor to the Telecommunication Outlet shall not exceed 295 ft (90 m).

- Contractor shall observe the bending radius and pulling strength requirements of the Category 5e/6 UTP cable during handling and installation.
- Each of cable between the termination block and the information outlet shall be continuous without any joints or splices unless approved by Designee.
- In suspended ceiling and raised floor areas where walker duct, cables trays or conduit are not available, the Contractor shall bundle station wiring with Velcro ties at appropriate distances. The cable bundling shall be supported via "J" hooks (every 5 foot or less) attached to the existing building and framework.
- Plenum cable will be used in all appropriate areas.
- If the interior of walls are not obstructed, the Contractor shall conceal horizontal distribution wiring internally within the walls. If such obstructions exist, Contractor shall secure approval by APS project manager prior to the use of an alternate method.
- The Category 5e/6 UTP cable shall be Underwriter's Laboratories (UL) listed type MPR, MPP, CMR, or CMP as stated later in this section.
- Contractor shall provide APS project manager with detailed As-Builds diagrams for cable runs within raised floor detailing exact locations of cable for review and approval by APS project manager after coordination with other contractors, architect or design professional and general contractor.
- Conduit runs installed by the contractor shall not exceed 100 feet or contain more than two 90 degree bends without utilizing appropriately sized pull boxes.
- All terminations will comply with ANSI/EIA/TIA 568B Standard
- Service loops required at all TR/ER/EF (10 ft or more) and the TO (3.28 FT or more)
- Ensuring that Horizontal cable bend radius is no less than four times the cable diameter. No tights bends.

Refer to the APS Standards Manual

Patch Cables:

- All patch cords shall exceed ANSI/TIA/EIA and ISO/IEC Category 5e/6 Specifications
- Patch cords shall be UL listed and UL-C certified.
- Cables colors for the following uses will be:
  a. BLUE – Data
  b. White– Phone
  c. Yellow – Wireless
  d. Green – Security Cameras
  e. Black – Mechanical/Electrical
  f. Gray – Intercom

- Cable jacket shall be "White" in color for Work Areas and cross connects
- Cable jacket shall be "Red" in color to identify Dmarc, router, CAT5e/6 backbones and stacking connections

Backbone Cabling:

- 6 – strand minimum, tight-buffer Fiber Backbones between Distribution Frames.
- Aerial, OSP Fiber cables shall be made of an indoor/outdoor/plenum rating where transitions are required from buildings.
- Contractor shall supply and install the transmission media and terminating hardware to provide interconnection between the MC and each TR in a star topology.
- All cable routes to be approved by project manager prior to installation.
- Riser and tie cables shall be extended between TR's utilizing the interflow conduit sleeves.
- Contractor shall observe the bending radius and pulling strength requirements of all backbone cables during handling and installation.
- Contractor shall supply and install the transmission media and terminating hardware to provide inter-building communications facility.

- All cable routes to be approved by project manager prior to installation.
- Contractor shall supply OSP copper cable, OSP optical fiber cable and electrical protection devices that will prevent electrical surges on the cable from entering buildings.
- All buried and underground conduits are required to contain a Tracer wire (pull rope, pull string, etc.) in the conduit. Service Entrances must be recorded as part of the As-Builts for future spotting references.
- Aerial cable will consist of U/V rated Category Cat 5e/6, or U/V rated fiber optic cable.
- Use self-supporting cable rather than lashed cable if : (1) It is available in the required size, (2) there is no existing strand for voice and data, (3) new cable cannot be lashed to existing cable unless approved by an APS representative, and (4) adequate space exists for growth.
- Aerial connecting hardware and enclosures must be UV and NEMA4 rated.
- All clearances and separations must meet NEC and local codes. NO contractor will install any cable on the roof/s of any APS facilities, or make any roof penetrations unless given written permission by M&O.
- The fiber cable runs will include a 10-foot Service loop at each distribution closet and/or point.

Fiber Specifications:

1. **50 micron Multi-mode Fiber**
   10 Gigabit bandwidth capacity

   300 meters (984 ft) maximum distance

   LC, SC type terminations and connectors

2. **62.5 micron Multi-mode Fiber**
   1 Gigabit bandwidth capacity

   220 meters (720 ft) maximum distance

   LC, ST or SC type terminations and connectors

3. **Single-mode Fiber**
   10 Gigabit bandwidth capacity

   40 kilometers (approx. 25 miles) maximum distance

   LC, ST or SC type terminations and connectors

Wireless Specifications: Wireless Access Points (WAPs) and Wireless Controllers shall be installed based on District standards and in compliance with IEEE's 802.11a, b,g,n,ac Wireless Networking standards. Access Point shall be powered based on IEEE's 802.3af or 802.3at Power-over-Ethernet Standards as determined by APS It Dept. Physical locations and number of Access Points will be designated from the Data Communications Division and mounted typically 96" AFF on the wall, or not to exceed 10' in height. Access Points mounted in gymnasiums must be housed in a protective, non-metallic, wireless enclosure. WAP's are to be labeled, asset tagged according to APS / District IT standards.

Pathways: In suspended ceiling and raised floor areas where duct, cable trays or conduit are not available, the Contractor shall bundle, in bundles of 50 count or less, station wiring with cable ties snug, but not deforming the cable geometry. Cable bundles shall be supported via "J" hooks (OR Erico CAT425 saddles or equivalent) attached to the existing building structure and framework at a maximum of five foot (5') intervals. The contractor shall adhere to the manufacturer's requirements for bending radius and pulling tension of all data cables.

Cables shall not be attached to or supported by fire sprinkler heads or delivery systems or any environmental sensor located in the ceiling air space. Cables shall not be attached or lift out ceiling grid supports or load directly on the ceiling grid. Plenum-rated cable ties shall be used in all appropriate areas.

Aerial pathways shall consist of rigid conduit masts and 30' utility poles, not to exceed a span of 75,' and wedge clamps as secure attachments to aerial messengers.

Portable Buildings: Network connections to Portable classrooms and offices shall be based on an aerial fiber service entrance in a star-distribution topology with a Quick-Disconnect Industrial connector. In rare cases, a wireless bridge may be specified. The following is a list of specifications for the Quick-Disconnect Industrial connector and fiber backbones:

Part#	Manufacturer w/ Description
TBD	OCC (Optical Cable Co.), LC, MM Industrial plug
TBD	OCC, LC, MM Industrial outlet
TBD	OCC, Outlet Dust Cap
TBD	OCC, Plug Dust Cap
OC-040818-01	OCC, 2 strand, 62.5 Multimode Fig. 8, w/ Blue jacket
BX__-WLS-900-OFNR	OCC, Multi-strand, Indoor/Outdoor/Plenum rated

Equipment Racks and Enclosures: The equipment racks shall be made of lightweight steel and include mounting hardware. Enclosures shall be lockable, vented, include fan kits (50 cfm max per fan), and mounted in compliance with NEC clearance codes and ANSI/EIA/TIA mounting standards. All racks shall be grounded to the isolated ground bar within the TR / ER using a standard ground lug and #6 jacketed green cable. Contractor may install electrical receptacles as required to power up Networking Equipment in MDF and IDF enclosures. Refer to APS Standards Manual

Administration: Identification All cables and conduits shall be labeled by the contractor at each exposed point or end with a unique identifier and a description of the cable function to ease individual cable tracing based on ANSI/EIA/TIA 606A and District's standards. Labels shall be permanent, waterproof, and readable from one foot with permanent lettering and shall not be removable by normal cable handling or normal operations.

As-Builts Requirements

Contractor is required to provide As-Built drawings at the completion of each project. They must be of professional quality, capable of being reproduced and with reasonable archival standards. As-builts shall be delivered within 10 working days after project completion. Hand-drawn As-builts are not acceptable. Upon completion of the project, paper and electronic copies of the As-builts are to be provided to the Data Communications Division, as well as a hard copy to the Site Technology Coordinator. As-builts are required to be drawn in the latest version of Autodesk's AutoCAD software and comply with the United States National CAD Standard as follows:

- ES - Electrical Site Plan - Details include Telecommunications pathways and spaces; Conduits, pull boxes, underground boxes, sleeves, masts and utility poles.

- TN-DATA, Telecommunications Network Layer - Details physical locations and labeling for all IP devices, including network drops, MDF, IDF's, wireless access points, cameras, intercom, mechanical and electrical and backbones.
- Labeling compliance with ANSI/EIA/TIA 606A standards and District standards
- Electronic As-builts will be sent as a complete set which include both the .dwg and .dwf formatted files

Grounding and Bonding Requirements: The contractor shall be responsible for providing an approved ground at all newly installed distribution frames, and or insuring proper bonding to any existing facilities. The contractor shall also be responsible for ensuring ground continuity by properly bonding all appropriate cabling, closures, cabinets, service boxes and framework. All grounds shall consist of #6 AWG copper wire and shall be supplied from an approved building ground and bonded to the main electrical ground. Bonding and grounding shall be in compliance with the NEC and ANSI/EIA/TIA 607 standards.

When required by local code, provide a Telecommunications Bonding Backbone utilizing a #6-AWG or larger bonding conductor that provides direct bonding between equipment rooms and telecommunications closets. This is part of the grounding and bonding infrastructure (part of the telecommunications pathways and spaces in the building structure), and is independent of equipment or cable.

Fire stopping and Penetration Sealants: Sealing of openings between floors, through rated fire and smoke walls, existing or created by contractor for cable pass through shall be the responsibility of the contractor. Any openings created by or for the contractor and left unused shall also be sealed as part of this work. All sealant materials will be installed according to manufacturer's directions and recommendations. No foam sealants are to be used.

Provide UL and ATSM approved fire stopping systems to restore fire ratings to all wall or floor or ceiling penetrations. Contractor must provide certification of such fire stopping along with as-builts indicating the locations of such penetrations.

The fire rating of the penetration seal shall be at least that of the floor or wall into which it is installed, so that the original fire rating of the floor or wall will be maintained as required by Article 300-21 & 22 of the NEC. Sealing of annular space of conduits is also required.

The sealant shall remain resilient and pliable to allow for the removal and/or addition of cable without the necessity of drilling holes. It shall adhere to itself in order to allow any and all repairs to be made with the same material. It shall allow for vibration, expansion and/or contraction without affecting the seal, cracking or crumbling.

Cable Testing: Contractor will provide a cable certification from the manufacturer based on their warranty period, as proof that the system is fully operational. If at any time during this period, cable or workmanship should be defective, the contractor will repair or replace in a timely manner at no charge to the District. The above-referenced certifications must be delivered to APS no later than 30 days after completion of the project. Test equipment manufacturers may include only Wirescope or Fluke. The contractor shall perform the cable tests for all cables specified as follows unless otherwise noted or approved by the owner: **Category 5e/6, UTP cables**

- All installed cable will be Channel and Permanent Link tested determining continuity, shorts, reversed pairs, split pairs, attenuation, return loss, NEXT, PSNEXT, ACR, PSACR, ELFEXT and PSELFEXT. The continuity of all grounds and bonds will also be tested.
- All of the installed station cables shall be tested for attenuation loss at 100 MHz and results reported in dB.
- Test 100% of all the station cable runs and provided patch cables for the correct jack pin terminations as specified.

Fiber Optic Cables

- All multi-mode fiber optic tests will be performed at the 850nm and 1300nm windows in both directions. All single mode fiber optic tests will be performed at the 1300 and 1550nm windows in both directions.
- All connectors will be tested and the loss measured in dB, connectors will have a loss of 0.5 dB or less to be accepted.
- All fiber optic links will be tested and the loss measured in dB/KM.
- All fiber optic links will be tested with an Optical Time Domain Reflectometer (OTDR) and a hard copy of the display screen shall be provided by the contractor to the owner for each link.
- The length of each fiber optic link shall be recorded.
- End to end testing is considered to be from the equipment end through the cross-connect to the terminal end.
- After testing is completed all circuits will be restored to their pre-test state (reconnected, re-terminated, etc.).

Reports and Certifications: The contractor shall be responsible for recording and providing to the owner all test data. Copies of all test results are to be submitted to the Data Communications Division in an electronic format and delivered via email. For all fiber optic cables within the required distance, a printout from an Optical Time Domain Reflectometer (OTDR) will be provided and correspond to a labeled fiber cable. All twisted pair copper cable must have an output of the test results with the station ID assigned.

Electronics: List of equipment to be installed per the Scope of Work provided.

*Switches:

1. HP 5120-48G-POE+ JG237A
2. HP 5120-24G-POE+ JG236A
3. HP X120 1G LX SX TRANSCVR JD118B
4. HP 2530-8G-POE+ J9774A
5. HP X121 1G LX SX TRANSCVR J4858C

*Wireless Access Point:

1. Product Number: J9845A HP 560 Wireless 802.11ac (AM) AP

Cabling & Infrastructure Scope of Work (By School Site)

Wireless Access Installations District-Wide. Cabling and infrastructure upgrades where required. The contractors will walk through and bid on the four listed schools and the awarded contractor will then proceed with pricing out the remaining schools listed below based on the number of Wireless Access Points (WAPs) that are specified. The format pricing will help determine the cost of the other chosen schools listed. The award will based off of a grading matrix.

Albuquerque Public Schools – Elementary School - Revised Scopes included**

Bandelier ES

- ** Revised SoW Upgrade Wireless Network (Uniprise) to each classroom per District Standards as follows - (IDF 2.0) Install 1- Drop, 1 - WAP; (Sub-IDF 2.02): Install 1- Drop, 1 - WAP, 1 - Inline P/S; (IDF 3.0): Install 5- Drops, 5 - WAP's; (IDF 4.0): Install 5- Drops, 5- WAP's; (IDF 5.0): Install 1- Drop, 1 - WAP; (IDF 6.0): Relocate Drop 6.0-1-03, Install 1 - WAP; (IDF 7.0): Install 4- Drops, 4 - WAP's; (IDF 8.0): Install 1 - 24 Port P/P, 1 - HP 5120-48G-POE+, 4- Drops, 4 - WAP's, Update As-Builts.

Albuquerque Public Schools – Middle Schools

Eisenhower Middle School

- Upgrade Wireless Network (Uniprise) to each classroom per District Standards as follows - (IDF 3.0): Install 1- Drop, 1 - WAP, (.30 - Port 48); (IDF 4.0): Install 3- Drops, 3 - WAP's, (Ports 1,3,5); (IDF 5.0): Install 7- Drops, 7 - WAP's, (.51 - Ports 39 - 45); (IDF 6.0): Install 1- Drop, 1 - WAP, 1 - Inline P/S, (.60 - Port 46); (Sub-IDF 7.01): Install 1- Drop, 1 - WAP, (Port 28); (IDF 8.0): Install 7 - Drops, Relocate Drop 8.0-1-32, 8 - WAP's, (Ports 41-47); (IDF 9.0): Install 1 - 24 Port P/P, 1 - 5120-48G-POE+, 7 - Drops, 7 - WAP's, (Ports 40-46); (IDF 10.0): Install 2 - Drops, 1 - WAP, (Ports 11 - 12), (1 WAP - onsite); (IDF 12.0): Install 4- Drops, 4 - WAP's, (.121 - Ports 43 - 46); - 33 additional, 1 onsite - 34 total) Update As-Builts.

Madison Middle School

Upgrade Wireless Network (Leviton / CommScope) to each classroom per District Standards as follows - (MDF): Install 1 - 5120-24G-POE+ (Surplus), 1 - Direct Connect Cable (Surplus), 3 - Drops, 3 - WAP's, (Ports 24-26); (IDF 2.0): Install 1 - 5120-48G-POE+ (.21), 1 -24 Port P/P, 12 - Drops, 12 - WAP's, (Ports 35-46), 60 - 2' Patch Cords; (IDF 3.0): Install 2- Drops, 2 - WAP's, 2 - Inline P/S's, (Ports 21 - 23); (IDF 5.0): Install 1- Drop,1 - WAP, 1 - Inline P/S, (.50 - Port 24); (IDF 6.0): Install 1 - 5120-48G-POE+ (.60), 3 - Drops, 3 - WAP's, (Ports 41-46); (IDF 7.0): Install 1- Drop, 1 - WAP, 1 - Inline P/S, (.70 - Port 14); (IDF 10.0): Install 1 - 5120-48G-POE+ (.102), 1 -24 Port P/P, 8 - Drops, 8 - WAP's, (Ports 35-46), (IDF 13.0): Install 1 - 5120-48G-POE+ (.130), 6 - Drops, 6 - WAP's, (Ports 37-46), (Sub-IDF 13.01): Install 1- Drop, 1 - WAP, 1 - Inline P/S, (Port 9); - 37 total) Swap our existing WAP patch cords to yellow patch cords Update As-Builts. Provide and install 8 new 48-Port Patch Panels

Albuquerque Public Schools – High School

Eldorado High School

- ** Revised SoW-

Upgrade Wireless Network (Uniprise) per District Standards as follows - (MDF): Install 1 - HP MSM 460 WAP; (Sub-IDF 1.01): Install 2 - HP MSM 460 WAP's; (IDF 3.0): Install 12 - HP MSM 460 WAP's; (IDF 5.0): Install 14 - HP MSM 460 WAP's; (IDF 7.0): Install 2 - HP MSM 460 WAP's; (Sub-IDF 7.01): Install 3 - HP MSM 460 WAP's; (Sub-IDF 7.02): Install 3 - HP MSM 460 WAP's; (Sub-IDF 7.03): Install 1 - HP MSM 460 WAP; (Sub-IDF 7.04): Install 3 - HP MSM 460 WAP's; (IDF 9.0): Install 9 - HP MSM 460 WAP's, 1 - 24 Port P/P; (IDF 10.0): Install 8 - HP MSM 460 WAP's; (IDF 12.0): Install 11 - HP MSM 460 WAP's; (IDF 13.0): Install 2 - HP MSM 460 WAP's; (IDF 14.0): Install 1 - HP MSM 460 WAP; Update As-Builts.

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Albuquerque Public Schools CONTRACTOR SCORING MATRIX – Cabling and Infrastructure

Albuquerque Public Schools will use a 150 point scoring matrix to evaluate all submitted quotes. Please, provide the information below.

TOTAL PRICE FOR E-RATE ELIGIBLE SERVICE 150 Points Total

Cost: Scoring shall be based on total cost for E-Rate eligible services.

Evaluation Points Summary

The following is a summary of evaluation factors and the maximum point values assigned to each. These will be used in the evaluation of each Offeror's proposal submitted.

	Factor	Points
	Mandatory Specifications	
1.1	**Past Experience:** Vendor shall provide detailed documentation of actual previously completed example projects of comparable size and complexity. All documentation, including logical and physical design maps shall be included, and should demonstrate the level of installation. Photographs desired. Past experience with District will also be included.	15
1.2	**References:** The ability to complete, manage and correctly bill projects is important to APS. Please provide proof of successful projects via customer references. APS requires **four (4)** references from customers where the Offeror provides similar E-Rate projects and SLD billing equal to or near the price provided in the vendor's response to this solicitation. Please include SPIN #, project type, project total, distance from home office, named contacts including telephone numbers and E-mail addresses. All references will be verified	10
1.3	**Contractor Profile:** Write a brief history of your company that includes its philosophy of doing business. Generally, APS will not accept a proposal from a business less than three (3) years old or which has failed to establish a proven record of business in similar environments. APS will not accept a proposal from a business that has no track record of providing said Priority Two services under the E-rate program. Fill out in its entirety the Form W-9 which will be supplied by the District with this 470 Form.	10
1.4	**Employee Resumes:** Provide a resume of every employee that will be assigned to APS. Resumes must include work history, licenses and certifications.	15
1.5	**E-rate Experience:** Contractor shall provide documentation indicating their knowledge of, and ability to, work within the E-rate environment to successfully maximize funding opportunities for the District and ensure the earliest possible project completion. Verifiable documentation shall be provided demonstrating that the proposed service is eligible for funding under E-Rate Priority Two. Such documentation shall reflect the vendor's previous experience providing similar services under Priority Two. Vendor shall provide a position statement on how they will deal with late FCDL (Funding Commitment Decision Letters) or funding denial in future years of the contract.	15
1.6	**E-Rate Eligible Cost: Material and Labor**	45

1.7	**Compliance with Technical Standards:** As stated above the District has standardized on certain networking electronics and is giving preference to vendors that provide solutions that fully adhere to the District's standards for equipment.	15
1.8	**CommScope Certified Partner:** As state above the District desires to utilize a CommScope Certified Partner, primarily for warranty purposes, and preference is being given to Offerors that meet this requirement.	15
1.19	**E-Rate Ineligible Cost: Material and Labor**	10
	Total Points	150

Asset Report

Selected vendor must provide a detailed asset report using the system and format as specified by the District that will include but not be limited to labeling, tagging, and reporting of asset to ensure compliance with District and E-rate Asset Control/Tracking Procedures. Label to contain WAP ID, Year of e-rate purchase, ID number, detailed location (Rm 101, West Hallway #3 of 7, etc.) Report to District would contain all of the above including purchase order number, serial number(s), asset tag number by each site.

Sample Report SCHOOL: Sample HS		**Albuquerque Public Schools**				
E-Rate Year: 2015		**SAMPLE INVENTORY SHEET**				
Date: 1-29-15						
Make	**Model**	**Part#**	**Serial#**	**Physical Location**	**Network Location**	**Telecom Outlet Location**
HP	HP5800G 24 SFP	JC103A	CN14BFR029	Office A118	MDF1.0	D6.0-101
HP	HP A5500 48G SI	JD370A	CNOBB9M01D	Office A118	MDF1.0	D1.01-87
HP	HP A5500 48G PoE	JD372A	CN07B9P02Z	Office A118	MDF1 0	D7.0-1-08
HP	HP A5500 48G PoE	JD372A	CN07B9POOJ	Hall H110	IDF2.0	D1.02-88
HP	HP A5500 24G PoE	JD371A	CNOBB9NOOR	Library Break	IDF3.0	D1.0-1-06
HP	HP A5500 24G PoE	JD371A	CNOBB9NOOF	Cafeteria	IDF4.0	D1.02-2-04
HP	E-MSM422	J9358B	SG1049K03T	Computer	1.0-1-14	D1.0-1-06
HP	E-MSM422	J9358B	SG1049K059	Room 213	1.0-1-43	D8.0-1-21
HP	E-MSM422	J9358B	SG0509K06P	Room 203	1.0-2-49	D1.03-1-32
HP	E-MSM422	J9358B	SG1049K04T	Room 214	1.0-2-71	D1.08-1-15
HP	E-MSM422	J9358B	SG0509K112	Room 104	2.0-1-03	D1.06-1-11
HP	E-MSM422	J9358B	SG1049K03G	Room 112	2.0-1-16	D1.07-1-01
HP	E-MSM422	J9358B	SG1049KOGS	Staff Lounge	3.0-1-15	D1.08-1-07
HP	E-MSM422	J935BB	SG1049K037	Cafeteria	4.0-1-13	D13.0-1-04

BID# 15-DD Network Equipment and Installation Services

Contractor Required Pricing Format

Quotes based on the following:

The Scope of Work identified in the attached E-rate Scope of Work.

Information provided at the Pre-bid meeting

Refer to APS Standards Manual

A Bill of Materials, broken down by task as below, **must** be included in this quote.

1. Project Tasks – E-Rate / Cost per Cat5e / 6 drop. Est.

Labor Cost	$
Material Cost	$
Total Tasks	$
Tax	$

2. Project Tasks – E-Rate / WAP Installation cost per unit. Est.

Labor Cost	$
Material Cost	$
Total Tasks	$
Tax	$

3. Project Tasks – E-Rate / Network Switch Installation cost per unit. Est.

Labor Cost	$
Material Cost	$
Total Tasks	$
Tax	$

4. Project Tasks – E-Rate / Conduit Pathways- estimated cost. Est.

Labor Cost	$
Material Cost	$
Total Tasks	$
Tax	$

5. Project Tasks – E-Rate / 5400s molding per foot.

Labor Cost	$
Material Cost	$
Total Tasks	$
Tax	$

The District expects service providers will provide an Excel version of the Item 21 Attachments in the format approved by USAC and the FCC. Offerors must ensure they provide the current approved Item 21 Attachment from USAC in an excel format that can easily be uploaded into USAC's online system. The approved templates are available at http://www.usac.org/sl/tools/forms/471-templates.aspx.

Signed: _____Date: _____

Printed Name and Title: _____

An authorized representative of the company must sign this Offer,

By signing, you have agreed to all terms and conditions of the Scope or Work herein.

*Note: APS assumes pricing submitted includes all labor and materials.

Contractor Required to Quote: Network Controller and Licenses

APS e-Rate Wireless Projects- Network Licenses and Controllers				
Manufacturer	**Part Description**	**Part#**	**QTY**	**Total**
HP	A7510 SWITCH	JD238A	EA.	2
HP	7500 6000W AC P/S- PWR Supply	JD227A#ABA	EA.	4
HP	384 GBPS A7500 FAB MOD W/ 2 XFP PTS	JD193B	EA.	4
HP	CAREPACK 3YR NBDHWEX7510 SWCH +24X7SW- service contract	U4D66E	EA.	2
HP	10500/7500 20G UNIFIED WIRE-WLAN MOD	JG639A	EA.	10
HP	CAREPACK 1Y NBD 10500/7500 20G EXCH PLUS-service contract	U8M31E	EA.	10
HP	FIO 10500/7500 WRD-WLAN MOD 128 AP E-LTU- License	JG649AAE	EA.	150
HP	CAREPACK 1YR24X7 NTWKS/W GROUP 180 LIC S- Service contract	HR808E	EA.	150
HP	IMC wireless Service Manager Software Module with 50-Access Point E-LTU- License	JF414AAE	EA.	40

Albuquerque Public Schools - Bid No. 15-DD, e-Rate Wireless Network Equipment Count - Appendix I

Company Name: _____ Representative:_____

Site	Switch Count	Unit Price per Switch	Total Price for Switches	Patch Panel Count	Unit Price per Patch Panel	Total Price for Patch Panels	WAP Count	Unit Price per WAP	Total Price for WAPs	Total Equipment Cost	Total Non-Equipment Cost	Total Labor	Grand Total
Description / Part #	HP 5120-24G-POE+ (JG236A)	$	$	COMMSCOPE - Uniprise, 24-pt Patch Panel Cat5e - UNP510-24P	$	$	HP 560 Wireless 802.11ac (AM) AP (J9845A)	$	$	For WAP + Switches + PPs per School	Cat 5e cable + Cat 5e components, etc. per School	For installation of all WAPs, eqmt., non-eqpmt. / per School	$
El Dorado HS	6		$ -	6		$ -	72		$ -				$ -
Atrisco Heritage Academy HS	8		$ -	8		$ -	102		$ -				$ -
La Cueva HS	7		$ -	7		$ -	73		$ -				$ -
Sandia HS	8		$ -	8		$ -	61		$ -				$ -
Tony Hillerman MS	6		$ -	6		$ -	48		$ -				$ -
LBJ MS	7		$ -	7		$ -	47		$ -				$ -
James Monroe MS	5		$ -	5		$ -	36		$ -				$ -
Albuquerque HS	7		$ -	7		$ -	67		$ -				$ -
Jimmy Carter MS	4		$ -	4		$ -	41		$ -				$ -
Washington MS	4		$ -	4		$ -	28		$ -				$ -
North Star ES	4		$ -	4		$ -	30		$ -				$ -
Ernie Pyle MS	8		$ -	8		$ -	38		$ -				$ -
Grant MS	7		$ -	7		$ -	32		$ -				$ -
Roosevelt MS	3		$ -	3		$ -	24		$ -				$ -
Georgia O'Keefe ES	4		$ -	4		$ -	32		$ -				$ -
Sunset View ES	3		$ -	3		$ -	27		$ -				$ -
Madision MS	5		$ -	5		$ -	37		$ -				$ -
Helen Cordero ES	6		$ -	6		$ -	31		$ -				$ -
Jefferson MS	5		$ -	5		$ -	30		$ -				$ -
La Mesa ES	5		$ -	5		$ -	33		$ -				$ -
Montezuma ES	4		$ -	4		$ -	29		$ -				$ -
Corrales ES	3		$ -	3		$ -	22		$ -				$ -
Double Eagle ES	3		$ -	3		$ -	23		$ -				$ -
Inez ES	3		$ -	3		$ -	22		$ -				$ -
Atrisco ES	4		$ -	4		$ -	25		$ -				$ -
Kennedy MS	5		$ -	5		$ -	30		$ -				$ -
McKinley MS	4		$ -	4		$ -	20		$ -				$ -
Taft MS	3		$ -	3		$ -	27		$ -				$ -

A. Montoya ES	3		$ -	3		$ -	20		$ -				$ -
Susie Rayos Marmon ES	6		$ -	6		$ -	32		$ -				$ -
SY Jackson ES	3		$ -	3		$ -	21		$ -				$ -
Desert Ridge MS	5		$ -	5		$ -	30		$ -				$ -
Garfield MS	4		$ -	4		$ -	26		$ -				$ -
Hayes MS	4		$ -	4		$ -	23		$ -				$ -
Acoma ES	2		$ -	2		$ -	17		$ -				$ -
John Baker ES	3		$ -	3		$ -	22		$ -				$ -
Mary Ann Binford ES	4		$ -	4		$ -	28		$ -				$ -
Osuna ES	3		$ -	3		$ -	20		$ -				$ -
Tierra Antigua ES	4		$ -	4		$ -	27		$ -				$ -
Cleveland MS	6		$ -	6		$ -	33		$ -				$ -
Eisenhower MS	3		$ -	3		$ -	34		$ -				$ -
John Adams MS	5		$ -	5		$ -	39		$ -				$ -
Alameda ES	4		$ -	4		$ -	17		$ -				$ -
Bel-Air ES	3		$ -	3		$ -	22		$ -				$ -
Hodgin ES	4		$ -	4		$ -	28		$ -				$ -
Longfellow ES	3		$ -	3		$ -	21		$ -				$ -
Armijo ES	4		$ -	4		$ -	23		$ -				$ -
Duranes ES	4		$ -	4		$ -	19		$ -				$ -
Pajarito ES	4		$ -	4		$ -	25		$ -				$ -
TOTALS:	222		$ -	222		$ -	1614		$ -	$ -	$ -	$ -	$ -

Albuquerque Public Schools - Bid No. 15-DD, e-Rate Wireless Network Equipment - Appendix II
HP Wireless Network Controls / Licenses / Care

Company Name: _____ Representative:_____

Part Number	Description	Manufacturer	Quantity	Unit Price	Extended Price
WLAN N+1 Failover Model					
JD238B	HP 7510 Switch Chassis	HP Networking	**2**		$ -
JD227A	HP 7500 6000W AC Power Supply	HP Networking	**4**		$ -
JD193B	HP 7500 384Gbps Fabric Module with 2 XFP Ports	HP Networking	**4**		$ -
JG639A	HP 10500/7500 20G Unified Wired-WLAN Mod	HP Networking	**10**		$ -
JG649AAE	HP Unified Wired-WLAN 128 AP E-LTU	HP Networking	**20**		$ -
U3LY2E	HP 3y NBD Exch 7510 Swt pdt FC SVC [for JD238B]	HP Networking	**2**		$ -
U3LX1E	HP 3y NBD Exch 10500/7500 20G U W FC SVC [for JG639A]	HP Networking	**10**		$ -
U4HW5E	HP 3y24X7HP UNIF WD-WLAN 128 AP FC SVC [for JG649AAE]	HP Networking	**20**		$ -
JF415AAE	HP IMC WSM 50-Access Point E-LTU	HP Networking	**40**		$ -
U4AP0E	HP 3y 24x7 HPNing Group 145 Lic FC SVC [for JF415AAE]	HP Networking	**40**		$ -
					$ -

Albuquerque Public Schools
Design Guidelines for Information Technology Infrastructure & Facilities
Edited January 1, 2015

APS Standards

Growing Education
Connecting Our Kids.

ALBUQUERQUE PUBLIC SCHOOLS
Technology Department

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ALBUQUERQUE PUBLIC SCHOOLS DESIGN GUIDELINES FOR INFORMATION TECHNOLOGY INFRASTRUCTURE FACILITIES

1. General

The Albuquerque Public Schools has identified the need to incorporate a structured approach to the integration of Information Technology Infrastructure facilities within the planning and programming of new construction projects and retrofit of existing facilities district wide. APS has embraced the need to actively support the technology environment of today as well as decades into the future. Key to this mandate is the necessity to integrate the budgetary, engineering, and architectural implications of a standards-based Information Technology Infrastructure system of pathways and spaces within and between the buildings.
Inter building Communication Infrastructure is designed for a useful life of 20 to 50 years. Intrabuilding pathways and spaces have the approximately the same useful life, and are intended for reuse when cable media is replaced. Cable media and equipment for Inter-and Intrabuilding distribution should be planned for a range of 5 to 15 years, which varies based on developments and changes in technology.

The TIA, EIA and the BICSI design manuals are the basis for the APS Design Guidelines and Specifications.

All questions concerning the intent, updates, and information not included in the APS Design Guidelines and/or Specifications and the information contained within this document shall be direct to the APS Technology Department.

2. Purpose and Scope

To provide Contractors, programmers, budgeters, planners, designers and architects the requirements, standards and guidelines, for inclusion in the construction programming of information technology infrastructure facilities. These guidelines apply to the physical aspects of new construction projects, as well as retrofit and upgrades of existing communication infrastructure facilities on the APS Campus's.

Note: Architectural and/or engineering firms selected for the planning and design of APS buildings must include the APS IT department for all designs and expertise. The Architectural and/or engineering firms are not to proceed with any modifications and or decisions without prior approvals from the APS IT department (Tony Otero, IT MGR, RCDD, EE98j) no exceptions!

Note: All deviations, changes or modifications to the requirements of these specifications, equipment, materials, methods, procedures and requirements of these documents are subject to the Approval of APS Information Technology Department.

This document provides descriptions and general specifications for the components that encompass the pathways, spaces, and cable media for both inter building and intra building information technology infrastructure systems. APS has a published set of specifications for the schools Data Communication Network that includes information for infrastructure, which these guidelines are intended to complement.

The application of the Guidelines varies from building to building, based on the building's purpose and layout. There are the specified minimum requirements for the infrastructure features described within this document; however, these may be subject to specific exception and modification upon approval by APS Technology Department according to the complexity and purpose of an individual building. In the case where the requirements set forth within this document expand upon or exceed those provided by APS in their existing specifications, the more stringent requirement shall prevail.

When applying these Guidelines to retrofit projects in existing building, the designer should consider that some of the requirements, particularly for space, might not be practical or even possible to achieve. These exceptions and modifications also shall be submitted to the APS Technology Department for reviewed and approved by and only by the Technology department.

Note: The architect, design team and contractor are directly responsible to provide, plan, design, engineer, construct and install all IT facilities and fixtures within these guidelines requirements providing installed systems are Sustainable, Assessable and Coordinated with other building systems to allow for Flexibility and Optimal use for future operational and maintenance activities.

This document includes guidelines for the planning and construction of Information Technology Infrastructure Cabling. Note that they are arranged in order starting with Intrabuilding infrastructure and media components for placement within buildings, and moving outward to the inter-building physical communication infrastructure. These are features created between buildings necessary to coherently connect them together.

Intrabuilding Spaces
- Service Entrances
- Equipment Rooms
- Technology Rooms
- Server Rooms

Intrabuilding Pathways
- Conduits
- Cable Tray
- Pull Boxes

Intrabuilding Cable Media
Equipment Racks and Cabinets
Optical Fiber Backbone Cable
Multi pair Copper Backbone Cable
Coaxial Cable
Horizontal Copper UTP Cable or FTP (as approved by APS IT) Inter Building Spaces (Transition Structures)
Communications Vaults/Maintenance Holes
Hand Holes
Inter Building Pathways
Ductbanks
Inter Building Cable Media Optical Fiber Backbone Cable Multi pair Copper Backbone Cable Coaxial Cable
Wireless
Special Systems
Alarms
Multi Media & Classroom Technologies
Project Requirements, Documents and Warranty
Project Design and Communication Requirements
Scheduling Requirements
Testing, Labeling, Documentation and Acceptance
Warranty Requirements

3. Life of These Guidelines

This set of Guidelines is a living document and intended for review and update by APS periodically as warranted by changes in building construction techniques and communications technology. APS IT retains the right to modify these documents on an interim basis between updates or for project specific requirements to meet the needs of APS Schools or IT Department.

4. Submittal Requirements

The contractor will provide the following submittals for all APS major projects. All requests for changes to the submittal package shall be approved by APS IT Department.

Note: Submittals are only required when crossing manufacturers

Design Phase Submittals: The design professional is to provide the following at the completion of the design phase:

Details of IT distribution and components for building and local distribution

Provide a specification that addresses all APS Standards, related items and activities. Include in specifications cabling system performance requirements, approved manufacturers and systems, testing requirements and warranty requirements.
Specifications shall only call out materials and systems or “approved equals” specified in the APS RFP / APS Guide Specifications. The term or similar terms such as “or equal” shall not be specified or recognized as an approved equal. All “approved equals” shall have the approval of APS IT Department.

Provide substantially complete specification for the IT systems. Address all applicable requirements of the APS IT guide specifications and Division 27 activities and items.

Riser Diagrams

Voice, Data and Wireless Access Point Locations with Outlet ID

Detail diagram of IT Equipment and Telecommunication’s Rooms fit out and footprint including cable tray, ground bar, backboard, equipment racks locations, etc. Ghost electrical, lighting, fire protection, HVAC and other support systems. Verify all clearances are met.

Detail diagram of equipment rack layout that includes components (i.e. UPS, electrical outlets, data switches, patch panels, fiber optic hardware, etc.

Site drawing that identifies all IT and other service provider (i.e. local exchange carrier, ISP, CATV etc.) infrastructure. Include the locations of

Notes applicable to the installation numbered to plan. Include conduit requirements for bend radius and transitions and similar specifics for construction or installation requirements.

Provide Raceway Distribution Plan

Define wireless coverage and design to requirements

Typical detail diagram of penetrations including firestop assemblies

Typical detail diagram related to cable tray design including, grounding, bonding, splicing, waterfalls and other transitions.

Typical detail diagram of cable support systems

Typical detail diagram of pull box and conduit assemblies

Typical detail diagram of raised floor sections and fit out.

Typical detail diagram of surface raceways and fit out including conduit entrance.

Typical detail diagram of floor boxes and poke thru devices including conduit entrance and power assemblies. Include all apparatus needed for assembly.

Detail of outlet box and conduit assembly to wall, floor, ceiling or access point.

Wireless Access Point Outlets and Hardware

Interface outlets and interface of Alarms and Building Systems

Detail of all ADA IT equipment requirements

Typical detail diagram of all other accessory and support apparatus

Typical detail diagram of all classroom equipment installations

Typical detail diagram of special IT equipment installations

Typical detail diagram of all multimedia equipment installations

Classrooms:

Provide more detail of room layouts, technology equipment, obstructions, and viewing lines from student seating and instructor positions.

Provide more details related to lighting, zoning and switching.

Define specific locations of changes in ceiling planes, light fixtures, technology projector lighting paths, HVAC diffusers with their air throw impact on projector screens, air return locations and noise. Define noise criteria (NC)

Provide a written Acoustical Report for classrooms.

Provide a written report of all Value Engineering decisions and items

Provide and updated Project Cost Estimate for IT deliverables.

Update the project schedule as related to IT activities.

Construction Phase Submittals: The design professional is to provide the following at the completion of the construction design phase:

Provide a complete final specification for the IT systems. Address all applicable requirements of the APS IT guide specifications and Division 27 activities and items

Provide notes and cross references for common work results in specifications. Place notes in related sections.

Provide a complete final of plans for the IT systems. Address all applicable requirements of the APS IT guide specifications and Division 27 activities and items.

Provide notes and cross reference notes and for all common work on related plans.

Provide notes for all transitions and instructions related to ceilings, confined spaces, walls, floors and other spaces.

Provide notes for specific instructions to the contractor for IT related work activities.

Ghost ceiling plans to IT drawings. Note all IT rooms and spaces are to be clear to deck above.

Provide outlet schedule that includes each Outlet ID shown on the IT plans, final room numbers Room, outlet requirements (Ports), Performance Requirements (i.e. Category 5E or 6 10 G), Activation requirements for voice and data, Set type (i.e. single line, digital multi line service set, FAX, wall phone, elevator phone, alarm etc. Verify outlet schedule to program requirements. Provide in electronic format to APS IT Dept and on plans as this will be used to assemble the cut sheet.

Provide final details for classrooms.

Floor plans, elevations and layout specifics

Technology equipment and relationship to view lines and obstructions

Define details and changes to IT equipment

Finalize lighting, zoning, switching, noise (NC), clearances HVAC requirements

Include final security requirements for classrooms and equipment.

Provide a final written report of all IT Value Engineering decisions items and activities.

Provide and updated a final Project Cost Estimate for IT deliverables.

Provide a final project schedule as related to IT activities.

Bid, Award and Construction Documents: The design professional is to provide the following during the construction phase.

Only APS IT approved contractors on contract shall be considered for any enterprise cabling projects. No other contracts to be excepted unless authorized by the APS IT department.

Notification of all substitutions for parts, products or systems is at the discretion of APS IT department.

All work designed and installed that does not meet APS IT Standards / guidelines or specifications may be rejected and shall be corrected, modified or installed at the project design team and contractors expense.

APS IT Department reserves the right to approve all assumptions and exceptions to IT project deliverables.

APS IT Department shall receive copies of all RFI's or other informational request related to IT project deliverables upon receipt by the project's design team.

Construction Substantial Completion Phase Submittals: The design professional is to provide the following at the completion of the construction phase:

As built floor plans with final outlet locations that include each outlet ID two weeks prior to first move date

Provide as built outlet schedule that includes each outlet ID shown on the IT plans, final room numbers Room, outlet requirements (Ports), Performance Requirements (i.e. Category 5e or 6 10 G), Activation requirements for voice and data, Set type (i.e. single line, digital multi line service set, FAX, wall phone, elevator phone, alarm etc. Provide two weeks prior to first move date.

Test results for all APS IT cabling projects including optical fiber, building distribution and horizontal cabling two weeks prior to first move date. Provide in electronic format direct from tester. Hand written test results are not acceptable.

Copy of contractor punch list for open IT items

Copy of cabling system warranty application two weeks prior to first move date

Construction Completion Phase Submittals: The design professional is to provide the following final documents at the completion of the project.

Final as built plans including modifications made during substantial completion.

Final as built outlet schedule including labeling ID

Final test results after punch list completion and APS IT verification.

Cabling system warranty certificate assigned to APS IT Department.

Resolution report for all punch list items
Final Value Engineering Report for IT items.

Manuals for all IT equipment and support systems

5. Codes & Standards

The specifications included within these Guidelines, incorporate generally accepted communications infrastructure practices described in industry recognized standards documents (and addenda) published by recognized standards bodies and organizations. These include applicable standards published by ANSI, IEEE, the Telecommunications Industry Association/Electronics Industries Alliance (TIA/EIA), ISO/IEC and Building Industry Consultant Services International (BICSI).

Note: It is the responsibility of the architect, design team and contractor to provide, plan, design, engineer, construct and install IT systems that meet the requirements of the APS IT Design Guidelines/Guide Specifications that is industry standard's compliant and meets the warranty and installation requirements of the system's manufacturer.

Note: The architect, design team and contractor are directly responsible to provide, plan, design, engineer, construct and install all APS IT facilities and fixtures in compliance to all building and trade codes and laws applicable to the State of New Mexico, City and the code Authority Having Jurisdiction (AJH). This includes code modifications to existing conditions with the project boundaries and adjacent areas where associated project work is required such as pathways and IT equipment spaces.

Provide full compliance with the American Disabilities Act of 1990 for all IT installations.

The most recent editions of the codes, laws, standards and specifications listed below shall be referenced for project design and construction requirements unless specifically addressed in the APS IT Design Guideline and/or Specifications.

ANSI/TIA/ EIA 568B, Commercial Building Telecommunications Cabling Standard
This prescribes the requirements for Intra building copper and optical fiber cable performance, installation and testing.

ANSI/TIA/EIA 569A, Telecommunication Standard for Pathways and Spaces
This standard includes specifications for the design and construction of pathways and spaces within buildings required to support information technology equipment and cable media.

ANSI/TIA/EIA 607, Commercial Building Grounding and Bonding Standard
This document includes the components of an effective grounding system for communication systems within public and commercial buildings.

ANSI/TIA/EIA 758 Customer Owned Outside Plant Telecommunications Cabling Standard
This standard provides specifications for Inter Building communication facilities that include cable media, pathways and spaces.

ANSI/TIA/EIA 862, Building Automation Systems Cabling Standard for Commercial Buildings
This standard describes the generic cable system for building automation systems (BAS) that are intended to support a multi-product, multi-vendor automation environment within public and commercial buildings.

ISO/IEC 11801
International Standard ISO/IEC 11801 specifies general-purpose telecommunication cabling systems (structured cabling) that are suitable for a wide range of applications (analog and ISDN telephony, various data communication standards, building control systems, factory automation).

Building Industry Consulting Services International (BICSI) Telecommunications Distribution Methods Manual
This is a manual of proven design guidelines and methods accepted by the telecommunications industry.

Building Industry Consulting Services International (BICSI) Specialty Manuals

Customer Owned Outside Plant
Wireless

ANSI/NFPA 70, National Electrical Code, (NEC) Current Edition
In addition to standards related to electrical safety, the NEC has several sections which specifically address low voltage cable installation.

NFPA 90 A: Installation of Air Conditioning and Ventilating Systems
This standard prescribes requirements for cabling fire ratings in ceiling spaces and the distribution of cabling within.

American Disabilities Act of 1990
This law mandates construction and installation requirements for handicap accessibility

Additional Standards:

All work not specifically related to the fore mentioned standards shall be performed in accordance with the applicable ANSI or International Standards associated to it.

Manufactures Specifications and Instructions:

In addition all work shall be performed to the applicable manufacturer's specifications and instructions pertaining to that work.

6. Definitions and General Requirements

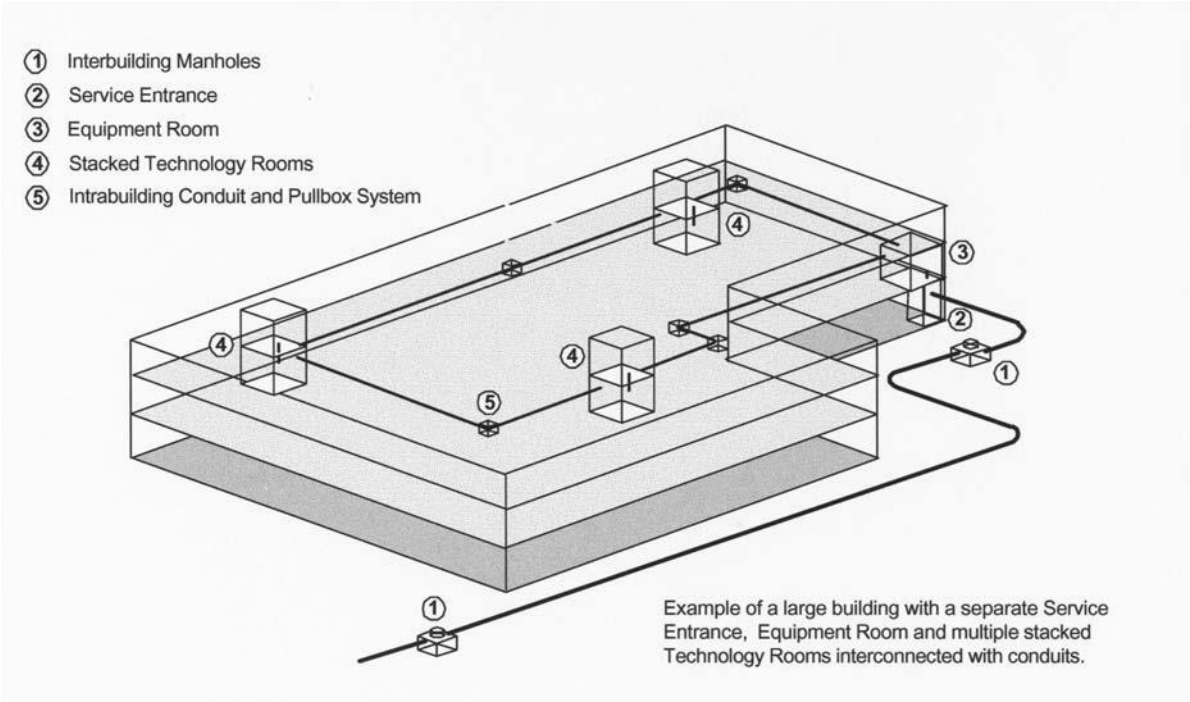
These definitions are arranged to present the logical order of their relationships to each other in an overall infrastructure topology.

Pathways – Structures - or hardware that provides a permanent and reusable route for housing and the protection of cable media installed between two points. These facilities also provide a permanent enclosure or mechanism that facilitates the addition or replacement of cable over time. Intrabuilding Pathways include cable tray and conduit, which may be used for horizontal or vertical routing of cable. The Intrabuilding communication cable system infrastructure includes the pathway and support hardware that concentrates supports and protects horizontal cable media between its origination point in the Equipment or Technology Room and the workstation outlet location. Horizontal support hardware is further defined as continuous, (e.g. Conduit, Cable Tray) and non-continuous (e.g. J-Hooks).

Inter Building Pathways - include direct buried and concrete encased ducts as well as Aerial cable routes are also examples of Inter Building Pathways, however, underground pathways will be constructed wherever possible, and Aerial Pathways shall only be used when buried or concrete encased facilities are not an option.

Spaces—Permanent structures that provide a protected area for the termination of cable and placement of equipment, allow for the dispersion and distribution of cable and worker access to facilitate the placement of cable. Intrabuilding Spaces include Service Entrances, Equipment Rooms, Technology Rooms, Server Rooms and Pull Boxes. Inter Building Spaces include Transition Structures such as Underground Communication Vaults (Maintenance Holes), Hand Holes and Termination Spaces such as Pedestals. See Diagram 1, Typical Large Building with Separate Service Entrance, Equipment Room and Multiple Technology Rooms; and Diagram 2, Typical Building with Equipment Room/Service Entrance and Multiple Technology Rooms; for an illustration of the relationship of Intrabuilding Space.

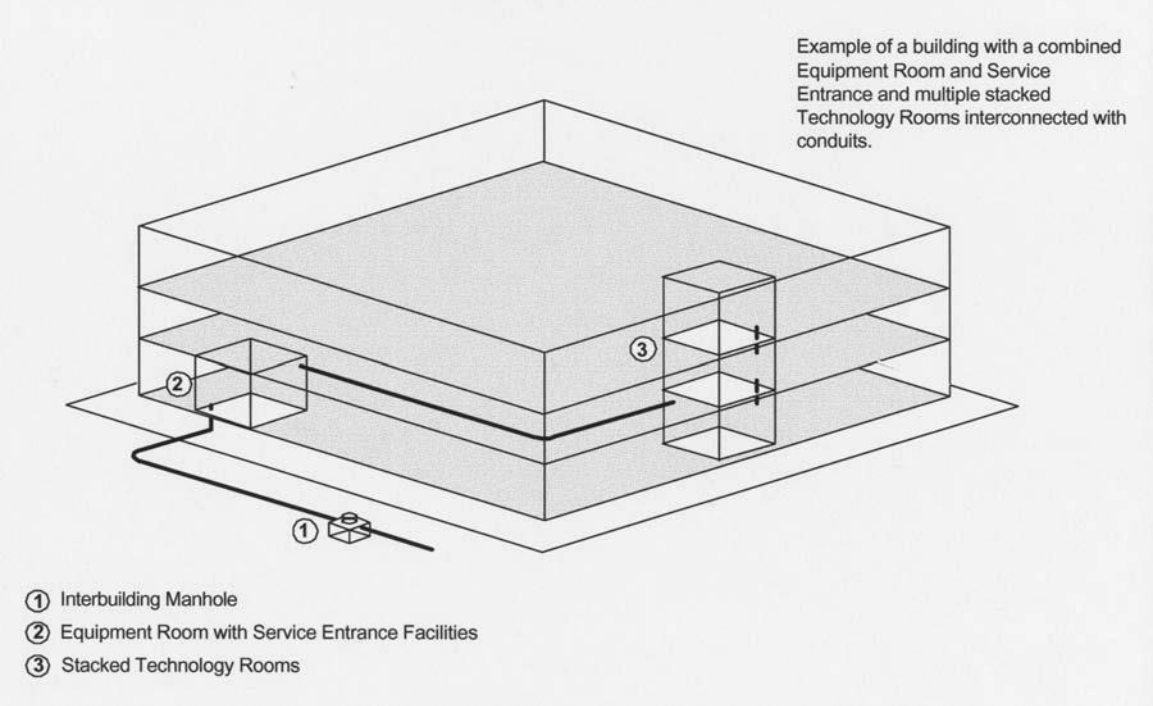
Typical Building Infrastructure with a Service Entrance



Entrance Facility (EF) not a typical installation but for future designs

APS Specification Size SE/EF/ER/TR 10ft x 12ft

Typical Building with a Combined Service and Equipment Room



Service Entrance Rooms - These are rooms typically located in building basements or on the ground floor of a building where there is no basement, and are the terminus of Inter Building conduits. Service Entrances are often the location where unrated Inter Building backbone cable is spliced to rated cable and/or electrical protector units for distribution within the building. There is no need for significant environmental support in these rooms other than what is provided in a standard office, since they do not contain sensitive electronic communications equipment. Convenience power, normal ventilation, adequate lighting, and a secured entry door are usually sufficient for these facilities. See Diagram 3, Typical Service Entrance Detail for an example of an a Service Entrance Room layout.

Equipment Rooms (ERs/ MDF) – These facilities are also referred to as MDF (Main Distribution Frame) Rooms or BDF (Building Distribution Frame) Rooms, and they are special-purpose rooms that provide space and maintain a suitable operating environment for the termination of backbone and campus cabling and house centralized communications and/ or computer equipment such as Core Switches,

Servers and PBX. The Equipment Room is considered the demarcation point within the building itself, the location where the Inter Building and Intrabuilding communication distribution systems, interconnect companies, ISP's , CATV and other outside service providers. Equipment Rooms differ from Technology Rooms in that Equipment Rooms are generally considered to serve a building or campus area, whereas Technology Rooms serve a floor area of a building.
Equipment Rooms may also include other building information systems such as classroom technology, community antenna television [CATV], multimedia, fire alarm, security, building management systems (BMS) and other building signaling systems. In some cases, an Equipment Room may also contain the service entrance facility for campus backbone, access providers, or both and serve as a Technology Room (TR). The Equipment Room is the recognized termination point for all backbone cabling in a building. The Equipment Room may require adjacent space and electrical provisions allocated for batteries, UPS, rectifiers, fire suppression systems, HVAC and other support systems. See Diagram 4, Typical Equipment Room Detail for an example of an Equipment Room layout. Ensure room size is adequate to accommodate the existing footprint with growth for the additional systems.

Technology Rooms (TRs) --, Also known as Wire Centers, IDF Closets, Sub TRs Holocom Cabinets for labs, Telecommunications Closets or Tele/Data Rooms, differ from Equipment Rooms (ERs) and entrance facilities in that they are generally considered to be floor-serving (as opposed to building or campus-serving) spaces that provide a connection point between backbone and horizontal distribution pathways. Technology Rooms 10ft x 12ft provide an environmentally suitable and secure area for installing cables, patchpanels, cross-connects rack- and wall-mounted hardware and technology equipment. The Technology Room is the recognized connection point between the backbone and horizontal pathways. Technology Rooms may require space and electrical provisions allocation for batteries, UPS, rectifiers, fire suppression systems, HVAC and other support systems. See Diagram 5, Typical Technology Room Detail for an example of a Technology Room layout. . Ensure room size is adequate to accommodate the existing footprint with growth for the additional systems.

Server Rooms – The requirements for Server Rooms is similar to Equipment Rooms or Technology Rooms. The Server Room requires racks, ladder racks, dedicated and convenience power and air conditioning. Air conditioning requirements could be higher and the calculation is provided in the Equipment Room section of this document. An infrastructure connection is required for cabling to either the Equipment Room or Technology Rooms to provide connectivity to the University data network. All requests and requirements for new server rooms shall be submitted to CNS and the Office of the CIO for approval during programming and prior to design.

Intrabuilding Backbone Cable – These cables are used to connect the Equipment Room to the respective Technology Rooms, primarily to carry signals to and from

the edge and core communication electronics equipment. Multi pair Copper Backbone Cable may also be used to concentrate alarm and building control system signals distributed throughout a building. Typically, Intrabuilding Backbone Cable consists of Multi pair Copper, High Strand Count Fiber Optic and Coaxial Trunk cables.

Inter Building/Campus/Off Campus Infrastructure – Includes the conduits, manholes, easements, right of ways, antenna, and other systems that support inter building IT transport systems. Also included are provisions necessary for public and private service providers to provide ITS services to APS off site facilities, buildings and campuses. ITS will be the ultimate provider of these services, however projects may have both fiscal and material responsibilities for their provision. The programmer or designer needs to address and include with IT these requirements when planning for both on and off campus locations in the planning and design of all APS facilities.

Note: Easements and/or written agreements are required for non APS entities such as the local telephone company, CATV providers and other carriers for the placement of their facilities on APS properties. It is the responsibility of the project design team to make application to and receive approval from the APS IT Department of Real Estate for these requirements prior to construction and placement.

Inter Building Backbone Cable -- Inter Building Backbone Cable is used to connect buildings together, in order to concentrate and distribute aggregated signals to and from Zone Hub-Level Core Electronic Systems. Inter Building Backbone is typically Multi pair Copper (hundreds to over one thousand pairs), High Count Optical Fiber Cable (up to hundreds of strands), and Coaxial Trunk Cable. Inter Building Backbone Cable is constructed to withstand the elements of cold, heat and moisture as well as the harsh external installation environment. The cable is manufactured with heavier jackets and sometimes even “armor” where rodent damage to cable is common. With few exceptions, it is not rated for installation within buildings, and must be spliced to riser or plenum-rated cable for continuation within buildings. These splices normally are housed in the Service Entrance, or in smaller buildings, co-located within the Equipment Room. See Optical Fiber Section for performance requirements for optical fiber. Subject to change per APS IT Department.

Optical Fiber Cabling – Inter and Intra Building Backbone
Both Single Mode (SM installation only required where applicable) and Multi-Mode optical fiber shall be specified for intra building systems. Single Mode fiber shall exceed ITU G.652.c/d., shall be low water peak and suitable for CWDM applications. Multimode Fiber shall be specified as 50/125 Um (OM2) for 500-meter lengths at Gigabit data rates. All terminations are to be LC connectorized with pigtails and fusion spliced in

the FDU. The designer and contractor shall verify both specified and submitted optical fiber cable and components for exact matching as specified by the manufacturer and the system being installed. This matching includes both performance and physical optical fiber matching. Only OCC shall be specified for new optical fiber installations at APS.

Horizontal Cable – This is predominantly 4-pair, high performance Screened /Foiled and/or Unshielded Twisted Pair (UTP) cable, as specified APS Dept., that is run from the Technology Room to the workstation. In limited applications, Optical Fiber and Coaxial cable is also installed in the horizontal environment. Generally, two cables is required to support each user device, (e.g. NJ, PC, printer, telephone) and dependent upon the projected equipment density, several UTP cables are usually installed in each workstation faceplate.

Category 5e, 24 AWG 100 MHz should be installed for all networking installations Per the APS standards.

Category 6, 23 AWG 250 MHz should be installed for all Power Over-Ethernet (POE) applications to more effectively dissipate heat generated from the power applications. Install only where applicable.

Outlet and Cable Labeling is essential to the successful installation, testing and quality control of cabling systems. The designer shall provide labeling identification for outlets on plans and provide a labeling schedule for each outlet. The outlet plan and schedule is to be kept updated at each phase. The contractor is to maintain the outlet plan and schedule in the projects as-built drawings and as-built schedule during construction. The outlet as built plans and outlet schedule shall be made available upon request to IT dept during construction for inspection, quality control or other purposes. A copy of the changes to outlets schedules and plans shall be provide to APS IT dept two weeks prior to occupancy. A final copy of the plans and schedule are to be submitted directly to IT as part of the final document submittal.

Optical fiber and multimedia cabling may be required for special applications in the horizontal cabling. The needs for these special applications need to be identified during programming. A centralized optical fiber distribution topology may be acceptable for a limited distribution of horizontal optical cabling to the desktop and is subject to the approval of APS IT Dept.

CATV/CCTV Media Cable – In many locations on APS campuses, coaxial cable is used for television signal distribution. In general, where this is required for legacy CATV (Community Antenna Television) distribution, a system of RG-6 and RG-11 cable should be installed. RG-6 will typically be sufficient for station or "drop" cable, whereas RG-11 is better suited for backbone cable use. Coaxial cable distribution systems require individual engineering for each building location which includes the placement of active and passive components (amplifiers, splitters and taps) at specific points in the system to ensure proper signal levels. As with UTP cable, plenum-rated coaxial cable should be installed wherever practical. The designer shall verify CATV requirements and include CATV and CCTV systems in their needs assessment. Only where applicable.

Wireless Data - Wireless data access is being deployed through out APS as part of the APS IT wireless project. Wireless access points (WAPS or AP's) shall be planned for and installed per the requirements of the end-users and the requirements set forth by APS IT department. Wireless shall be deployed in all public areas such as classrooms, conference rooms, study areas, stadiums, open areas adjacent to buildings, etc.. Wall Height 96" AFF - no ceiling installs. Typically a wireless access point survey will be conducted by APS IT for final placement. Typical power deployment for wireless at APS uses Power Over-Ethernet Technology (POE) eliminating the need for a power outlet at the access point. The requirements for wireless service can vary depending up the planned use of the system and the exact system requirements. These needs should be determined during programming and early design with APS IT Dept. assistance because of budgetary and service considerations. For specific wireless deployment guidelines refer to the APS Wireless Guideline Specification.

Multi Media, Visualization Labs and High Technology Classrooms - New Classrooms, meeting rooms, auditoriums, and other areas that have requirements for high-speed data, video, teleconferencing and other technology applications must be planned for and installed according to the needs of the end-users and the

Albuquerque Public Schools Information Technology Department. All related requirements should be planned, programmed, designed and approved by the Office of the APS IT Department. Systems shall be designed and installed to the manufacturer's specifications and applicable ANSI/ISO standards. Provide an equipment and system warranty as well an equipment schedule and owners manuals to APS IT Dept. two weeks prior to occupancy. Provide to APS IT Dept. coordinate and verify cabling and/or wireless equipment transport requirements. Ensure equipment and project provided transport compatibility.

Special Conditions – The Design Team shall identify special requirements for work done in operational areas adjacent to or within projects. Special instructions shall be give pertaining to dust and water mitigation, security, occupant safety, utility location, traffic control, and similar needs or conditions. Special considerations shall be given to areas that provide patient care, research, artifacts, and similar areas.

7. Design Criteria – Spaces

Note: The information provided in this document contains common work requirements with other trades and disciplines. The design team is responsible that common work results are included in the design and are distributed to all disciplines to ensure continuity in the design and construction of APS IT project requirements.

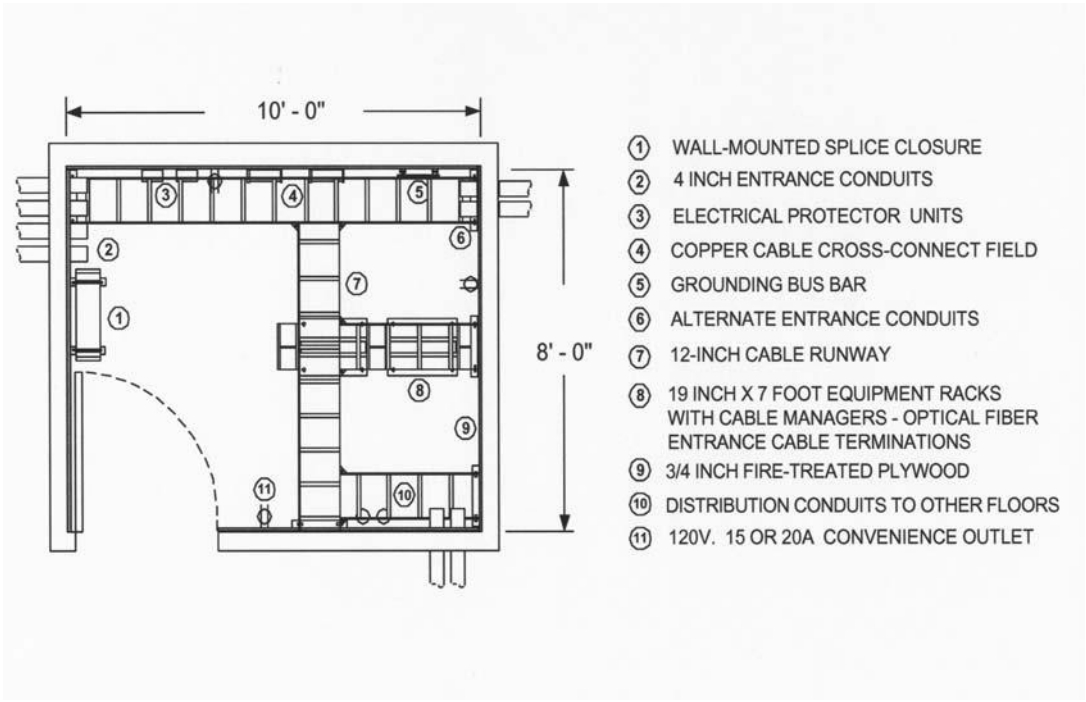
8. Design Criteria for Service Entrances

Size and Location of Service Entrance - A separate Service Entrance may be required in large buildings where a separate Equipment Room is to be built. In buildings of 10,000 sq. ft., or larger, a room size of 80 sq. ft. is a minimum size with a minimum dimension of 8 feet.2 The Service Entrance shall be dedicated solely to Information Technology and related facilities. Equipment that does not support the Service Entrance (e. g., pipes, duct work, distribution of building power) shall not be located in or pass through the Service Entrance. Do not locate Service Entrances in any place that may be subject to water infiltration, steam infiltration, humidity from nearby water or steam, heat (e. g., direct sunlight) or any other corrosive atmospheric or adverse environmental conditions. Avoid locations that are below water level unless preventive measures against water infiltration are employed. Locate the Service Entrance far enough away from sources of EMI to reduce interference with the telecommunications cabling, including EMI from electrical power supply transformers, motors, generators, Magnetic Resonance Imaging (MRI) and X- ray equipment, radio transmitters, radar transmitters, and induction heating devices. Provide conduits for both a primary and redundant entry points into the buildings. **Note: No ER's, EF's, TR's are not to have outdoor accessibility.**

TR/ER/MDF/IDF Size Guild Line

If the serving area is…	
460 m2 (5000ft2) or Less	3 m(10ft x 2.4 m (8ft)
Larger then 460 m3 and less than or equal to (>5000ft2 to 8000ft2)	3 m(10ft x 2.74 m(9ft)
Larger then 740 m2 and less than or equal to (>8000 ft2 to 10000ft2)	3 m(10ft x 2.74 m(9ft)

Typical Service Entrance / Entrance Facility



Ceiling Clearance-The minimum ceiling clearance shall be 9.5 ft above the finished floor with ceiling protrusions (e. g., sprinkler heads) placed to assure a minimum clear height of 9 ft. clear of obstructions, to provide space overhead for Ladder Racks or cable trays and conduits. To permit maximum flexibility and accessibility of cabling pathways, ceilings are not allowed in Service Entrances.

Doors and Access Control Service Entrances
Doors should be equipped with electronic access controlled locks and be at least 3 ft. wide and 7 ft. tall.3 Doors should be equipped with sweeps, however, doorsills are not recommended because they impede the movement of equipment**. NOTE: doors should be designed to open outward unless prohibited by code.** This provides additional usable space and reduces constraints on the service entrance room layout and space requirements.

Flood Prevention - Locate the Service Entrance Rooms above any threat of flooding. Avoid locations that are below or adjacent to areas of potential water hazard (e. g., restrooms and kitchens). Ensure walls are sealed to prevent water seepage. Provide a floor drain to prevent flooding from the accidental seepage of water from entrance cables and ducts. It is recommended that water detection alarm system be installed in the service entrance room.

Cable Trays and Raceways - Provide ladder type cable trays, splice supports, and other support devices to support entrance cables. Also include 3 to 4 inch rigid conduits or heavy duty ladder type trays to extend cabling to the building equipment room. Coordinate with APS IT department for installation requirements.

Wall Requirements - Service Entrance walls should extend from the finished floor to the structural ceiling (e. g., the slab), painted white and be fire-rated for a minimum of one hour.4 Service Entrance walls should not have windows installed, nor is it desirable to locate Service Entrances on perimeter/curtain walls where windows comprise the entire surface of the wall.

Backboard - Provide AC-grade plywood, 8 ft. high with a minimum thickness of 0.75 in. around the perimeter of the room. Plywood shall be fire-rated and treated on all sides with at least two coats of white latex, or preferably, white, fire resistant paint.5 The bottom of the plywood shall be mounted 18 in. AFF (Above Finished Floor). One Hour Rating Stamp exposed.

Lighting - Provide adequate and uniform lighting that provides a minimum equivalent of 50 foot-candles when measured 3 ft. above the finished floor level. Locate light fixtures a minimum of 9 ft. above the finished floor. Locate light switches near the entrance to the Technology Room.

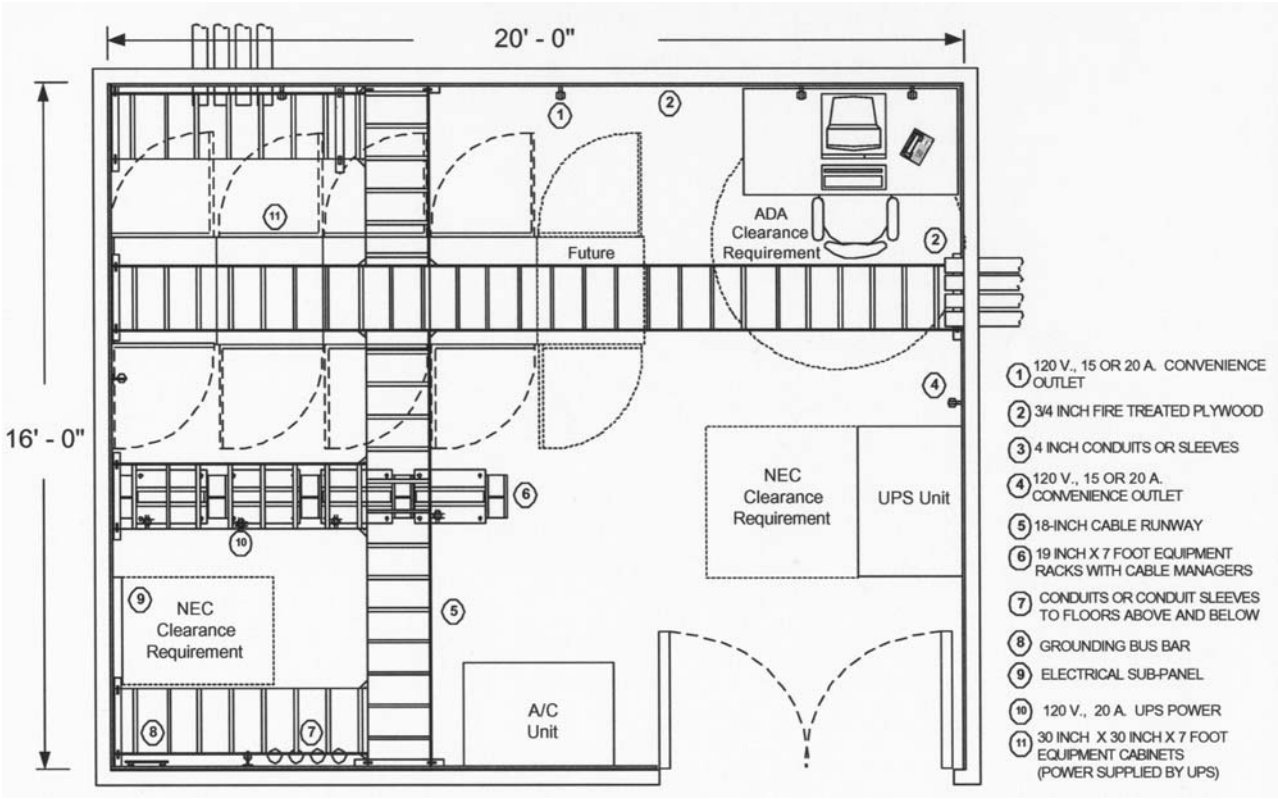
Environmental Control - The Service Entrance should be provided with ventilation, heat and cooling which is similar to a standard office to prevent extremes in temperature and humidity. Unless active electronic components are present, separate, 7 x 24 hour environmental control is not required.

Power and Grounding – Provide 120 V., 15A or 20A, 60 Hz, non-switched, convenience power receptacles (NEMA 5-15R, 5-20R) on perimeter walls.6 Outlets should be recessed in walls, surface-mounted outlets and conduits are not acceptable. Provide 1- 120 V., 15A or 20, 60 Hz and 1- 120V 30A outlets per 4 post rack. Grounding: Ground bus, connected directly to electrical panel. Ground shall also be provided and installed by APS preferred contractor using a conductor sized as required to provide a minimum of 2 Ohms of resistance. Provide labeling which states: “DO NOT DISCONNECT”. Note: refer to the NEC and Bicsi for grounding sizing and requirements. All work need to meet and or exceed codes and standards.

Fire Control and Detection - The Service Entrance should be equipped with a standard pressurized fire sprinkler system as required for general office and common spaces. Smoke detectors connected to a central fire alarm panel within the building shall also be provided.

9. Design Criteria for Equipment Rooms

Typical Equipment Room



Size and Location of Equipment Room - The Equipment Room may vary from 300 sq. ft. to 1000 sq ft or larger in size, with a minimum dimension of 15 ft. in one direction[7]. The size of the Equipment Room must be determined by the footprints of equipment to be installed to assure proper sizing and include space for future equipment installation. **The final size of the Equipment Room shall be approved by APS IT Department.**

If the Equipment Room supports the outside cabling connections, it shall be located so that it can support two physically separate points of entry. The space shall be planned to accommodate the outside plant cabling and other systems located in the equipment room when no Service Entrance room is provided.

The Equipment Room shall be accessible for the delivery of large equipment throughout its useful life. NOTE: not to be outside accessible.

Collocation of other approved low voltage systems in the technology room may require additional space allocation to the room. The Equipment Room may also serve as a distribution point for horizontal cabling. If so the equipment shall be located to accommodate horizontal cabling distance requirements of 295 feet to the

[7]Vantage Technology Consulting Group, Inc., *TR and ER Standards, 2002.* Additional guidance for the sizing of Equipment Rooms may be found in Building Industry Consulting Services International (BICSI) *Telecommunications Distribution Methods Manual, 9th Edition* Chapter 7, p.7-12

voice/data outlet. The room should also be aligned for a vertical riser to the Telecommunications Rooms on each floor. **Note: Conduit pathways not to exceed 150ft.**

Unacceptable Locations - The Equipment Room shall be dedicated solely to telecommunications, campus backbone cabling, centralized computer equipment and other related infrastructure. Do not locate Equipment Rooms in any place that may be subject to water infiltration, steam infiltration, humidity from nearby water or steam, heat (e. g., direct sunlight) or any other corrosive atmospheric or adverse environmental conditions. Avoid locations that are below water level unless preventive measures against water infiltration are employed. Locate the Equipment Room far enough away from sources of EMI to reduce interference with the telecommunications cabling, including EMI from electrical power supply transformers, motors, generators, Magnetic Resonance Imaging (MRI) and X- ray equipment, radio transmitters, radar transmitters, and induction heating devices. As Equipment Rooms are frequently occupied by working technicians and sensitive electronic equipment, the room location should not be adjacent to sources of constant, excessive, low or high frequency noise, such as air-handling equipment, pumps, generators, and the like.

Note: Systems that do not support the Equipment Room (e. g., pipes, duct work, distribution of building power) shall not be located in or pass through the Equipment Room. This includes plumbing, electrical, HVAC, gas and other utilities.

Architectural Requirements

Clearances - The following clearances shall be maintained for equipment racks and 4 post racks, and cabinets in the Equipment Room. A minimum of 3 ft. of clear working space from equipment and cross-connect fields. Including an additional minimum of 6 in. depth off wall for wall- mounted equipment. Aisle clearances shall be a minimum of 36 in. wide.

Cable Pathways within the Equipment Room

Overhead cable trays - Cable tray systems shall be provided for routing equipment and backbone cables between cross- connects, equipment, and backbone pathways. Tray shall be coordinated with lighting, air-handling systems, and fire extinguishing systems so that fully loaded trays will not obstruct or impede their operation. Ladder racks trays are to be specified in equipment rooms and for all cable entrance points into rooms. Cable Tray layout shall be approved by APS IT Dept. prior to construction and a detail drawing of the equipment room is to be provided. Ensure tray systems are specified and supported to meet both weight and the number of installed cables including an additional 40%of space for future growth. The sagging of cable trays is not acceptable. Cablofil -basket tray for pathways and CPI- ladder rack for TR/ER/MDF rooms all recommended by APS.

Access floor systems - Access floors may be provided to route cables in large Equipment Rooms. Access floor systems (often called “raised floors”) are often recommended by equipment manufacturers and are frequently used for telecommunications cabling when the Equipment Room serves multiple applications (e. g., both computer and PBX equipment). Raised floor applications require cable tray and/ or raceways for cabling distribution. Design and install to manufacturer specifications and project requirements.

Ceiling Clearances - The minimum ceiling clearance shall be 9.5 ft. above the finished floor with ceiling protrusions (e. g., sprinkler heads) placed to assure a minimum of 9 ft. clear of obstructions, to provide space over the equipment frames for cables and suspended cable trays. To permit maximum flexibility and accessibility of cabling pathways, drop ceilings are not allowed in Equipment Rooms. The ceiling space should be open and walls extended from floor to deck.

Doors and Entryways - Design entryways to accommodate the transport of heavy equipment in and out of the space. If freight elevators are not available design to accommodate rigging for equipment movement. Ensure the primary access is not impeded by stairs or other impediments to the movement of heavy equipment.

Equipment Rooms shall have doors that are at least 3.5 ft. wide and 7 ft. tall equipped with a door sweeping outward not inward. Since large equipment is often located in the Equipment Room, a double door 6 ft. wide by 7.5 ft. tall is recommended. Doorsills are not recommended because they impede the movement of equipment. Outside door access is not preferred but through an entrance to the inner building or provides direct access from a public area or hallway.

Ensure that doors are installed and lockable prior to cable termination and equipment installation.

NOTE: Doors that open outward (unless prohibited by code) provide additional usable space and reduce constraints on Equipment Room layout. Additional space shall be provided to provide for the loss of usable space when doors open inward of the equipment room.

Security and Access Control - Equipment Rooms will typically house high-value and mission critical electronic equipment. Electronically controlled access systems (proximity readers, card swipe, etc.,) shall be provided to ensure restricted access. Planners should consider the addition of security surveillance systems to record ingress and egress occurrences for Equipment Rooms that are not frequently occupied by technicians. Provide final key requirements to the APS Key Shop.

Dust and Static Electricity - Bare concrete floors are a considerable source of dust, and conventional vinyl floor tile promotes the generation of static electricity. Anti-static floor tiles should be provided in each Equipment Room. Imbed 2 in.

copper tape between the anti-static tile and the conductive adhesive 1.5 feet from the wall. Leave 12 in. of copper tape exposed above the anti-static tile for grounding to copper signal ground bus bar in each Equipment Room.

Note: Ensure that the Equipment Room is free and sealed from dust prior to cable termination and equipment installation. Provide doors, locks and seal penetrations prior to the termination of cabling, installation of IT hardware and equipment.

Flood Prevention - Locate Equipment Rooms above any threat of flooding. Avoid locations that are below or adjacent to areas of potential water hazard (e. g., restrooms and kitchens). Do not install fan coil units or water piping in equipment rooms overhead. Place water detection alarm devices in the room.

Wall Requirements - Equipment Room walls should extend from the finished floor to the structural ceiling (e. g., the slab), be covered with two coats of white latex or fire-retardant white paint and be fire rated for a minimum of one hour. Equipment Room walls should not have windows installed, nor is it desirable to locate Equipment Rooms on perimeter/curtain walls where windows comprise the entire surface of the wall.

Backboard - Provide AC-grade plywood, 8 ft. high with a minimum thickness of 0.75 in. around the perimeter of the room. Plywood shall be fire-retardant and treated on all sides with at least two coats of fire- resistant paint. The bottom of the plywood shall be mounted 18 in AFF (above finished floor). Ensure the fire retardant stamp is visible in one location.

Structural Requirements - The floor rating under distributed loading must be 4.8 kPa – 12kPa(100-250 lbs/sq.ft.) and the rating for concentrated loading must be greater than 8.8 kN (2000 lb/sq.ft) in areas that will support telecommunications equipment such as batteries and UPS equipment. If access flooring is used in the Equipment Room, it must be rated accordingly.8 Provide minimum of 18” of clearance underneath raised floor applications, verify exact raised floor height requirements with CNS/ITS prior to specification. Verify floor loading requirements the requirements of the planned equipment installation.

Mechanical System (HVAC) Requirements

Environmental Control - Provide Equipment Room with either dedicated HVAC equipment, or access to the main HVAC delivery system. Thermostatic controls should be located within the room itself to prevent setting changes by unauthorized personnel. ITS equipment requires the HVAC system to function 24 hours per day, 365 days per year. If a building’s HVAC system cannot ensure continuous operation (including weekends and holidays), provide a stand- alone HVAC unit with

independent controls for the Equipment Room. If an emergency power source is available in the building, connect the HVAC system that serves the Equipment Room to it.

Plan the design of HVAC systems for easy future upgrades and replacement. The heat dissipation requirements for IT equipment are increasing with the need for more power to produce higher bandwidth transmission.

The HVAC system that serves the Equipment Room should be tuned to maintain a positive air pressure differential with respect to surrounding areas with a minimum of one air change per hour in the Equipment Room. Provide equipment to control humidity and air quality if needed.

Provide HVAC that will maintain continuous and dedicated environmental control (24 hours per day, 365 days per year). The system shall include a manual thermostat within the room for override control as required. Maintain positive pressure with a minimum of one air change per hour in the Technology Room.

Provide:

Temperature: mean of 63 degrees with an operating range of 41 to 86 degrees

Relative Humidity: 15 to 65%

Estimated Heat Loads: 2500 to 7,500 BTU per equipment cabinet or rack. Verify exact requirements.

Estimated Heat Loads for Server Rooms should be calculated using the following: Estimate 5-7 Kilowatts per rack. The conversion is 3,412 BTU's Per 1KW.

The mounting of HVAC units or water piping above equipment or equipment racks shall not be permitted. Do not locate HVAC units requiring chilled water or drainage in the equipment room. Install drains for condensation lines.
Install heaters when necessary to achieve proper humidity levels.
The need for a humidifier shall be evaluated when interfacing an HVAC unit into spaces with swamp coolers or other high humidity areas.

Electrical System Requirements

Lighting - Provide adequate and uniform lighting that provides a minimum equivalent of 50 foot-candles when measured at the finished floor level, properly distributed throughout the room. Locate light fixtures a minimum of 9 ft. above the finished floor. Locate light switches near the entrance to the Equipment Room.

Emergency lighting systems that operate on trickle-charge storage batteries are required as a safety precaution in the event of an inadvertent power outage or emergency power shutdown.

Coordinate the lighting layout with the equipment layout, especially overhead cable trays, to ensure the light is not obstructed. Power for the lighting shall not come from the same circuits as power for the telecommunications equipment.

Power - Verify exact equipment power requirements with APS IT Dept. Coordinate exact power requirements equipment and footprint with APS IT Dept. prior to design.

Note: All power outages shall be coordinated and approved by APS IT Dept. once operational and notice given seven days in advance of the outage to APS IT Dept.

Provide individual branch circuit serving a single load from the feeder panel directly to a branch circuit receptacle (for cord- and- plug connected equipment), or equipment power terminal (for hardwired equipment).

Provide branch circuits for equipment power that are protected and wired for 110V, 30A (NEMA L5-30R) and 208V, 20A (NEMA L6-20R)

Provide above each equipment rack dedicated to electronic equipment a tray mounted dedicated 110 V 20A 4-plex, 110V 30A twist lock. Only if required 208V 20A, 30A outlets secured to cable tray and mounted above the equipment racks in addition to wall outlets.

At minimum, provide wall mounted dedicated, non-switched 20A, 120 Volt (V) alternating current (AC) with locking electrical outlets (NEMA L5-20R) and straight blade NEMA 5-20R receptacles for equipment power, each on separate branch circuits. Dependent on equipment requirements, wall mounted 208VAC power may also be required.

If emergency power is provided for the building, provide for emergency service to the equipment room for dedicated power. Connect lighting and HVAC to the generator. Generator emergency power is necessary to provide uninterrupted voice service for VOIP service and certain data networking requirements for an extended service beyond UPS capacity. Verify the requirement for a power generator with APS IT Dept. during programming and prior to design.

Any outlets in the Equipment Room that are protected by UPS or generator power shall be terminated on red receptacles for ease of identification.

Identify dedicated power outlets by circuit number labeling

All outlets must be on non-switched circuits.

Design, and provide for power and space and rack(s) for a rectifier and or batteries when needed. Verify requirements with APS IT Dept.

APS IT Department will provide local UPS's to power essential IT equipment.

If the Equipment Room houses RF generating equipment, power should originate from an isolation transformer.

Do not install transformers or other high EMI emitting equipment in any technology or equipment room.

Do not install transformers in any technology or equipment room. If the Equipment Room houses RF generating equipment power should originate from an isolation transformer.

Provide surge protection for equipment power circuitry.

Emergency Power-Off Switches (EPO) - The Equipment Room shall have an Emergency Power Off Switch (EPO) located in the corridor adjacent to the entrance of the Equipment Room. EPO switches control power to all equipment within the particular room and allow a complete power shutdown in the event of a fire or other extreme emergency. The EPO switch also needs to control power to the rectifier, batteries (if present) and the HVAC system. The EPO switch shall also have signage and a hinged, clear plastic cover installed over it to prevent accidental power shut down. Signage shall note Emergency Power Shut Off.

Convenience Power - Provide separate duplex 120 V AC convenience outlets (NEMA 5-15R) for tools, test sets, etc., located at least 15 in. above the finished floor, placed at approximately 6 ft. intervals around perimeter walls and identified and marked as such. Label outlets to identify them as for convenience.

Dedicated Power Feeders - Provide Equipment Rooms with a power supply circuit that serves only the Equipment Room and terminates in its own electrical panel. The feeders that supply the power for telecommunications equipment in Equipment and Technology Rooms should be dedicated only to supplying that equipment. More than one dedicated feeder may be required for large installations with a wide variety of telecommunications equipment. Power required for other equipment in the room (e. g., fluorescent lighting, motors, and air conditioning equipment) shall be supplied by a separate feeder, conduit, and distribution panel.

Backup Power - Because of the “mission-critical” nature of the Equipment Room, it is strongly recommended that backup power be provided, allowing a controlled shutdown of the equipment in the event of a power failure. If emergency power is provided for the building, provide for emergency service to the equipment room for dedicated power. Lighting and HVAC should be connected to the generator. A single module UPS with parallel (maintenance) bypass, 100% isolation from raw utility power and 30 minute (expandable to 60 minute) battery capacity at full load shall be provided. Any outlets in the Equipment Room that are protected by UPS or generator power shall be terminated on red receptacles for ease of identification.

Bonding and Grounding - Provide a copper signal ground busbar in each Equipment Room. The ground conductor shall be copper cable sized as required to provide less than 2 Ohms of resistance. The conductor shall be cad-welded directly to the U-fer Ground, Main Building Entrance Ground, or building steel. Provide labeling which states: “DO NOT DISCONNECT”. Ground bars shall minimally comply with the TIA 607 standard. Bonding of the cable tray and conduits must be continuous from the TGB in each Telecommunications room to TMGB located in the equipment room. Continue bonds to each equipment rack. Bond each equipment rack individually to TMGB or TMG.

Fire Suppression System Requirements

General - Coordinate the layout of fire protection systems with the equipment layout to avoid obstructing sprinklers, access to the alarm, or other protective measures.
Preaction Sprinkler Systems
Provide a fire alarm system with heat and smoke detectors and multi-zone, pre-action, dry pipe fire suppression system. A manual fire suppression “hold-off” shall be installed adjacent to the main entrance to the data center. Locate a phone and data connection in the Equipment Room in order to contact emergency response personnel. Provide sprinkler heads in wire cages to prevent accidental operation.

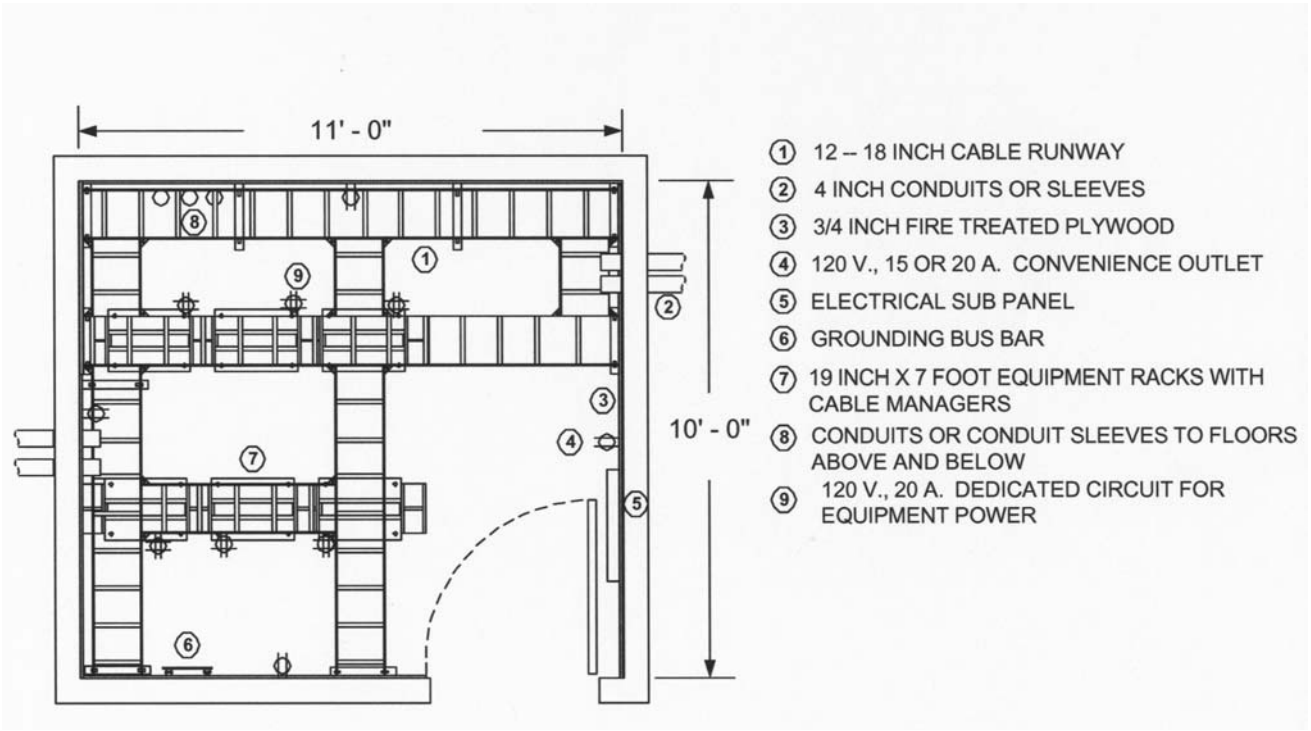
Gas Fire Suppression Systems - Dependent upon the density and criticality of electronic equipment housed in the Equipment Room, planners should consider the installation of a gas fire suppression system. An example of where this may be appropriate is Core Network Hub Rooms. Gas fire suppression systems such as FM 200 system employing agents such as heptafluoropropane, requires construction of an air-tight envelope, provision of space for tanks and manifold equipment as well as special discharge annunciator systems. For this reason, planners must weigh the acquisition costs of these systems versus the risk of extended service outages that could be caused by a catastrophic fire in the most critical Equipment Rooms.

Portable Fire Extinguishers - Mount portable fire extinguishers (with appropriate ratings) in the Equipment Room as close to the entrance as possible.

10. Design Criteria for Technology Rooms

The following provides general requirements for all Technology Rooms.

Typical Technology Room



Size and Location of Technology Rooms

Floor Space Served - There must be at least one Technology Room per floor or up to 10,000 sq ft. Multiple rooms are required if the cable length between the Technology Room and the telecommunications outlet, including slack, exceeds 200 ft.

Size Requirements - Technology Rooms shall be minimally 100 to 120 Sq. Ft. in size, depending on the systems they will contain. The rooms shall be roughly square, with a minimum clear dimension of 10 ft. in one direction. The size of the Technology Room must be determined by the footprints of equipment to be installed to assure proper sizing. Collocation of other approved low voltage systems in the technology room will require additional space allocation to the room. Ensure space for special data systems such as LANS, CATV, patient monitoring and other health care systems.

Clearances - The following clearances shall be maintained for equipment and cross-connect fields in the Technology Room:

A minimum of 36 in. of clear working spaces for aisles, in front of and behind equipment and patch panels, doorways, electrical panels and other equipment

A minimum of 6 in clearance depth off wall for wall-mounted equipment

Verify equipment footprints: design equipment and fixtures to ensure working clearances with future growth of minimally one rack.

Architectural Requirements

Ceiling Clearance - The minimum ceiling clearance shall be 9.5 ft. above the finished floor. To permit maximum flexibility and accessibility of cabling pathways, suspended ceilings are not allowed in Technology Rooms. Ceiling shall be open from floor to deck.

Doors - Technology Rooms shall have doors with keyed locks and access that is at least 36 inches wide and 7 ft. tall. Doors shall be equipped with sweeps, however, doorsills are not recommended because they impede the movement of equipment. Provide doors that open outward unless prohibited by Code, Ensure the primary access is not impeded by stairs or other impediments to the movement of heavy equipment. Provide direct access from a public area or hallway. Ensure 36 inch clearances from all equipment. Ensure that doors (temporary or permanent) to Technology Rooms are installed prior to cable hardware installation and termination.

Dust and Static Electricity - Bare concrete floors are a considerable source of dust, and conventional vinyl floor tile promotes the generation of static electricity. Anti-static floor tiles should be provided in each Equipment Room. Imbed 2 in. copper tape between the anti-static tile and the conductive adhesive 1.5 feet from the wall. Leave 12 in. of copper tape exposed above the anti-static tile for grounding to copper signal ground busbar in each Technology Room.

Prior to the installation of technology hardware, cable termination, ensure that room is clean and free of dust and dirt.

Flood Prevention - If possible, locate Technology Rooms above any threat of flooding. Avoid locations that are below or adjacent to areas of potential water hazard (e. g., restrooms and kitchens).

Floor Loading - In general, provide a minimum floor loading of 2.4 kPa – 4.8 kPA(50 –100 lb/sq.ft.). Ultimately, the Architect shall determine structural requirements

Other Uses - Technology Rooms must be dedicated Information Technology functions including multi media, CATV, CCTV, classroom technologies and related support facilities, such as alarms and other low voltage communications systems. Equipment not related to the support of the Technology Rooms such as piping, duct work, and distribution of building power shall not be located in, or pass through, the Technology Room. Technology Rooms must not be used as passageways for unauthorized persons to other facilities within the building. Technology Rooms shall not have roof access for maintenance (such as hatches) that could pose security or environmental (i.e., rain leakage) threats.

Wall Requirements - Technology Room walls shall extend from the finished floor to the structural ceiling (e.g., the slab), be covered with two coats of white latex or fire-retardant white paint and be one hour fire-rated or as required by the applicable codes and regulations. Technology Room walls should not have windows installed, nor is it desirable to locate Technology Rooms on perimeter/curtain walls where windows comprise the entire surface of the wall.

Backboard - Provide AC- grade or better plywood, 8 ft. high with a minimum thickness of 0.75 in. around the perimeter of the room. Plywood shall be either fire-rated or treated on all sides with at least two coats of fire- resistant paint. The bottom of the plywood shall be mounted 18 in. AFF (Above Finished Floor)

Mechanical System (HVAC) Requirements

Provide HVAC that will maintain continuous and dedicated environmental control (24 hours per day, 365 days per year). If the building's HVAC system cannot ensure continuous operation (including weekends and holidays), provide a stand- alone HVAC unit with independent controls for the Technology Room. Thermostatic controls should be located within the room itself to prevent setting changes by unauthorized personnel. Maintain positive pressure with a minimum of one air change per hour in the Technology Room. Design to accommodate future HVAC upgrades and replacements.

Provide:

Temperature: Mean of 63 degrees with an operating range of 41 to 86 degrees

Relative Humidity: 15 to 65%

Estimated Heat Loads: 2500 to 7,500 BTU per equipment cabinet or rack.

The mounting of HVAC units or water piping above equipment racks shall not be permitted. Install drains for condensation lines. Install heaters when necessary to achieve proper humidity levels.

Electrical System Requirements

Lighting - Provide a minimum equivalent of 500 Lux (50 foot-candles) measured at floor level, evenly distributed. Locate light fixtures a minimum of 2.6 m (8.5 ft) above the finished floor. Emergency lighting systems which operate on trickle-charge storage batteries are required as a safety precaution in the event of an inadvertent power outage.

Coordinate lighting with equipment racks, trays, HVAC equipment and other obstructions to ensure the required light levels. Power for lighting shall not be on circuits providing power for IT equipment or convenience outlets.

Power - Technology Rooms shall be equipped to provide adequate electrical power. Verify all equipment power requirements with APS IT Dept.

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At minimum, provide three wall mounted dedicated, non-switched 20A, 120 Volt (V) alternating current (AC) with locking electrical outlets (NEMA L5-20R) and straight blade NEMA 5-20R receptacles for equipment power on racks, each on separate branch circuits.

Provide tray mounted dedicated 110 V 20A 4 plex, 110V 20A twist lock and 208V 20A outlets secured to cable tray and mounted above the equipment racks in addition to wall outlets. Dependent on equipment requirements, wall mounted 208VAC power may also be required.

Do not install transformers in any technology room. If the Technology Room houses RF generating equipment power should originate from an isolation transformer.

The room should include a dedicated power panel that supports both voltages to allow for future addition of circuits and allow for isolated equipment shutdowns.9 Provide circuit number labeling on dedicated outlets. Dedicated power should feed from the dedicated panel in the Equipment Room.

If emergency power is provided for the building, provide for emergency service to the Technology room for dedicated power. Connect lighting and HVAC to the generator. APS IT Dept. will provide UPS’s to power essential IT equipment.

Any outlets in the Technology Room that are protected by UPS or generator power shall be terminated on red receptacles for ease of identification.

Provide separate duplex 120 V AC convenience outlets (NEMA 5-15R or 5-20R) for tools, test sets, etc., located at least 18 in. above the finished floor, placed at approximately 6 ft. intervals around perimeter walls and identified and marked as such.

All outlets must be on non-switched circuits.

Provide surge protection for equipment circuitry.

Bonding and Grounding - Provide a copper signal ground busbar in each Technology Room. The ground lead shall be a copper cable sized appropriately to provide a minimum of 2 Ohms of resistance, cad-welded to the Ufer Ground or building steel. Provide labeling which states: “DO NOT DISCONNECT”.

Provide:

Ground bars shall minimally comply with the TIA 607 standard.

Bonding of the cable tray and conduits must be continuous from the TGB in each Technology Room to TMGB located in the equipment room. Continue bonds to each equipment rack. Jumpers are excepted just as long as Continuity is verified.

Bond each equipment rack individually to TMGB or TMG.

Fire Suppression System Requirements - Provide wet-pipe system with sprinkler heads in wire cages to prevent accidental operation. Smoke detectors are required.

11. Communication Cable Trays

Purpose - Cable Tray is intended for above ceiling installation for the creation of main pathways for the management of high volumes of cable through corridors, and for access and egress to Equipment Rooms and Technology Rooms. Refer to APS electrical standards.

General Installation Considerations

Coordination with Other Trades - Cable Tray installation must be coordinated continuously with the other trades, (Structural, Electrical, Mechanical, Ceiling installers, etc.,) during construction to ensure that it will be accessible once construction is completed. In general the tray should be placed about 8 inches above the suspended ceiling to ensure access once the ceiling is in place. One foot clearance shall be maintained on two sides of the cable tray.

Routing - Where possible, Cable Tray should be routed over common use areas such as corridors and not be routed over restrooms, electrical rooms. Avoiding routes over classrooms, exam rooms, offices and other private areas is important where repeated access to the tray would disrupt normal teaching or work activities. Use manufacturer specified turns and waterfalls for elevation transitions. Cable tray shall be installed continuous. Use 4 inch conduits through solid ceiling or in accessible areas. Bonding of the cable tray and conduits must be continuous. The capacity of the conduits shall equal the capacity of the cable tray. Maintain clearances from fluorescent lights, ballast and other EMI sources as specified by the manufacturer of the cabling system and the industry standards specified in this document.

Heavy Duty or Medium Cable - Tray shall be installed in areas where a high density of communication cable is to be installed. IT designers should be consulted during early stages of design to determine the projected density of cable to be supported. Aluminum is preferable to steel due to weight and corrosion considerations. Ladder rack type cable tray is preferable as it allows access and egress of cable from above or below the tray. Ladder type cable tray shall be installed in equipment rooms, technology rooms, in the corridors adjacent to those rooms, and in areas supporting more than 200 cables. Solid bottom configurations may be required in transition areas, (e.g. across hard ceilings), in areas where the tray is accessible to the public or areas where the density of air handling equipment or structural members above the ceiling prohibits access to the tray. Flanges should be configured inward to assist in containment of cable within the tray.

Light Duty Cable Tray - Welded wire or “Basket”-type Cable Tray is acceptable for installation in areas where the density of cable, typically 200 cables or less and does not warrant the installation of a Heavy or Medium Duty Cable Tray. Basket type tray is particularly well suited for installation below raised access floors. Install wire or welded type cable tray areas where a two foot clearance is accessible from one side and one foot from the top side. The arch of clearance shall be continuous.

Dimensions - In general, Cable Tray should be a minimum of 18 in. wide, with a depth of 4 in. Narrower cable tray may be acceptable for locations with low volumes of cable; however, narrower Cable Tray shall not be substituted for the 18 in. standard without prior approval. Ensure rail height will accommodate future growth.

Support Requirements - Where possible and practical, wall mounted angle brackets shall be used to support the cable tray. For locations away from a supporting wall, a trapeze-style support is to be used along the span of the Cable Tray. The trapeze is constructed of channel stock (i.e., Unistrut) and 5/8 in. threaded rod. The trapeze support elevation should allow a minimum of 8 in. between the top edge of the cable tray and the slab above. Appropriate threaded rod anchors are to be selected and approved by the Project Structural Engineer.

trapeze supports to manufacturers specifications and at cable tray intersections and terminations. Sagging of cable tray due to heavy cable loads is not acceptable. Place labels on each side rail 20 feet apart: “Not for Support ‘Do Not Stand or Walk”.

Seismic bracing for the Cable Tray as required by Code, shall be installed along Cable Tray routes. Coordination of lateral and oblique bracing locations must be effected with the other disciplines whose equipment and systems share the area above the suspended ceiling.

Cable Tray Bonding and Grounding Requirements - Cable Tray shall be bonded to the Telecommunications Grounding Bus Bar in the Technology Room(s) on the same floor. All non-contiguous segments of the Cable Tray shall be bonded together using appropriately-sized copper wire ensuring less than 2 Ohms of resistance, with crimp-on lugs. The lugs shall be bolted to each segment of the Cable Tray to ensure electrical continuity throughout the length of the Cable Tray system. . Cable tray bonding shall minimally comply with the TIA 607 standard and meet the manufacturer’s installation specification using manufacturer approved methods. Bonding of the cable tray and conduits must be continuous from the TGB in each Telecommunications room to TMGB located in the equipment room. Continue bonds to each equipment rack.

Cable Tray Fire and Smoke Stopping Requirements - Cable Trays that penetrate fire-rated walls shall be equipped with wall penetration sleeves at each location, and have appropriate firestopping materials installed after the placement of cable has been completed. Fire and smoke stopping applications for cable trays must be re enterable. The use of foam type products is not approved. Firestopping bricks and pillows are recommended for most applications. All systems are to be UL approved for the application intended. Provide and complete the manufacturer’s firestopping label at all penetrations.

Communication Cable Ladder Rack - Ladder sacks, shall be installed within Technology and Equipment Rooms to route cable to or from sleeves, risers, ducts, cable trays to termination fields within equipment racks or mounted on walls. It does not have the trough characteristics of cable tray, and therefore, it provides continuous support with an ease of access. This is a highly desirable in Technology Rooms where moves, adds and changes to cable routing are relatively frequent.

Install ladder racks around the perimeter of equipment rooms and technology rooms. Provide cross runs of Ladder Racks perpendicular to perimeter runways while overhead and parallel to equipment racks.

Materials and Applications - Ladder Rack is available in various widths, and therefore may be used for a range of cable types and volumes. Ladder Racks may be mounted vertically on walls and be used to support riser cable from floor to ceiling

as it passes between floors. Ladder Rack systems are typically contained within the confines of a single room or closet, and it is not normally installed through walls, floors or ceilings in the same manner as conduit and cable tray. The well-designed Ladder Racks system uses a combination of the walls, the top of equipment racks and threaded rods for bracing and support.

Attachment of Ladder Racks to these components provides the integrity of a mutually supporting system. Provide manufacturer specified transitions, turns, waterfalls and other parts to maintain bend radius requirements for the structured cabling system. Despite this level of structural integrity, Local Building Codes may require additional seismic bracing for code compliance.

Communication Ladder Racks Bonding and Grounding - In Technology and Equipment Rooms, the ladder rack system shall be bonded to the Telecommunications Ground Bus with an appropriately sized copper wire to ensure not more than 2 Ohms of resistance. In areas where Ladder Racks is installed outside of Technology and Equipment Rooms, including riser closets and other locations, bonding and grounding of Communication Ladder Rack is also required. Bond ladder racks to the cable tray distribution system.

12. Communications Conduit Systems

Purpose - Conduit is intended as a permanent and continuous Intrabuilding pathway for communication cable. Conduits are used in locations where access to cable tray is unavailable, where portions of the pathway span are inaccessible (i.e. embedded in walls), and used as a pathway for small quantities of cable where cable tray is impractical. Conduit is relatively easy to bend, and it is used extensively to provide structured pathways where significant changes in cable direction are necessary. Conduit is used to protect cable from damage, and to minimize EMI interference. In addition, certain conduit materials may be used to house non-rated cables between end points to ensure NEC Code compliance.

Conduit General - All conduits shall be supported to meet code requirements. Ream all conduits ends. Install bushings at all ends and terminate in boxes. Conduits shall not extend beyond terminators and shall not extend into boxes. Does not use pull boxes or LB's for conduit turns. Maintain conduit diameter when hand bending.

Conduit Quantity and Diameter - The quantity and diameter of Conduits vary with their application. In general and typically, large diameter Conduits, such as 2, 4-inch Conduit, is typically used for major trunk routes, and they are installed in multiples to provide spare capacity. Install 2, 4 inch conduits in all intra and inter building pathways including building entrances. 1" EMT for all stub outs.

Conduit Bend Limitations - In general, conduits shall not have more than 180 degrees of bends or turns in a segment without the installation of a pullbox. Placement of pull boxes must be considered as another contender for above-ceiling space when planning conduit routes. Typically supply large pull boxes with hinged covers that are accessible from the bottom of the box. Provide sufficient access to the cover to perform cable-pulling operations. (See the discussion of Intrabuilding Communication Cable System Pull Boxes, in Section7.5).

Conduit Fill Ratios - Communication Conduits have fill limitations based on the number and size of cables installed within them. Planning the number and diameter of conduits required for specific routes should be based on the anticipated cable load, and guidance for fill ratio calculations provided in ANSI/ TIA/EIA/569 and the NEC.

Provide for a 40% growth of the cable system for future installations.

Conduits to Individual Communication Outlets, Floor Boxes and SMR - Conduits serving individual workstation outlets are smaller in diameter and typically are specified to be 1.00 inches in diameter for up to six cables for Category 5E, four cables for Category 6 10G FUTP, or 3 cables for Category 6 A 10G. Conduit to floor boxes should be 1.50 inches in diameter. In new construction conduits should be run continuous from the outlet box to the cable tray installing pull boxes where necessary to meet bend radius requirements. They are to be connected to double-gang, deep device boxes (2 1/8 “box with a 1” box extension and mud ring), equipped with a single-gang drywall ring at the outlet location.

Conduits to Surface Mounted Raceways (SMR) shall be sized to equal the capacity of the SMR channel or cabling capacity. The raceway size of the SMR must be designed to meet the size and number of cables to be installed and include space for the installation of communication outlets. Individual workstation conduits are to be dedicated to only one outlet box, floor box or SMR each, and shall not be “daisy-chained” together.

Note: the designer is to verify outlet box specifications and ensure adequate space is provided to meet all warranty requirements, bend radius and termination requirements.

Conduits to Building Roof - A minimum of one 2-inch rigid galvanized steel conduit should be installed which penetrates the roof membrane and routed to the Technology Room on the uppermost floor of the building. This conduit will provide a pathway to the roof for the connection of antennas to the building backbone. The penetration of the roof must be weather-sealed as specified by APS IT Department / M&O/ APS Facilities. The exposed end of the conduit shall be equipped with a weather head to prevent the entrance of moisture, insects, birds, etc. Should the penetration point not be collocated with the antenna placement location, and it is not practical to route

conduit within the building, horizontal conduit shall be placed along the roof from the penetration in the roof of the Technology Room to where the antenna is to be set. Horizontal conduit shall be affixed to free-standing redwood blocks (2”X 4”X 12”) with galvanized conduit straps. The redwood blocks are to be placed along the route from penetration to the antenna site no more than 8 feet apart. Should the antenna require power for steering motors, separate power conduits must also be provided.

Conduit Materials

Rigid Galvanized Steel - (RGS, or Rigid Metallic Conduit [RMC] per NEC) is used in areas exposed to the outside elements both above and below ground or in hazardous conditions, etc.. It is an optional material specified by the NEC for the containment of non-rated cables that pose a smoke inhalation hazard in the case of fire.10 RGS Conduit is heavier than either Intermediate Metallic Conduit (IMC) or Thin wall Electrical Metallic Tubing (EMT) and thus requires more robust support structures to hold it in place. RGS also requires the use of threaded couplers and fittings that add to installation costs due to the increased labor necessary to assemble several sections together. The thickness of the walls of RGS Conduit make the use of Conduit bending machines an absolute necessity for field installation.

Intermediate Metallic Conduit - (IMC) IMC Conduit is used in areas exposed to the outside elements, and although it is Galvanized like RGS Conduit, its walls are of thinner gauge steel, and IMC is not often used in direct-buried applications. IMC Conduit is acceptable for non-rated cable installation. IMC Conduit may be used, however, to carry riser-rated cable and inner duct in vertical and horizontal cable applications. The thickness of the walls of IMC Conduit makes the use of Conduit bending machines strongly recommended.

Thin Wall Electrical Metallic Tubing (EMT) - EMT is used primarily for both high- and low- voltage electrical installations within the confines of an environmentally-controlled building. EMT is relatively light, and in smaller diameters, easy to form using only hand tools. EMT Conduit connectors and fittings are available in two configurations, either the more commonly seen “Set-Screw” Type, or the virtually air-tight “Compression” Type fittings. In general, set-screw connectors and fittings comply with NEC Code for low-voltage applications and are suitable for most installations. EMT Conduit is not acceptable for non-rated cable installations or building entrances. EMT Conduit may be used, however, to carry riser-rated cable and inner duct in vertical and horizontal cable applications. Short sections of EMT Conduit are commonly used as sleeves for wall penetrations, and floor cores for riser applications.

Flexible Conduit (Flex) - The use of Flexible Conduit is not the preferred alternative for communication cable installation and shall not be used when EMT Conduit is practical for use. Installation of Flex Conduit is an acceptable option in congested ceilings, walls, for connections into modular furniture, or similar applications when approved. When using Flex Conduit, increase the diameter of the Flex by one trade

size over what the requirement would be using smooth-wall conduit.

Plastic Conduit/Polyvinyl Chloride (PVC)/Liquitight Conduit - Plastic and PVC Conduit is to be used for underground duct construction between buildings and vaults. Liquitight Conduit is commonly used as a flexible pathway for higher voltage electrical conductors in wet environments. The use of Plastic, PVC or Liquitight Conduit within buildings is not recommended due to NEC Code compliance issues for fire rating.

Innerduct - Innerduct is sometimes referred to as sub-duct and is used primarily as a means to subdivide large diameter metallic, Nylon or plastic Conduits / Maxcell into distinct pathways for fiber optic cable, however, copper cable is sometimes placed within Innerduct to prevent tangling with other cables already present. Innerduct is available in plenum, riser-rated, and non-rated materials, for interior and exterior applications, in a range of diameters, as well as a variety of colors for ease of identification. The most common configuration is corrugated Innerduct which is very flexible and provides a low friction pulling environment. Innerduct is produced in solid and ribbed styles as well. Beside installation within conduit, Innerduct can be placed by itself within cable trays, suspended from ceilings using cable hangers, and run vertically through sleeves as pathways for riser cables.

Conduit Support Requirements - Conduits require substantial support mechanisms such as channel stock/threaded rod trapeze supports. Individual Conduits may be supported using threaded rods with clamps. Conduits can also be attached to the underside of cable trays and affixed to walls where practical. Supports are particularly critical at points on the pathway route where significant changes in direction (i.e. 90-degree bends) occur. This support is necessary due to the lateral forces incurred by the conduit when cable is pulled through the bend itself. In some areas, seismic bracing of conduit is required by local building codes. Accommodations for lateral and oblique bracing struts must be coordinated with the other disciplines that vie for critical ceiling space.

Bonding and Grounding of Conduits - Bonding of Conduits to the Telecommunications Grounding System is required. At the termination of Conduit runs within Technology Rooms, attachment of a ground wire between the Telecommunications Ground Bus to grounding rings installed on Conduit box connectors should be accomplished to ensure electrical continuity of the conduit system. Bonding and grounding must be performed where metallic conduit is installed or embedded in concrete. Any electrical potential will require bonding and grounding, which includes all metals.

Firestopping of Conduits - Partially filled and empty conduits that pass through Fire-rated walls or through floors shall be fire stopped in accordance with NEC11 and Local Fire Codes. Metallic re-enterable listed devices are preferred. Flexible non- hardening, fire stopping putty or pillows are also commonly used as these materials can be readily removed (and replaced) for additional cable installation when necessary. It's the responsibility of the APS Preferred Contractor to comply with all requirements and installations.

Labeling of Conduit - All newly placed conduits designed to carry distribution cables, both fiber optic and copper, shall be labeled as "Communications" at least every 25 feet. The labeling shall be of a permanent nature such as manufactured labels stenciling or other ITS/CNS agreed upon methods. Follow APS standards and use the color coding for the special systems. All cables and conduits shall be labeled by the contractor at each exposed point or end with a unique identifier and a description of the cable function to ease individual cable tracing based on ANSI/EIA/TIA 606A and District standards. Labels shall be permanent, waterproof, and readable from one foot with permanent lettering and shall not be removable by normal cable handling or normal operations.

Miscellaneous Conduit Requirements - In order to protect cable from damage during installation or static conditions following installation, Conduits should be cut square, with the cut ends reamed and deburred. Plastic bushings are to be installed over the each end of every Conduit. To facilitate cable installation, nylon or polyethylene pull strings shall be placed in each Conduit from end to end. Conduit plugs are not necessary for empty or spare Conduits in indoor environments, however, any empty conduit or duct which traverses the outdoors should have a conduit plug installed to prevent the introduction of noxious gases or water into the building.

Pull boxes

Intra Building Communication Cable System Pull Boxes - Pull Boxes are used in conjunction with conduit installations to provide access to cables at appropriate locations for distribution to tributary locations and to facilitate cable installation along the route after the length and the number of bends in a conduit run make cable pulling difficult.

Materials - For indoor use, NEMA Type 1 pull boxes are adequate for most applications. For areas exposed to heavy moisture, chemicals or weather elements, NEMA Type 3 or 4 Pull Boxes are usually required. The configuration of pull boxes varies, as some are equipped with hinged covers, others with removable covers which are screwed or bolted on. The configuration selected should account for the accessibility of the pull box once all construction is completed, and other fixtures or finishes may interfere with removal of the cover for access.

Placement - In general, a pull box is required every 100 feet of conduit run, and/or after 180 degrees of directional change has been affected. For example, a pull box should be placed along the route after two 90 degree bends, 25 feet apart are encountered. Consideration should be made for the direction of cable pulls, or, if this is ambiguous, pull boxes should be placed on both end of such bends. The use of pull boxes for directional change itself shall be avoided, since the pulling and frictional forces absorbed by the inside radius of conduit sweeps cannot be mitigated. Pull boxes should be placed after bends in conduit such that the resulting pulls are straight through the pull box and the directional change is accommodated by the sweep of the conduit.

The size of pull boxes make placement above suspended ceilings a challenge, since in most commercial buildings, the area above the T-bar grid is typically congested with mechanical and electrical equipment. This equipment occupies the area above ceilings in addition to structural components that comprise the basic building itself.

Ensure conduit terminations and terminations are mounted flush to the surface of the pull box to ensure optimal usage. Ensure all box covers are secured tightly.

Pull Box Support Requirements - Pull Boxes are structures permanently affixed to the building structure. They can be attached directly to the ceiling slab, or suspended by 4-point threaded rod supports anchored to the ceiling.

Pull Box Bonding and Grounding Requirements - As pull boxes become an integral part of the conduit system, the conduit connectors that attach the conduits to the box create electrical continuity with the conduits themselves. Individual bonding of pull boxes is not normally required.

Firestopping of Pull Boxes - As pull boxes are designed to be resealed with the appropriate cover after they have been accessed, firestopping of conduits within Pull Boxes is not required.

Labeling of Pull Boxes - All newly placed pull boxes designed to carry distribution cables, both fiber optic and copper, shall be labeled as "Communications". The labeling shall be of a permanent nature such as manufactured labels stenciling or other ITS/CNS agreed upon methods.

Horizontal Cable Support Hardware (Non-Continuous) - Non-Continuous Horizontal Cable Support Hardware is used in locations where the communication cable is not supported by continuous systems such as cable trays or conduit. Since support is not continuous, cable weight is concentrated at the intervals of the support hardware. Therefore, Non-Continuous Cable Supports shall be placed not more than 4 feet apart in linear runs.

J-Saddle Hooks - These components are metal stampings configured in a “J” form, which provide a broad cradle or saddle support for bundles of cable. The larger surface area of the saddle prevents kinking, or crimping of high-performance UTP cable. J-Saddle Hooks are available in a variety of sizes and they can accommodate a range of cable bundle sizes and weights. These hangers may be supported by threaded rod, beam clamps, etc., and can be “ganged” together to provide a number of support way points along a cable route. As this type of hanger preserves critical UTP cable geometry, they are the preferred method for non-continuous cable support. These are approved for use in small projects and renovations when approved. All j-Saddle hooks shall be rated by the manufacturer for the Category of cables (i.e. Category 5e,6) being installed. Standards require 5ft and less in spacing.

Bridle Rings - The use of bridle rings is not approved for supporting communications cabling.

13. Intra & Inter Building Cabling Systems

Inter Building Cabling Approved Manufacturers

OSP Copper Cable - CommScope, Systimax

OSP Optical Fiber Cable – OCC, CommScope, Systimax

OSP Optical Fiber Splicing – OCC, CommScope, Systimax

OSP Copper Splicing – Components as Specified and/or Approved by APS ITS

Intra Building Cabling Approved Manufacturers

Riser Copper Cable – CommScope, Systimax, and Approved Cabling Systems

Riser Optical Fiber Cable – OCC, CommScope, and Approved Cabling Systems

Horizontal Cabling Systems –

Category 5e UTP– CommScope, Systimax

Category 6 UTP – CommScope, Systimax

Category 6-10-G F/UTP – CommScope, Systimax

Fiber Specifications:

1. 50 micron Multi-mode Fiber

   10 Gigabit bandwidth capacity

   300 meters (984') maximum distance

   LC, SC type terminations and connectors

2. 62.5 micron Multi-mode Fiber

   1 Gigabit bandwidth capacity

   220 meters (720') maximum distance

LC, ST or SC type terminations and connectors

3. Single-mode Fiber

10 Gigabit bandwidth capacity

40 kilometers (~25 miles) maximum distance

LC, ST or SC type terminations and connectors

Part#	Manufacturer w/ Description
TBD	OCC, CommScope, LC, MM Industrial plug
TBD	OCC, CommScope, LC, MM Industrial outlet
TBD	OCC, CommScope, Outlet Dust Cap
TBD	OCC, CommScope, Plug Dust Cap
OC-040818-01	OCC, 2 strand, 62.5 Multimode Fig. 8, w/ Blue jacket or CommScope
BX__-WLS-900-OFNR	OCC, Multi-strand, Indoor/Outdoor/Plenum rated or CommScope

Requirements - The cabling system shall meet or exceed the following performance requirements:

Intrabuilding Backbone (Riser) - The Intrabuilding Backbone shall support standards-based network protocols up to and including 10 Gigabit Ethernet.

Intrabuilding Backbone (Link): The Link connections (between Technology Rooms on a floor) shall support standards-based network protocols up to and including 10 Gigabit Ethernet.

Backbone Cabling:

- 6 – strand minimum, tight-buffer Fiber Backbones between Distribution Frames.
- Aerial, OSP Fiber cables shall be made of an indoor/outdoor/plenum rating where transitions are required from buildings.
- Contractor shall supply and install the transmission media and terminating hardware to provide interconnection between the MC and each TR in a star topology.
- All cable routes to be approved by project manager prior to installation.
- Riser and tie cables shall be extended between TR's utilizing the interflow conduit sleeves.

- Contractor shall observe the bending radius and pulling strength requirements of all backbone cables during handling and installation.
- Contractor shall supply and install the transmission media and terminating hardware to provide inter-building communications facility.
- All cable routes to be approved by project manager prior to installation.
- Contractor shall supply osp copper cable, osp optical fiber cable and electrical protection devices that will prevent electrical surges on the cable from entering buildings.
- All buried and underground conduits are required to contain a Tracer wire in the conduit. Service Entrances must be recorded as part of the As-Builts for future spotting references..
- Aerial cable will consist of U/V rated Category Cat 5e/6, or U/V rated fiber optic cable.
- Use self supporting cable rather than lashed cable if : (1) It is available in the required size, (2) there is no existing strand for voice and data, (3) new cable cannot be lashed to existing cable unless approved by an APS representative, and (4) adequate space exists for growth.
- Aerial connecting hardware and enclosures must be UV and NEMA4 rated.
- All clearances and separations must meet NEC and local codes. NO contractor will install any cable on the roof/s of any APS facilities, or make any roof penetrations unless given written permission by M&O.
- The fiber cable runs will include a 10-foot Service loop at each distribution closet and/or point.

Horizontal Cable: The horizontal cabling shall support standards-based network protocols of up to1 Gigabit Ethernet or 10 Gigabit Ethernet as determined through programming or by end user requirements. It shall be installed or supplemented in specific locations as defined by end user requirements with either copper or optical fiber cabling that shall support up to10 Gigabit Ethernet connections.

Category 5e, 6 UTP 24, 23 AWG shall be installed for all wireless applications. Subject to change per industry standards.

All cables shall be certified to comply with advertised performance and warranted against defects by the manufacturer for industry-standard time periods. Specifically, the cabling system shall support the following network and communication protocols:

Horizontal Cabling:

- Contractor shall supply horizontal cables to connect each data communication Telecommunication outlet.
- Unless otherwise noted on the floor plans or within this document, the type of horizontal cables used work location shall be rated Category 5e/6 UTP. Per APS Standards.
- Network Cable jacket and Wall jacks shall be BLUE in color.
- The Category 5e/6 UTP cables shall be run using a star topology format from Telecommunications Room on each floor to every individual Telecommunication Outlet.

- All cable routes to be approved by APS project manager prior to installation of the cabling.
- The length of each individual run of horizontal cable from the Telecommunication Closet on each floor to the Telecommunication Outlet shall not exceed 295 ft (90 m).
- Contractor shall observe the bending radius and pulling strength requirements of the Category 5e/6 UTP cable during handling and installation.
- Each of cable between the termination block and the information outlet shall be continuous without any joints or splices unless approved by Designee.
- In suspended ceiling and raised floor areas where walker duct, cables trays or conduit are not available, the Contractor shall bundle station wiring with Velcro ties at appropriate distances. The cable bundling shall be supported via "J" hooks (every 5 foot or less) attached to the existing building and framework.
- Plenum cable will be used in all appropriate areas.
- If the interior of walls are not obstructed, the Contractor shall conceal horizontal distribution wiring internally within the walls. If such obstructions exist, Contractor shall secure approval by APS project manager prior to the use of an alternate method.
- The Category 5e/6 UTP cable shall be Underwriter's Laboratories (UL) listed type MPR, MPP,CMR, or CMP as stated later in this section.
- Contractor shall provide APS project manager with detailed As-Builds diagrams for cable runs within raised floor detailing exact locations of cable for review and approval by APS project manager after coordination with other contractors, architect or design professional and general contractor.
- Conduit runs installed by the contractor shall not exceed 100 feet or contain more than two 90 degree bends without utilizing appropriately sized pull boxes.
- All terminations will comply with ANSI/EIA/TIA 568B Standard
- Service loops required at all TR/ER/EF (10 ft or more) and the TO (3.28 FT or more)
- Ensuring that Horizontal cable bend radius is no less than four times the cable diameter. No tights bends.

Patch Cables:

- All patch cords shall exceed ANSI/TIA/EIA and ISO/IEC Category 5e/6 Specifications
- Patch cords shall be UL listed and UL-C certified.

Cables colors for the following uses will be:

a. BLUE – Data

b. White– Phone
c. Yellow – Wireless
d. Green – Security Cameras
e. Black – Mechanical/Electrical
f. Gray – Intercom

- Cable jacket shall be “White” in color for Work Areas and cross connects
- Cable jacket shall be “Red” in color to identify Dmarc, router, CAT5e/6 backbones and stacking connections

Note: The designer is to ensure that the manufacturer of the selected cabling system shall have included horizontal cabling link loss budget test requirements for the installed system. Any cabling system that does not have established link loss budgets shall not be approved for use. Provide Link Loss budget requirements for the UTP or F/UTP to APS IT Dept. prior to the final product selection.

14. Equipment Racks and Cabinets

General - Intrabuilding Cable patch panels used for both Intrabuilding Cable and Horizontal Cable termination, wire managers, and electronic equipment, will be mounted in standard 19-inch x 7-foot aluminum equipment racks. Manufacturers shall be approved by APS.

Cable Management - Essential to the proper installation of cable and equipment is vertical and horizontal cable management hardware which must be considered in the space planning layout of every Equipment and Technology Room. Typical vertical cable managers add approximately 6 inches of width to each of the outboard sides of a single equipment rack. Ensure vertical and horizontal management system will accommodate patch cords for a fully loaded patch panel and allow for an additional 20 percent growth. The designer and architect shall take the additional space requirements for vertical and horizontal managers in consideration to determine the equipment footprint, the specified clearances and room space requirements. In situations where rows of multiple racks are “ganged” together, one vertical cable manager is placed between two adjoining racks. (i.e., an array of two racks would require a minimum of three vertical cable managers).

Equipment Racks - The equipment racks are to be mounted in Equipment Rooms and Technology Rooms in the quantity necessary to support all necessary cable, hardware and equipment. Four post racks are typically specified. The layout or footprint of equipment racks and equipment must be detailed on project plans and approved by APS IT Dept. A minimum allowance of 25% percent vacant rack unit space or 1 vacant rack minimum (which either is larger) is required for future growth in the Equipment Room and Technology Rooms of each facility. One rack unit (RU) is 1-3/4 inches in height, and a standard 7 –foot equipment rack has a mounting capacity of approximately 44 RU’s. Termination and cable management equipment are manufactured in standard multiples of RU’s in height.

Equipment racks are typically supported and braced by overhead Ladder Racks

(Ladder Rack) which serves the dual purpose of providing support and a means for routing cable to the termination hardware installed within the racks themselves. Provide both vertical and horizontal transitions. Use only manufacturer approved accessories and attachments.

Equipment Racks and Enclosures: The equipment racks shall be made of lightweight steel and include mounting hardware. Enclosures shall be lockable, vented, include fan kits (50 cfm max per fan), and mounted in compliance with NEC clearance codes and ANSI/EIA/TIA mounting standards. All racks shall be grounded to the isolated ground bar within the TR / ER using a standard ground lug and #6 jacketed green cable. Contractor may install electrical receptacles as required to power up Networking Equipment in MDF and IDF enclosures.

Equipment Cabinets - Equipment cabinets are used typically in Equipment and Server Rooms where large and heavy electronic equipment is mounted. However, depending upon program or technology requirements, space and clearance requirements for cabinets should be taken in consideration when planning Technology rooms. Equipment Cabinets have the same mounting configuration as equipment racks, the mounting rails are typically 19-inches wide, 7-feet tall, and have a 44-RU capacity. Since they have a depth dimension as well, Equipment Cabinets allow four-point support and suspension of hardware. For example, large zone hubs can be 10-12 RU's in height, and be 20 inches in depth. They may weigh over 100 lbs. Manufacturers of such hardware usually specify mounting rails that require attachment to the front and rear of a cabinet for adequate support. Cabinets can be customized with, cooling, fans, locking doors, and other appliances that make them a versatile element of the communications infrastructure. Additional space shall be planned for to allow the installed cabinets to meet the space and clearance requirements previously specified in this document. Requirements for these products are project specific and should be determined during programming or as early in the design phase as possible.

Provide vertical and horizontal cable and patch cord management to accommodate a fully loaded unit as specified for equipment racks in determining patch cord management requirements.

15. Intra Building Cable Termination Hardware

Intra Building Copper Backbone Cable Termination Hardware - Multi pair Copper Backbone cable is to be terminated on 110-style termination blocks, with 5-pair connectors. 110 blocks will either be attached to the plywood backboard or mounted on brackets within the equipment racks as determined by APS IT Dept. The layout or footprint of termination hardware and equipment must be detailed on project plans and approved by Information Technology/Telecommunications.

Data Patchpanels – Install system compliant patchpanels that are four pair pinned TIA/EIA B per manufacturer's specifications and instruction.

Telco Patchpanels - Install Telco pinned, connectorized, 48 port patchpanels with pins 3, 4,5&6 activated and install 25 pair connectorized cables. Terminate the 25 pair cables to the 110 connector blocks activate 2 pair per patch panel port or jack. Test each port pair and pin for continuity, grounds, shorts, opens, crosses and splits.

Intra Building Optical Fiber Backbone Cable Termination Hardware - Optical fiber cable shall be terminated within a Fiber Distribution Unit (FDU) with appropriate connectors according to APS specifications. The FDU is to be mounted within the Equipment Racks according to APS guidelines. Dedicate each optical fiber cable to a FDU that incorporates splice trays. Fusion spliced pigtails using SC connectors. The layout or footprint of FDU's and optical fiber equipment must be detailed on project plans and approved by Information Technology/Telecommunications.

Centralized Optical Fiber Distribution and Optical Fiber to the Desktop - When a limited number of optical fiber connections are required to the desktop with locations scattered on various floors, the installation of a centralized optical fiber distribution system is permitted with approval from APS IT Dept. The use of this system will optimize the use and cost of optical fiber ports and equipment. The design and installation of the system shall meet all the requirements of TIA/EIA 568-B and the NEC.
The designer is to ensure that deep outlet boxes are specified during the design to accommodate optical fiber bend radius and termination requirements.

The designer will specify 50/125 um optical fiber per the requirements of TIA/EIA 568-B.3 including addendum 1.The purpose of this addendum is to provide additional transmission performance specifications for 50/125 µm optical fiber cable capable of supporting 1Gb/s serial transmission up to 300m (984 ft.) using 850 nm nominal wavelength lasers. The cables shall be 900 µm tight buffered fibers. Cable color shall be orange.

Mechanical optical fiber terminations are preferred at the work area outlet. Verify with APS IT Dept. the exact connector requirements for the planned installation.

16. Intra Building Optical Fiber Testing, Labeling and Acceptance Requirements

Optical Fiber Testing, Labeling and Acceptance Requirements - Intra building optical fibers shall be tested using a tester and power meter that is specified to test links at short distances. Test and label the optical fiber to the manufacturer's system requirements, TIA/EIA 568-B standard's requirements and APS specifications. Verify labeling is consistent with numerical alignment of fibers Power meter test results (attenuation) and OTDR traces shall be submitted to APS IT Dept. two weeks prior to occupancy. Bi-directional testing is required for all links.

Optical fiber coupler/panel insert colors:

Single Mode – Blue

Laser Optimized Multi model 50 Um– Aqua
Multi Mode - Tan

All FDU's and optical fiber connectors are to be labeled using an electronically printed label. An adhesive shall be secured to the FDU door. All FDU's are to be labeled sequentially on equipment racks.

Acceptable Testers: Fluke DTX 1800 for Intra building testing procedures.. Others testers are acceptable with prior approval by APS IT Dept.

17. Horizontal Cabling Media

Horizontal Cable Media - There remains a large installed base of Category 5e cable on the APS schools. However, as new buildings are constructed, and renovations of older buildings occur, APS intends to transition to the deployment of Category 6 - 10G F/UTP UTP cable for high speed applications. Category 6 - 10G FUTP cable is a standardized cabling media for the support of converged technologies at 10 Gigabit data speeds. The end user and APS IT data requirements must be verified during programming of early design to determine the exact category of performance for cabling requirements. Category 5e, 6 UTP is specified for all POE and Wireless applications.

Horizontal (station) Category 5e UTP or Category 6 10G F/UTP UTP cabling systems shall be, supplied by manufacturers approved by APS IT Dept., will run from the Technology Rooms to outlets located throughout the facility. Maximum cable length is 90 Meters (295 feet). Each outlet will be provided with multiple, standards- based cables, faceplates, and connectors. Workstation termination hardware shall be the preferred manufacture approved by APS. The typical number of cables for each outlet is two cables which can be of mixed category cabling media. An outlet schedule shall be prepared during programming to determine the exact requirements for each outlet. This schedule will determine the exact horizontal cabling requirements for both design and budget. It also allows each outlet to support multiple information systems without requiring re-cabling. The following cables will be provided installed as "home runs" from the Technology Room to each outlet it serves. Note: per the APS spec is 4 locations in a class room and only two occupied.

Cabling Type Horizontal	Quantity
Cat 5e, or 6 10G F/UTP UTP copper cables and termination hardware. Cable color blue.	**Determined by programmed outlet schedule or typical of two.**
Option: 50/125 um 900 um tight buffered multimode optical fiber that meets or exceeds TIA/EIA-B.3-1(ISO 11801 OM3) laser optimized for 500 meter lengths at 10 Gigabit data rates with LC connectorization at the patch panel. Outlet connectorization TBD by ITS/CNS Cable Color: Orange	**Determined by programmed outlet schedule.**
Option: RG-6 Quad-Shield coaxial cable for legacy media distribution with F – connectorization. Cable Color: White	**Determined by programmed outlet schedule**

Horizontal Cable Media Termination Hardware - Horizontal UTP Cable for either voice or data applications will be terminated on 48-port / 24-port, RJ-45 style patch panels. Terminating connectors shall be modular and patchpanels shall be interchangeable support multiple categories of performance of applications. Optical fibers and coaxial links to the horizontal shall be terminated in separate dedicated patchpanels.
Optical fiber horizontal links are to be SC connectorized using mechanical or hand polished connectorization at the patchpanel and mechanical connectorization with connector type as specified by APS IT Dept. at the outlet. Verify exact connector types with APS Information Technology/Telecommunications.

The category and number of cables per outlet shall be specified in programming and approved by APS IT Dept. prior to design. Typical installations for APS installations require outlets require two - Category 5e, 6 cables for new projects. Verify with owner the exact number and category of cabling and ports per outlet with the owner before designing.

Future Growth - Planners shall provide enough spare ports to support 25 percent growth of the standard outlet configurations in the facility being served. (e.g., for a facility with 100, 4-cable outlet terminations in a particular Technology Room, the planner must provide space for the greater than of 25 additional outlets or 100-additional ports for growth.

Optical Fiber to the Desktop - Certain program requirements for high bandwidth may require optical fiber to the desktop. Typically a four fiber 50/125 UM tight buffered cable terminated at the FDU (patchpanel) connectorized with SC connectors shall be installed. The optical fiber shall meets or exceeds the

requirements of TIA/EIA-B.3-1(ISO 11801 OM2) with SC connectorization at the patch panel. Outlet connectorization will be specified by APS IT Dept.

Intra Building Coaxial Cable Termination Hardware - Where coaxial cable is used for signal distribution, the design of the broadband system will dictate the location of cable termination hardware. Typically, broadband signals require the placement of splitters, amplifiers and directional taps, which are more practical to mount on plywood backboards. In some cases, however, rack-mounted patch panels equipped with BNC or F-type connectors may be sufficient for system requirements.

18. Horizontal Cable Media Testing, Labeling and Acceptance

Horizontal Cabling Testing - Test results for cabling shall be submitted to APS IT Dept. two weeks prior to occupancy. Testing shall be performed is accordance to the TIA/EIA
568-B or other applicable standards body testing requirements and the manufacturers specifications for the installed system.

The testing of systems shall meet the requirements of the current draft or standard. The performance of the tested cabling system shall meet the more stringent requirements of either the draft standard or manufacturer's specification.

Minimum Testing Requirements - The passing of both link and channel parameters are required as the primary measurements of acceptance. The manufacturer shall provide test requirements for both link and channel performance for twisted pair cabling systems to pre-qualify for the proposed system. Marginal or star pass measurements either pass or fail will not be accepted by APS IT Dept.

Optical fiber links shall be tested using a power meter measuring for link loss at a budget established from the link component's (connector + optical fiber + connector) as specified by the manufacturer and TIA/EIA 568-B. One directional testing is required for horizontal links that pass initial testing.

Test results shall be submitted in electronic format directly from the tester. The results shall be submitted in Excel format. Hand written test results will not be accepted.

Acceptable Testers: Fluke DTX 1800 for Intra building testing. Other testers are accepted as approved by APS IT Dept.

Note: No cabling system shall be specified nor will be accepted by APS IT Department that does not meeting the aforementioned cabling testing requirements.

Optical Fiber Polarity - All optical fibers in the optical fiber shall be terminated in numerical order without a compensation for polarity. APS IT will make the required polarity adjustments at the patchcord.

Labeling and Documentation - all labeling and as-built outlet schedules shall be completed prior to testing. All patchpanels and outlets are to be labeled using an electronically printed label. An adhesive label or otherwise secured attachment method shall be secured to the patchpanels. Patchpanels, ports and cables are to be labeled sequentially on equipment racks. Ports and cables are to be labeled sequentially on patchpanels by outlet number except for changes made after base termination. Telecommunications plans shall show the placement of outlets and outlet identification designations on plans no later than design documents.

Approved Contractors - All contractors for copper horizontal cable systems shall be approved and certified to install all acceptable manufacturer systems for UTP and FUTP cabling systems which are: OCC, CommScope and their system partners.

19. Inter Building Pathways

Ductbanks - Inter Building Communication Duct Banks are communication infrastructure pathways that carry communication cables between buildings in a campus environment. The duct itself is typically constructed of contiguous segments of schedule 40 or 80 PVC conduit. In the absence of a multi-building campus, ductbanks complete the underground connection between the building and specified ITS/CNS vaults or building where a combination of copper, fiber optic and in some cases, coaxial cable is distributed from the carrier to the user building. Ductbanks can be constructed in several configurations, each with a differing level of permanence and durability. Duct banks are to be concrete encased unless otherwise specified or approved by ITS/CNS.

Transition Structures - Are spaces classified as vaults, manholes, handholds, and pedestals where cable is distributed and routed to other locations such as buildings. These structures allow technicians access to cable and splices to perform maintenance or to modify distribution configurations. The size of the transition structure selected for installation is determined by the number of ducts and potential cable count the structure must contain with spares for maintenance and repairs.. Transition structures should be placed at accessible locations for critical inter building backbone cables and splices, and therefore shall be secured by tamper resistant locking mechanisms. This measure will minimize the potential for serious disruption to campus communications in the event of malicious damage or destruction of these cables.

The following provides general requirements for all inter building communication duct banks and transition spaces as components of the overall communication cable system infrastructure. Ductbanks used for low voltage communication facilities are not permitted by Code to be collocated with electrical transmission cables.

Inter Building Communication Duct Banks - Inter Building Communication Duct Banks are designed to provide a permanent and durable pathway system which is available for the delivery of entrance cable from carrier service providers, or as part of a campus Inter Building backbone system connecting several buildings together.

Building Entrance Conduit Requirements – Entrance conduits requirements for buildings will vary depending upon the size, use and ITS service requirements. Large buildings, zone hubs, PBXs', entrances for LEC's and CLEC's may require from 6 to 10 or more conduits. The minimum conduit entrance facility is 4-4" conduits, encased in a concrete mixture, sloped out and down to the entrance manhole. The minimum size conduit diameter is 4" for all conduits relating building entrances. Seal building entrances with water tight conduit plugs. Requirements are project specific and the designer shall contact ITS/CNS for specific requirements.

Duct Bank Conduit Requirements – The ductbank size for backbone systems shall be 4 – 4" conduits encase in a concrete mixture. Install a minimum of a #6 AWG ground wire terminated to a ground rod in each pass through structure and a measured pull line of 400 lbs continuous through the system. Terminate the ground wire at the building grounds at all termination points. Install water tight plugs, rod and mandrel to clean system after its construction. The minimum size conduit diameter is 4" for all applications in inter building applications.

Routing of Ductbanks - Inter Building Communication Duct Banks carry vital backbone cable media which serve a host of facilities on Campus. Severing of the inter building backbone can potentially cause a loss of communications to the buildings downstream of the damage.. For this reason it is critical that ductbanks be routed around buildings, and that in no case does the pathway for the inter building backbone pass through a building on its route through campus.

Duct Bank Configuration and Quantity of Ducts - Once it is in place, modification to communication ductbank is often impractical. It is critical, therefore, to plan for adequate expansion and growth of the communication system at the time the ductbank is constructed, rather than after the fact. This is especially true of concrete-encased duct banks. No less than four ducts should ever be installed at the time of construction, including for building entrances of over 10,000 sq ft. The exact number of ducts required shall be approved by ITS/CNS. This rule applies, even if only a small number of cable pairs or strands of fiber that partially fill just a single duct are projected to be required over time. Ductbanks are configured in arrays, typically with several rows stacked together. 1 x 4, 3 x 3, 3 x 4 are examples of duct arrays, which also correspond to the arrangement of duct openings in pre-cast concrete vaults and manholes where transitions occur.

Duct Bank Construction Materials and Methods - As the majority of inter building communication ductbanks are installed in utility populated areas; the ducts must share underground pathways with existing underground infrastructure components such as water lines, gas lines, and sanitary systems and so on. As these utilities frequently need to be dug up for maintenance and repairs, it is critical that the communications infrastructure be provided the highest level of durability to prevent inadvertent damage by backhoes and other heavy equipment. Only 3000 p.s.i. compaction concrete-encased ductbanks are considered acceptable for installation in these environments.12 The duct material itself should be Trade Size 4 (4-inch diameter), PVC Schedule 40 EB or equal for concrete encasement, and suitable for contact with concrete. Schedule 80 EB or Rigid Steel conduits shall be installed in areas where non – encased duct banks have been approved. Install a measured pull line rated a minimum of 800 lbs tensile strength into each duct secured on each end. Install re enterable duct plugs in vacant ducts.

Duct Placement - Duct routing should be planned with consideration for distance between Transition Structures and difficulty of cable pulls, particularly when high-count multi pair copper cables are necessary. The minimum radius for curves is 15 feet. Trenches should be dug with the following depth and width considerations for concrete pours:

Concrete-Encased Ductbank Dimension Guidelines

Ground Cover	**Minimum of 36 inches**
Top Level of Concrete	**Minimum 2 Inches above top duct**
Concrete on Outer Sides of Ductbank	**Minimum 4 inches**
Concrete Between Ducts	**1 inch (above, below and to each side)**
Bottom Level of Concrete	**Minimum 1.5 inches**

Ductbank Marking and Locating - A metallic warning tape, detectable with magnetic location equipment, shall be buried directly over the path of the Ductbank approximately 18 inches above the ducts.

Ductbank Termination At Building and Vaults - Communication Ducts should be terminated with bell-end connectors, flush with the inner surface of the wall.

Duct Bank Grounding and Bonding - A solid copper insulated # 6 copper wire shall be installed and terminated in an empty duct for duct bank locating purposes. Provide continuous grounding wire connectivity the entire length of the ductbank.

Inter Building Spaces: Vaults, Hand Holes, etc. (Transition Structures)

Purpose - Inter building spaces are essentially Transition Structures that allow access to cable installed within underground ductbanks (i.e. vaults, manholes, hand hole, etc). These structures are required by Codes to be exclusively for low voltage communication cable and equipment. They may not be collocated with electrical transmission lines or facilities. Transition structures provide a protected location for the storage of splice cases and slack loops of cable. The transition structures also facilitate the distribution of cable to multiple locations by providing a junction point for ducts radiating in several directions.

Pedestals are above-ground enclosures which are used for the termination or splicing of campus backbone cables. As pedestals are vulnerable to vandalism and other damage such as from vehicle impact, their use on the UNM Campus is not permitted without approval from UNM Information Technology/Telecommunications.

Selection of Transition Structure Type - The type of structure chosen for installation is dependent on the number of ducts in the span. These can range from vaults measuring 20 feet long, and 12 feet deep, to small, shallow, hand holes only a several feet square. In most cases, preformed concrete structures are available in several sizes and capacities from large vaults down to hand holes. Rarely is it necessary to form and pour a custom structure on-site. Structures also have weight-bearing cover/lid capacities that range from light pedestrian traffic to deliberate heavy vehicular traffic. The appropriate rating should be selected based on the anticipated exposure of the structure to these differing traffic types. Minimum accepted rating for transition structures is typically 20-H and the use of Quazite Pre-cast Polymer Concrete boxes is not permitted without ITS/CNS approval. The impact resistance rating of the structure shall also be evaluated prior to specification. Verify exact size, impact rating and load requirements with CNS. Contact UNM / IT/ CNS for approval before specifying this type of structure.

Placement of Transition Structures - Structures should be placed after 180 degrees of directional change has been affected in the ductbank route. In straight or relatively straight runs, there should be no more than 400 feet between structures. Structures should not be used as the apex of 90 degree changes in duct direction. Sweeps and structures should be planned such that the sweep occurs outside of the structure, allowing straight cable pulls through the structure itself.

Transition Structure Accessories and Equipment -Transition structures require the following equipment: or hardware to be installed:

A sump, or gravel drainage in the case of small hand holes

Corrosion-resistant pulling eyes

Cable racking and attachments

Grounding cables installed per applicable codes or practices

Ladder

Watertight duct plugs

20. Inter Building Backbone Cable Media

General - This section describes the cable materials and configuration of inter building backbone cable media. This type of cable is specifically designed for use in areas exposed to the elements and that will be subjected to harsh installation conditions. Every type of cable listed shall be warranted by the manufacturer against defects in material or performance. The contractor shall verify upon receipt the cable; regardless of type (copper or optical fiber shall be free from defects or damage and meets the specified and code requirements for the installation. The liability for replacement of installed defective, damaged, non specified or non code compliant cable is at the expense of the contractor.

Note: The contractor shall verify and ensure that the cables specified and installed meet the intended use and are code compliant prior to procurement.

Optical Fiber Backbone Splicing – All optical fiber splices in the backbone shall be fusioned spliced. The splice case and splicing apparatus shall be approved by APS IT Dept.

Optical Fiber Backbone Termination – Termination of optical fiber back bone cabling shall be fusion spliced with SC pigtailed connectors in a splice tray incorporated into the Fiber Distribution panel. Optical fibers are to be terminated in numerical sequence without compensation for polarity.

Optical fiber coupler/panel inserts

colors: Single Mode – Blue

Laser Optimized Multi model 50 Um– Aqua

Multi Mode - Tan

Testing Backbone Optical Fiber Cable, Labeling and Acceptance - Inter building optical fiber cable- shall be tested using both at tester capable of providing both power loss and an OTDR trace. When building and testing installed circuits the installer shall provide a circuit loss budget (attenuation) and OTDR trace for the channel (end to end). Bi-directional testing is required for all links and circuit

channels. Acceptable testing perimeters shall meet the link loss budget for combined components.

All FDU's and optical fiber connectors are to be labeled using an electronically printed label and shall be visibly secured to the FDU door. All FDU's are to be labeled sequentially on equipment racks.

Approved manufacturers - approved manufacturer systems for optical fiber systems are: OCC, CommScope, Uniprise, Systemax. Strand count shall be specified by APS IT Dept. Other manufactures will only be accepted and approved by APS IT Department and that includes existing manufacturers.

Acceptable Testers: Fluke DTX 1800 for Intra building testing. Others testers as approved by APS IT Dept.

21. Multi pair Copper Backbone Cable

Multi pair Copper Backbone Cable is diminishing due to VOIP technologies since optical fiber has overshadowed copper cable's bandwidth carrying capacity and physical size. Nonetheless, multi pair copper backbone cable will remain an important element in the school districts for analog lines uses like elevators and fax machines.

Typical multi pair Outside Plant (OSP) Copper Backbone Cable is constructed with a heavy polyethylene jacket over a metallic shield. The cable pairs inside the jacket are coated with a water displacement gel in the event the water integrity of the jacket is lost.

Multi pair copper backbone cable is unrated and must be terminated, spliced within 50 feet of building entry, or if these distances are exceeded, the cable must be installed in rigid conduit for its entire length. All OSP cables are to be transitioned by splicing non filled rated pre terminated protector rated cable assemblies. Multi pair copper cable is conductive and capable of delivering damaging and potentially lethal electrical surges to equipment and personnel caused by lighting strikes or by exposure to high voltage electrical current. For this reason, multi pair copper cable spliced to, manufacturer electrical protector units with cable tails at the service entrance. This equipment protects personnel and equipment within the building from electrical shocks caused by factors outside the building. The type and manufacture of electrical protector units will be determined by APS IT Department; however, splices or protector unit panels should be mounted on

backboards within the Service Entrance/Equipment Room.The square footage necessary for this equipment varies with the pair count of the multi pair copper cable entering the building and should be calculated within the planned size for the space as part of the footprint.

Copper Splicing - Splices for all inter building backbone cable types are to be spliced within building service entrances or manholes. The contractor is to provide a well ventilated, clean working environment for all placement splicing and termination operations. All work areas shall be left cleaned, all cables are properly supported, landscape restored, safe and water sealed during and at completion of work.

Approve splice modules are 3M 4000 or 710 series. All splices are to be colored coded, dressed, wrapped per applicable use, and bonded. All OSP spices shall be filled with a re enterable waterproofing encapsulate and sealed in an splice case approved by APS IT Dept. Splice diagrams shall be submitted to APS IT Dept upon completion.

Inter Building Multi Pair Cable Testing

Provide to APS IT Department wire map test and results for opens, shorts crosses, grounds and splits. Provide measurements for all failures and repair deficiencies. Provide results of all pairs whether pass or fail for each pair directly from the test equipment nor in Excel format if not. Include the project name, technician names and date tested. Provide test results two weeks prior to substantial completion of the project

Note: All defective pairs shall be corrected and retested prior to the submittal of test results.

Note: APS IT Dept. recommends that all testing be completed prior to the closing of splice cases, to allow for immediate repair of defective pairs. The contractor is responsible to protect all work until acceptance.

Inter Building Coaxial Backbone Cable
Where necessary, coaxial backbone cable shall be installed for the distribution of baseband and broadband signals. Coaxial cable is subject to high levels of attenuation (signal loss over distance) and large diameter coaxial cable is often used to mitigate this loss. Coaxial cables of ½ inch diameters and larger, are expressed as decimal equivalents for the diameter in inches, (e.g. .500, .625, .750 and 1.000) this type of Coaxial cable is very rigid, and must be installed using specialized equipment. The engineering of coaxial distribution systems will dictate the cable diameter, location of splices, amplifiers and other distribution equipment throughout the system. Additional conduit shall be provided for required installations.

22. Warranties, Quality Control and Commissioning for Horizontal, Intra and Inter Building Cabling Media

The Contractor shall provide a one year warranty on all parts, product and labor for all project deliverables. The Contractor shall apply for and receive a manufacturer's warranty of not less than 20 years for labor and material prior to start of work for the cabling system.
APS IT Dept. shall be copied on the contractor's notification to manufacturers for warranties.

The Contractor shall request for the cabling system manufacturer a warranty inspection at infrastructure rough in and at the completion of termination. APS IT Dept representation shall be included in the warranty inspections.

The manufacturer's warranty certificates shall be assign to Albuquerque Public Schools IT Department.

23. Information Technology Infrastructure Reinforcement Guidelines

The threat of terrorism to our critical infrastructure assets dictate that facility and technology management take precautions toward the hardening and preservation of key facilities and equipment. Awareness of the unconventional means that terrorist elements use to affect their ends, Information technology infrastructure is particularly vulnerable to these threats due to the ubiquitous nature of communications facilities. The following Table provides suggested steps that planners and designers implement in order to mitigate the threat of vandalism, or sabotage.

Reinforcement Requirements: Vantage Consulting

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Facility Class Definitions

Facility Class Definitions	
Class	**Explanation**
General Campus Areas	**This applies to the Campus as a whole, or because of the location of a facility, it may not belong to a specific building, but be placed in a common area.**

Class 1 Facility	**This would be classified as a critical building or facility, where the damage or loss of the communication infrastructure would cause a major safety or health and welfare crisis on the Campus. Examples include: The UNM Building, The Hospital, The Telecommunications Building, and Public Safety.**
Class 2 Facility	**This type of Facility is key to the operation of the University, yet not as critical as a Class 1 Facility. Examples could include, Scholes Hall, Residence Halls, and major classroom buildings.**
Class 3 Facility	**A Class 3 Facility is one which has importance to the University, however, it is not a building heavily reliant on communications. Examples could include Lecture Halls and warehouse facilities.**

Vantage Infrastructure Reinforcement Elements

The following table provides a list of Infrastructure Elements that may be implemented as buildings are retrofitted, or in new construction projects. Their overall benefit will be to enhance the physical security of critical information technology assets.

Infrastructure Reinforcement Elements					
Infrastructure Reinforcement Elements	**General Campus Areas**	**Class 1 Facility**	**Class 2 Facility**	**Class 3 Facility**	**Explanation/Purpose**
Install locks and liquid-tight seals on manholes/handholes	**X**				Prevent unauthorized access and the introduction of flammable liquids into manholes.
Enclose generators, fuel tanks, and oil, coolant reservoirs for emergency power generation systems	**X**				Prevent sabotage of equipment.

Infrastructure Reinforcement Elements					
Infrastructure Reinforcement Elements	**General Campus Areas**	**Class 1 Facility**	**Class 2 Facility**	**Class 3 Facility**	**Explanation/Purpose**
Construct Secondary and Tertiary access pathways		**X**			Provide alternate pathways of ingress/egress into buildings in the event of destruction of primary route or cable.
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Install security access controls to Service Entrances, Equipment Rooms and Technology Rooms		**X**	**X**	**X**	Implement card readers, surveillance cameras and the “Two-Man Rule”for access of 3rd party vendors and maintenance technicians.
Secure air handling equipment serving communications facilities to prevent tampering		**X**	**X**		Prevent the shutdown, or intentional contamination of air supplies (chemical or bacteriological) and HVAC systems serving critical communication facilities
Remove labels and signs from Service Entrances, Equipment Room, and Technology Room doors.		**X**	**X**	**X**	Make rooms look non-descript, make identification by non-communications/technology personnel difficult.
Transition all aerial cable to underground facilities	**X**	**X**	**X**	**X**	Aerial cable is vulnerable to damage from fire, extreme weather, vehicle impact and outright destruction from chainsaws or axes.

Infrastructure Reinforcement Elements					
Infrastructure Reinforcement Elements	**General Campus Areas**	**Class 1 Facility**	**Class 2 Facility**	**Class 3 Facility**	**Explanation/Purpose**
Plug and seal duct opening in duct banks including vacant ducts and ducts with existing Cable installed.	**X**	**X**	**X**	**X**	Prevent the introduction of flammable liquids or water into ducts.

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Additional APS Specifications / Details:

Wireless Specifications: Wireless Access Points and Wireless Controllers shall be installed based on District standards and in compliance with IEEE's 802.11a, b,g,n,ac Wireless Networking standards. Access Point shall be powered based on IEEE's 802.3af or 802.3at Power-over-Ethernet Standards as determined by APS It Dept. Physical locations and number of Access Points will be designated from the Data Communications Division and mounted typically 96" AFF, or not to exceed 10' in height. Access Points mounted in Gyms must be housed in a protective, non-metallic, wireless enclosure. WAP's are to be labeled, asset tagged according to APS / district IT standards.

Pathways: In suspended ceiling and raised floor areas where duct, cable trays or conduit are not available, the Contractor shall bundle, in bundles of 50 or less, station wiring with cable ties snug, but not deforming the cable geometry. Cable bundles shall be supported via "J" hooks attached to the existing building structure and framework at a maximum of five foot (5') intervals. The contractor shall adhere to the manufacturer's requirements for bending radius and pulling tension of all data cables.

Cables shall not be attached to or supported by fire sprinkler heads or delivery systems or any environmental sensor located in the ceiling air space. Cables shall not be attached or lift out ceiling grid supports or load directly on the ceiling grid. Plenum rated cable ties shall be used in all appropriate areas.

Aerial pathways shall consist of rigid conduit masts and 30' utility poles, not to exceed a span of 75,' and wedge clamps as secure attachments to aerial messengers.

Portable Buildings: Network connections to Portable classrooms and offices shall be based on an aerial fiber service entrance in a star-distribution topology with a Quick-Disconnect Industrial connector. In rare cases, a wireless bridge may be specified. The following is a list of specifications for the Quick-Disconnect Industrial connector and fiber backbones:

As-Builts Requirements

Contractor is required to provide As-Built drawings at the completion of each project. They must be of professional quality, capable of being reproduced and with reasonable archival standards. As-builts shall be delivered within 10 working days after project completion. Hand-drawn As-builts are not acceptable. Upon completion of the project, paper and electronic copies of the As-builts are to be provided to the Data Communications Division, as well as a hard copy to the Site Technology Coordinator. As-builts are required to be drawn in the latest version of autodesk's AutoCAD software and comply with the United States National CAD Standard as follows:

- ES - Electrical Site Plan - Details include Telecommunications pathways and spaces; Conduits, pull boxes, underground boxes, sleeves, masts and utility poles.
- TN-DATA, Telecommunications Network Layer - Details physical locations and labeling for all IP devices, including network drops, MDF, IDF's, wireless access points, cameras, intercom, mechanical and electrical and backbones.
- Labeling compliance with ANSI/EIA/TIA 606A standards and District standards
- Electronic As-builts will be sent as a complete set which include both the .dwg and .dwf formatted files

Reports and Certifications: The contractor shall be responsible for recording and providing to the owner all test data. Copies of all test results are to be submitted to the Data Communications Division in an electronic format and delivered via email. For all fiber optic cables within the required distance, a printout from an Optical Time Domain Reflectometer will be provided and correspond to a labeled fiber cable. All twisted pair copper cable must have an output of the test results with the station ID assigned.

APS Billing Procedures:

All contractors are to comply with APS billing process's and are to turn in all required documentation prior to any billings which includes progress billings. The processes includes turning in Test results, As-Builds, and progress walk through inspections, Final walk throughs and warranties after project completion and or progress inspections that are to be performed by APS IT Department. We are simply requesting that no invoices be submitted until everything has been approved and received from the contractor. On that note we also request that you submit all invoices to the APS IT PM (David, Chris and Kathy- CC Tony Otero on all emails) you are working with for pre-billing review and approval so that the APS IT PM can verify that the estimate you submitted matches the final invoice. Once the APS IT PM has verified that the invoice matches the SoW then the APS IT PM will forward your invoice to accounts payable for processing- the contractor will be CC on the email.