DIVISION 27 00 00 COMMUNICATIONS

SECTION 27 00 00 COMMUNICATIONS

1. GENERAL.
   A. This division provides design guidelines for the telephone and data distribution systems at TTU. Full specifications are the responsibility of the Designer.

   B. Three types of cable are classified as communications at Tennessee Tech University, telephone, television, and data fiber. These cables can be further classified as indoor and underground cable. Various sizes of telephone cable exist throughout the campus, especially the underground cabling system.

   C. All work contained in this document must be performed by technicians BSCI certified in the field of work being completed.

   D. ANSI/UL/NEC standards must be followed closely in the completion of any sections enclosed in this document where applicable.

   E. Any material or equipment contained in the document may be substituted by a comparable product upon written pre-approval of the University.

   F. Refer to ANSI/UL/NEC regulations for the bend radius on communications cable, installation, and proper termination.

   G. Refer to ANSI/UL/NEC/FCC regulations for bend radius on television cable, proper termination, and end-user signal levels.

   H. A typical workstation will consist of one voice jack and two data jacks unless otherwise requested.

   I. A typical data-only drop will consist of two data jacks unless otherwise requested.

   J. Allow for TTU ITS review of Design Development Phase documents to locate Wireless Access Points.

   K. TTU will arrange for the following scope of work:
      1. Providing data concentrators, hubs, servers, computers, and other active devices.
      2. Telephone switch (PBX) and handsets.

   L. All cabling shall be Contractor-provided and Contractor-installed.

M. Warranties are required for all communications system components. The maximum available warranty should be specified for materials, equipment, and workmanship represented in this division.
   1. All installation personnel shall meet manufacturer's training and education requirements for implementation of extended warranty program.

2. EXECUTION.
   1. Conduct a pre-installation site survey meeting including TTU ITS, Telecom, Campus Representative, and the Contractor prior to systems installation for trade coordination and conflict identification/prevention.

SECTION 27 05 26 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

1. GENERAL.
   A. Grounding shall conform to ANSI/TIA/EIA 607(A) Commercial Building Grounding and Bonding Requirements for Telecommunications, National Electrical Code®, ANSI/NECA/BICSI568 and manufacturer's grounding requirements as minimum.

   B. Bond and ground equipment racks, housings, messenger cables, and raceways (including J-Hooks.)

   C. Connect cabinets, racks, and frames to single-point ground which is connected to building ground system via #6 AWG green insulated copper grounding conductor.

SECTION 27 05 28 PATHWAYS FOR COMMUNICATIONS SYSTEMS

1. GENERAL.
   A. All communications services are contained in underground conduit and travel through a university owned manhole system.

   B. Conduit is required for cable paths between outdoor entrances of facilities, main communications room, communications spaces on adjacent floors, and office spaces.

   C. The contractor is responsible for following all pertinent electrical and communications codes when installing conduits.

   D. Penetrations through floor and fire-rated walls shall utilize intermediate metallic conduit (IMC) or galvanized rigid conduit (GRC) sleeves with appropriate protective bushings and shall be fire stopped after installation and testing, utilizing a firestopping assembly approved for thatapplication.

E. Building Entrance Conduits. These conduits can be classified as those pathways used to connect outdoor manholes with a building.
   1. A minimum of two (2) four-inch conduits will be required from the manhole to the MDF, normally on the ground floor and sealed at each end to prevent water penetration.
   2. One conduit shall be supplied with duct allowing multiple paths for fiber optic and other small cabling. From that point a minimum of two feeder conduits measuring a minimum of 2-½ inches are required to each IDF. These 2-½ inch conduits may be enlarged if wiring is greater than conduit size.
   3. Depending on the layout of the building, more conduits may be required if multiple wings exist on the adjacent floors.

F. Office Space Conduits provide communications services to point of use. These include but are not limited to telephone, cable television, and data services.
   1. A minimum of one ¾-inch conduit per service must be taken from the wall box insert to the nearest accessible ceiling space.
   2. Telephone, cable television, and data may occupy the same conduit.
   3. Each conduit shall house a pull string that is strong enough to allow placement of communications cabling.
   4. Cables in accessible ceiling spaces shall be properly supported by J-hooks or cable tray. Wire trays may also be utilized for cable distribution.

SECTION 27 05 36 CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

1. GENERAL.
   A. Trays that are used to support horizontal cabling may be used to support riser cables provided the cable tray's carrying capacity can accommodate the riser cables.

   B. Shall be sized to accommodate future installations and building growth. Initial cable fill not to exceed 25% of tray capacity

   C. Shall be installed in accessible ceiling areas only and shall transition to a minimum of four 4-inch EMT conduits when routed over fixed, hard, and inaccessible ceiling spaces.

   D. Cable tray shall transition to a fire rated assembly to penetrate walls. Where conduits drop down onto cable tray provide plastic spillways installed onto the end of the conduit to prevent kinking of the installed cable bundle.

   E. Penetrations through firewalls shall allow cable installers to firestop around the cables after they are installed. Tray-based mechanical firestop systems shall be used when a cable tray penetrates a fire barrier. All firestopping installations shall be labeled in accordance with ANSI/TIA-606.

   F. Shall meet the requirements in ANSI/TIA-569 and applicable addenda.

G. Cable trays shall not be placed within 5-inches of any overhead light fixture nor within 12-inches of any electrical ballast.

H. A minimum clearance of 12-inches above and 12 to 18-inches to one side of the cable tray shall be maintained at all times. All bends and T-joints in the cable trays shall be fully accessible from above (within one foot).

I. Cable trays shall be mounted no higher than 12-feet above the finished floor and shall not extend more than 4-feet over a fixed ceiling area.

2. PRODUCTS.
   A. Cable trays shall be steel wire basket or mesh suitable for hallways and false ceiling areas.

   B. Cable trays shall be a minimum of 12-inches wide and 2-inches deep. The use of carbon steel, electro zinc plated wire basket tray system is the preferred cable tray system within the corridors. Refer to manufacturer fill charts for correct sizing.

3. EXECUTION.
   A. Install all cable tray systems per manufacturer's requirements.

   B. Cables installed in cable trays shall not contain or be fastened with Velcro, tape, or plastic cable ties (tie-wraps).

SECTION 27 05 53 IDENTIFICATION & LABELING FOR COMMUNICATIONS SYSTEMS

1. GENERAL
   A. Labeling shall conform to ANSI/TIA/EIA606(A) standards. In addition, provide the following:
      1. Label each outlet with permanent self-adhesive label with minimum 3/16 in. high characters.

      2. Label each cable with permanent self-adhesive label with minimum, 1/8 in. high characters, in the following locations:
         a. Inside receptacle box at the work area.
         b. Behind the communication closet patch panel or punch block.

      3. Use labels on face of data patch panels. Provide facility assignment records in a protective cover at each telecommunications closet location that is specific to the facilities terminated therein.

      4. Use color-coded labels for each termination field that conforms to ANSI/TIA/EIA606(A) standard color codes for termination blocks.

5. Labels shall be machine-printed. Hand-lettered labels shall not be acceptable.

6. Label cables, outlets, patch panels, and punch blocks with room number in which outlet is located, followed by a dash and a number to indicate particular outlet within room, i.e., 137-01, 137-02. Indicate riser cables by an R then pair or cable number. Labels must be identical at all locations along the cabling pathway. Contractor is to submit labeling scheme for approval.

7. Mark up floor plans showing outlet locations, type, and cable marking of cables. Turn these drawings over to the owner four (4) weeks prior to move-in to allow the owner's personnel to connect and test owner-provided equipment in a timely fashion.

8. A machine-readable file (i.e. spreadsheet, CSV document, etc.) must be provided to the owner detailing the IDF, rack, patch panel, port, and label for each connection. This document shall be delivered to the owner before acceptance of project by owner.

SECTION 27 10 00 STRUCTURED CABLING

1. GENERAL.
   A. The Designer is responsible for determining where plenum cable is to be used and where PVC jacketed cable can be utilized.
      1. Non-plenum rated cable is acceptable unless otherwise required by code.

   B. All cables must be identified and labeled according to standards in Section 27 05 53.

   C. Contractor shall install and terminate contractor-supplied voice and data cabling from outlets shown on the plans to the local IDF.

   D. CABLE TELEVISION.

      1. Television cable consists of two categories: underground and indoor. The indoor cable at TTU consists of RG6 and RG11. Some longer runs may have been accomplished using .625 hard line, but those cases are rare.

      2. The TTU campus television services consist of a copper-based plant.

      3. All trunk and distribution equipment, hard line passives, and taps are Cisco (formerly Scientific Atlanta).

      4. All underground trunk cable is .625, flooded.

5. All RG6 cable is terminated using SNS6 type fittings. Single indoor cable runs utilize RG6 cable.

6. Underground cabling is .625 hard line. All cable television cable will be terminated with the equipment listed in part E, SPLICING and TERMINATIONS, below.

7. Any bends in the hardline cable that disfigure the outer appearance will require re-installation of the material.

8. Any televisions requiring QAM television services should have a RG6 tri-shielded cable installed. The cable should terminate at the nearest IDF and be contractor provided.
   a. Apartments in residence halls will not be provided television services.

9. All material required to provide television services is the responsibility of the contractor.

E. VOICE.
1. Telephone cable consists of 2 categories, underground and indoor. Underground cable can be found in manholes or outdoor pedestals. Most indoor cable at TTU is CAT3.

2. Any IDF feeding service to a standard phone or QAM television point should have a feed from the MDF. The feed from the MDF for standard phone service should be a 25 pr. CAT3 cable, terminated on a 66M block. The feed from the MDF for QAM television services should be a RG11 cable. All material should be contractor provided.

3. Voice backbone cable shall be contractor-provided, contractor installed. Underground backbone cabling shall be REA PE-89.

4. Vertical/horizontal copper voice backbone cabling consists of multiple pair unshielded twisted- pair installed from the main cross-connect (MC) located in the MDF to the horizontal cross-connect (HC) located in each IDF.

5. Voice telecommunications station cable CAT6 shall be contractor-provided, contractor installed.

6. All voice cables will consist of tan jacketed non-Plenum Category 5e cable terminated with a RJ11 jack and terminated on 66 blocks in the IDF.

F. DATA.
   1. Vertical/horizontal backbone cabling consists of 24-strand OS1 single-mode fiber optic cable installed from the MDF to each IDF and will serve as the data communications fiber backbone.

   2. Building feed cabling consists of 24-strand OS1 single-mode installed from the MDF to the campus data center.

   3. All fiber optic cabling must be terminated using color coded fusion spliced pigtails with LC-UPC style connectors unless otherwise specified.

   4. All data cables will consist of black jacketed, non-Plenum Category 6 or 6a cable as specified, terminated with a RJ45 jack and terminate the cables on rack mounted modular patch panels located in the appropriate MDF or IDF. (TIA/EIA 568C2)

G. FIRE PANEL.
   1. Fire Panel horizontal cabling consists of 12 strand OM3 multi-mode fiber optic cable installed to the fire panel location from the MDF. Fiber Optic cable should be installed in a single, unbroken run between adjacent building fire-panels.

   2. Contractor shall terminate both ends of the fiber optic cable in the appropriate connector.

H. SPLICING and TERMINATIONS.
   1. TELEPHONE.
      a. Phone service shall be Contractor-terminated.
      b. Indoor phone cabling is terminated on a 66M type block.
      c. Underground cable can be terminated with UR or UY Scotchloks.
      d. In manhole terminations, the existing splice case configuration shall be used and sealed tightly to prevent water penetration.
      e. All splicing necessary to activate telephone services is the Contractor's responsibility.

   2. CABLE TELEVISION.
      a. All cable television drops shall be Contractor-terminated at the jack will be tested and recorded for a minimum level, 4db @ Channel 2 and 7db @ Channel 71. Tilt will be maintained between these channels at a rate of 5db positive.
      b. All splicing necessary to activate television services is the Contractor's responsibility.

3. DATA.
   a. All fiber optic cabling must be terminated using fusion spliced pigtails with LC-UPC style connectors unless otherwise specified.
   b. All Category 6A data cables shall be terminated with a RJ45 jack and terminate the cables on rack mounted modular patch panels located in the MDF. (TIA/EIA 568C2)
   c. All splicing and terminations for data cabling is the Contractor's responsibility.

2. PRODUCTS.
   A. TELEPHONE.
      1. CONTRACTOR-PROVIDED, CONTRACTOR INSTALLED.
         a. Underground telephone cable should be 24awg. REA PE-89.

   B. CABLE TELEVISION.
      1. CONTRACTOR-PROVIDED, CONTRACTOR INSTALLED.
         a. CABLING. For indoor and outdoor television cable and material associated with that service:
            i. Belden Indoor RG6 Cable (Single Runs) Part # 1613A RG-6
            ii. Commscope Siamese CAT5e/RG6 Quad-Shield Cable Part # UH58120
            iii. Underground television cable should be .625 meeting specs for Commscope P3 625 JCASS.

         b. TERMINATIONS. For indoor and outdoor television material associated with termination of that service:
            i. Cisco Multimedia Hardline Taps and Splitters
            ii. Cisco Distribution and Trunk Amplifiers 870MHz
            iii. Thomas-Betts SNS6 F-Type Fittings
            iv. Gilbert Hard Line Connectors

   C. DATA.
      1. OWNER-PROVIDED, CONTRACTOR-INSTALLED.
         a. Panduit Mini-Com Faceplate 2 Position Part # UICFPSE2IW
         b. Panduit Mini-Com F-Type Connector Part # CMFBAWH

      2. CONTRACTOR-PROVIDED, CONTRACTOR-INSTALLED.
         a. CAT6: Cable must be CommScope CS34R CAT6 4 pair 23 AWG, solid conductor, U/UTP with non-plenum black jacket UN884020514/10, or General Cable GenSPEED 6 Category 6 4 pair 23 AWG, solid conductor, U/UTP with non-plenum black jacket 7133807.
         b. CAT6a: Data station cable (copper) must be CommScope CS44R CAT6a 4 pair 23 AWG, solid conductor, U/UTP with non-plenum black jacket UN884032614/10.
         c. Alternate products meeting the same specifications may be used with prior approval of Owner.

3. EXECUTION.
   A. Installers for data cabling connections must complete Panduit Installer Training to provide access to the Panduit warranty program for all connections.

   B. Adhere to manufacturer's published specifications for pulling tension, minimum bend radii, and sidewall pressure when installing cables.
      1. Where manufacturer does not provide bending radii information, minimum-bending radius shall be 15 times cable diameter. Arrange and mount equipment and materials in a manner acceptable to the Designer and the Owner.

   C. Install station cabling to the nearest Intermediate Distribution Frame (IDF) on the same floor unless otherwise requested.

   D. Attach cables to permanent structure with suitable attachments at intervals of 48 to 60 inches. Support cables installed above removable ceilings.

   E. Use lacing bars to secure the cables at the back of the data racks, to allow for easy installation of network equipment and manage all service loops above the ladder racks.

   F. Manage service loops for fiber and copper separately.

   G. Install adequate support structures for 10 feet of service slack at each IDF.

   H. Support riser cables every three (3) floors and at top of run with cable grips.
      1. Limit number of four-pair data riser cables per grip to fifty (50).

   I. Install cables in one continuous piece. Splices shall not be allowed.

   J. Provide over-voltage protection on both ends of cabling exposed to lightning or accidental contact with power conductors.

SECTIONS 27 15 53/27 15 54 COMMUNICATIONS FIBER & COPPER CABLE PLANT TESTING

A. Testing shall conform to ANSI/TIA/EIA568.2-D standard. Testing shall be accomplished using level IIIe or higher field testers.

B. Test each pair and shield of each cable for opens shorts, grounds, and pair reversal. Correct grounded, and reversed pairs. Examine open and shorted pairs to determine if problem is caused by improper termination. If termination is proper, tag bad pairs at both ends and note on termination sheets.

1. Perform testing of copper cables with tester meeting ANSI/TIA/EIA568.2-D requirements.

2. If copper cables contain more than the following quantity of bad pairs, or if outer sheath damage is cause of bad pairs, remove and replace the entire cable.

CABLE SIZE	MAXIMUM BAD PAIRS
<50	0
50 to 100	1
101 to 300	1 – 3
301 to 600	3 – 6
>601	6

3. If horizontal cable contains bad conductors or shield, remove and replace cable.

C. Initially test optical cable with a light source and power meter utilizing procedures as stated in ANSI/TIA/EIA52614A: OFSTP14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant and ANSI/TIA/EIA5267 Measurement of Optical Power Loss of Installed Single Mode Fiber Cable Plant. Measured results shall be plus/minus 1 dB of submitted loss budget calculations. If loss figures are outside this range, test cable with optical time domain reflectometer to determine cause of variation. Correct improper splices and replace damaged cables at no charge to the Owner.

1. Cables shall be tested at 850 and 1300 nm for multimode optical fiber cables. Cables shall be tested at 1310 and 1550 nm for Single Mode optical fibers.
2. Testing procedures shall utilize “Method B” – One jumper reference.
3. Bi-directional testing of optical fibers is required.

D. Perform Optical Time Domain Reflectometer (OTDR) testing on each fiber optic conductor. Measured results shall be plus/minus 1 dB of submitted loss budget calculations.

1. Submit report for each cable tested.
2. Submit electronic files with test results and program to view results if necessary.

E. Where any portion of system does not meet the specifications, correct deviation and repeat applicable testing at no additional cost to the Owner.

SECTION 27 20 00 DATA COMMUNICATIONS

1. GENERAL.
   A. DATA DISTRIBUTION ROOMS.
      1. Each building will have one or more Intermediate Distribution Frame (IDF) rooms to provide network access services for the floor or area in which they are located. Each building will have an IDF serve as the building entrance and distribution location for network services designated as the Main Distribution Frame (MDF). For small single-story buildings, the MDF may be the only network room necessary.

      2. At least one IDF must be present on every occupied floor of a building. All portions of the floor, including the building envelope, must fall within a cabling distance of 270 feet from an IDF. Cabling distances are to be measured assuming all cabling paths are aligned parallel to building corridors. To simplify distance calculations, any location within 190 feet of the IDF will fall within the 270-foot cabling distance limitation. IDFs should be centrally located within the floor area it serves to maximize the floor space they can serve.

      3. In multi-story buildings, IDFs should be in vertical stack alignment wherever possible.
         a. Discuss exceptions to IDF room stacking requirements for renovation projects with TTU ITS during design.

      4. At least two conduits 4” in diameter with appropriate pull boxes and access must be provisioned from each IDF to the building MDF.

      5. IDFs should be easily accessible and accessed directly from public hallways. Access should not be through offices, bathrooms, other utility spaces, or janitorial spaces.

      6. IDF rooms shall not be used as passageways to other rooms.

      7. If an IDF will house other systems including, but not limited to, audio-visual (A/V) equipment, fire alarm panels, building management systems, cable tv, camera systems, telephone infrastructure, or computer servers, usage must be approved by TTU ITS prior to construction.

      8. Measures must be taken to prevent water intrusion; water, sewer, chemical, or drain piping of any kind shall not be routed through or within an IDF.

      9. IDFs shall not be in any place that may be subject to water or steam infiltration, humidity from nearby water or steam, heat, and any other corrosive atmospheric or environmental conditions.

10. IDFs and the cabling they support shall be separated from sources of electromagnetic interference such as induction devices, transformers, ballasts, power supplies, elevator equipment, generators, motors, X-ray generators, photocopiers, microwave ovens, and similar equipment nor be located near sources of mechanical vibration.

11. Equipment not related to the support of the IDF (e.g., piping, ductwork, pneumatic tubing, etc.) shall not be installed in, pass through, or enter an IDF.

12. The IDF shall be designed and provisioned per ANSI/TIA/EIA-569-B Commercial Building Standards for Telecommunications Pathways and Spaces and per the BICSI Telecommunications Distribution Methods Manual (TDMM) current edition.

13. Each IDF shall be a minimum size of 10’ x 12’ with no obstructions or protrusions (beams, columns, etc.) that decrease the usable square footage available.
    a. Discuss exceptions to minimum size requirements for renovation projects with TTU ITS during design.

14. Each IDF shall have a minimum 36”-wide solid door without any windows. Doors shall swing outward into the hallway. If a double door is used, any center mullion must be removable.

15. IDFs shall not have raised or false floors. Floor finishes should be smooth and not susceptible to static electricity build-up.

16. No lay-in tile or hard ceiling shall be installed over the IDF space.

17. IDF lighting should be controlled by a manual switch located inside the room and should be sufficient to provide 50-foot candles measured 3’ above the finished floor on all sides of installed racks.

18. Power outlets for network UPS units must be provided from emergency power-protected panels if present in the building to each rack.

19. Additional standard quad power outlets for tools or other equipment must be provided a minimum of every 6 feet along all walls.

20. Sufficient HVAC to service installed networking equipment must be designed and installed for 24 hours per day, 365 days per year operation.

21. HVAC equipment installed inside the IDF should be mounted over the door to prevent water damage to network equipment.

22. All IDF walls shall be covered with 4’ x 8’, ¾” thick plywood. Any paint applied to the plywood should be fire retardant. Plywood shall be installed 18” above the finished floor (above standard electrical outlets) and extend 8 feet up the wall.

23. Sprinkler heads should not be installed in IDFs unless required by code. If required, they should be positioned as far away from equipment rack locations as possible.

24. Telecommunications grounding and bonding systems shall be installed to support the telecommunications infrastructure. The requirements for this system are specified in ANSI-J-STD-607-A: The Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

25. All network closet doors are to be storeroom functional lockset. They must be in a permanently locked state and always require a key to open. They must not have a lock knob or button on the inside that allows the set to be unlocked when closed.

2. PRODUCTS.
   A. GENERAL.
      1. Where no preferred manufacturer is listed, provide products of manufacturers in compliance with requirements.

      2. Any substitutions must be approved by Owner.

   A. OWNER-PROVIDED, CONTRACTOR INSTALLED.
      1. Wall Data Outlets.
         1. CAT6: Jacks will be Panduit Mini-com Cat6 Modules in Red CJ688TGRD.
         2. CAT6a: Jacks will be Panduit Mini-com Cat6a Modules in Yellow CJ6X88TGYL.
         3. All jacks shall be installed to manufacturer specifications with no exposed twisted pairs.

      2. Patch Panels. Patch panels will be Panduit Mini-com 24 port 1U modular patch panels.

      3. Optical Fiber Jumpers.

      4. Voice and Data Faceplates. Faceplates will be Panduit sloped jack 2 or 4 port faceplates for single gang box installations in Off-White color. Locations requiring more than 4 ports will require separate single gang junction boxes for each 4 ports installed. Any unused ports must be sealed with the appropriate color matched blanks.

5. Indoor Wireless Access Points.
    1. Access points installed in suspended ceiling areas will be mounted to the ceiling grid with the appropriate hardware.
    2. Wall-mounted access points must be mounted perpendicular to the wall using an appropriate projecting wall bracket.
    3. Installation will include mounting and connections to network drops.
    4. Configuration will be performed by the Owner.

6. Outdoor Wireless Access Points.
    1. Outdoor wireless access points shall be mounted no higher than 16 ft above the outside grade. Exterior wall penetration will be ¾ inch conduit with liquid-tight fittings and up to 2 ft of liquid-tight conduit to the access point.
    2. All cable and conduit connections to the access point will descend below the connection point to provide a drip loop.
    3. A 10 AWG ground wire must be installed between the outdoor access point and bonded to the building structure.

7. Network Data Switches. Installation will include mounting, connections to network patch panels, and power. Configuration will be performed by the Owner.

8. Uninterruptable Power Supply (UPS). A NEMA L6-30R outlet must be installed on a dedicated, generator-protected circuit for each UPS unit.

9. Power Distribution Units (PDUs).

B. CONTRACTOR-PROVIDED, CONTRACTOR INSTALLED.
    1. Rack-mounted optical fiber termination tray. Trays must support at least 36 LC terminated strands of fiber per 1RU tray. Trays must have slack and splice management with the ability to extend the tray forward while mounted for inspection and service. Tray must include any necessary hardware or splice protectors to complete installation.

    2. Splice trays. Splice trays or cassettes for use in non-rack mount locations must properly manage cable slack and protect splices.

    3. Optical fiber jumpers. Optical fiber jumpers must be LC duplex of the appropriate fiber type to match the connecting devices and/or fiber panels.

    4. Optical fiber pigtails. Pigtails must be color coded with industry standard color sequencing, at least 0.5 meter in length, and factory terminated with LC-UPC connectors. Connectors must be color coded by fiber optic type using industry standard color codes.

5. Open frame equipment rack. Racks must be four post, square hole, 19-inch equipment mounting, open frame, adjustable depth racks, 45 rack units in height. Cage nuts and mounting hardware for patch panels and equipment must be provided by the contractor. Rack must be secured to the service loop wall with a ladder rack style horizontal support. Racks are to be installed, pre-set to 30 inches of depth for equipment mounting unless otherwise requested.

6. Surface-mount or ceiling junction boxes. Boxes are to be plastic Panduit single gang low voltage junction boxes in off-white color (Part JBX3510IW-A) or alternate meeting the same specifications with prior approval of Owner.

7. Surface-mount or ceiling data outlets. Data outlet housings are to be plastic single gang or surface mount low voltage housings in off-white color and allow for properly securing Panduit Mini-Com Voice and Data modules.

8. Furniture inserts. All installations outside of standard junction boxes and faceplates must include all appropriate adapters and inserts to allow for properly securing Panduit Mini-Com Voice and Data modules.

9. CAT6 data patch panels. Patch cables must be 1-foot length for patch panels and junction box mounted wireless access points and 3-foot length for ceiling tray installed access points. Patch cables must be black, snagless, and CAT6 certified.

10. CAT6A data patch cables. Patch cables must be 1-foot length for patch panels and junction box mounted wireless access points and 3-foot length for ceiling tray installed access points. Patch cables must be black, snagless, and CAT6A certified.

SECTION 27 30 00 VOICE COMMUNICATIONS

1. GENERAL.
   A. The TTU campus telephone system consists of a copper-based plant. Various cable sizes are utilized depending on services needed.

   B. New construction or full-building renovations will utilize CAT6 type cable.

   C. Existing indoor cabling is copper based with a mixture of CAT3 and CAT5e material.

   D. The telecommunications cabling system generally consists of VOIP utilizing the data network, wall telephones in classrooms, and the Main Distribution Frame (MDF) Rate Demarcation Point (RDP) is located in the MDF.

E. In residence halls, two CAT6 cables shall be installed in the hallways of each wing for emergency phone use. One CAT6 cable will terminate at the data rack. The other will terminate at a telephone demarcation point. Location must meet ADA guidelines.
   1. Emergency phones shall be Contractor-provided, Contractor-installed.

F. Install two CAT6 cables installed to each elevator phone. One CAT6 cable will terminate at the data rack. The other will terminate at a telephone demarcation point.

2. PRODUCTS.
   A. OWNER-PROVIDED, CONTRACTOR INSTALLED.
      1. Panduit Mini-Com Faceplate 2 Position Part # UICFPSE2IW
      2. Panduit Mini-Com 6 Wire Jack Part # CJ66UWHY
      3. Wall Voice Outlets.
      4. Voice Termination Blocks.
      5. Listed Voice Building Entrance Protectors.

   B. CONTRACTOR-PROVIDED, CONTRACTOR INSTALLED.
      1. Siemons 66M Block Part # S66M 1-50
      2. Siemons 66M Mounting Bracket Part # S89D
      3. CommScope CAT5e cable Part # 5ENP4P24-BE-P-GCC-PV
      4. Underground Cable PE-89, minimum 24 AWG unless duct size dictates 26AWG
      5. All voice cables will consist of tan jacketed non-Plenum Category 5e cable terminated with a RJ11 jack and terminated on 66 blocks in the IDF.
      6. Residence hall emergency phones shall be an emergency phone with push button calling and no keypad.
         a. Basis of Design: Code Blue IP1500/1501 Series full duplex VoIP speakerphone.
         b. Substitutions must be approved by TTU.

Surface Mounted (IP1500) Flush Mounted (IP1501)

SECTION 27 40 00 AUDIO-VIDEO COMMUNICATIONS

1. GENERAL.
   A. Wall Monitors / Digital Signage.
      1. Monitors shall not be recessed or built in.

      2. Provide full 4’ x 8’ sheet of ¾” plywood blocking in wall for wall mounted monitors in new construction or where feasible for renovations.

      3. Monitor installation shall comply with applicable ADA guidelines, including but not limited to head clearance and extension into traffic paths.

      4. Power, data, and pathway to above-ceiling (where applicable) at 72” A.F.F. behind all displays.

5. Pullout/scissor mounts are preferred over articulated arms or flat/tilt mounts whenever possible. These pullout mounts may be recessed into backboxes to maintain ADA protrusion compliance.

6. Any digital video transmission distances greater than 72” shall use shielded CAT6 lines adapted at the ends rather than HDMI or other direct cabling.

B. Projection Systems.
   1. Tensioned screens shall be used when the size of the screen meets or exceeds 120” diagonal. Un-tensioned is preferred below that size.

   2. Physical 3-way control switch shall be installed in the wall near the room entrance at standard switch height.

   3. Ceiling-recessed screens are preferred whenever possible.

   4. Screens shall not be installed into hard ceiling.

   5. Ceiling mount poles for projector mounts shall not exceed 36” whenever possible.

   6. Projector mounting locations shall fall at least 24” away from light fixtures and other obstructions.

   7. Projectors shall be serviceable by a 10’ ladder whenever possible.

C. Video Walls.
   1. Video walls shall use direct-view LED technology or newer.

   2. Dedicated power circuit requirements and heat loads shall be calculated and accounted for prior to finalizing a video wall model.

   3. Any video wall shall have a dedicated closet and rack space located within 100 feet of the video wall location.

D. Classrooms.
   1. Classrooms shall have a specified teaching location, with an approved AV lectern containing equipment rack rails.

   2. The teaching location shall have at least a duplex outlet for power, a quad network drop, and an 8”x8” NEMA enclosure, to which the AV integrator will mount a custom disconnect plate for AV connections house within the lectern. These power, data, and disconnect plates must be grouped as close together as possible, no more than 24” apart, at standard outlet height.

3. Audio loudspeakers shall be ceiling-recessed where feasible.

4. Classroom lighting shall be separated into at least two circuits, with independent control over the row of lights closest to the teaching display.

E. Other Typical Spaces.
   1. Large venue/auditorium spaces shall require dedicated AV equipment rack space separate from Networking or other low-voltage equipment. While a dedicated room is preferred, AV racks may live alongside Networking or other low-voltage racks only if a secure, lockable partition separates them (i.e., with the Networking rack in the more secure section). In this case, additional thermal load from any AV equipment must be calculated and accounted for in the room's cooling/HVAC design.

F. Signal Pathways and Conduit.
   1. Any display (projector, video wall, or monitor) needs a signal path back to the source location. In offices, that would be the owner's desk. In classrooms, that would be teaching station location. In conference rooms, that would be the conference table.

   2. Any floor core drills that will contain AV connections and/or cabling must also have another core drilled under a nearby wall, preferably the wall where the display will be installed, and preferably with conduit stubbed above-ceiling.

   3. AV shall have dedicated conduits separate from other low-voltage wiring whenever possible.
   4. Any conduit that feeds AV low-voltage cabling to a display shall be at least ¾" in diameter.

   5. Classroom connection boxes shall have two 1 ½" conduits stubbed out above-ceiling.

G. Designer is responsible for verifying and accounting for heat load added to spaces by types and sizes of equipment specified for use.

2. PRODUCTS.
   A. Smaller spaces (with 49 or fewer seats) shall use Extron control systems in accordance with campus Learning Spaces standards.

   B. Larger classrooms and other large venues shall use QSYS control systems.

   C. Sony cameras that feed the AV systems (i.e., for non-security purposes) are preferred.

   D. Samsung monitors and TVs are preferred.

   E. Epson projectors and Dalite screens are preferred.

F. Chief projector mounts are preferred.

G. Middle Atlantic racks and Spectrum lecterns are preferred.

3. EXECUTION.
   A. For capital projects, campus will generally purchase AV equipment and installation off an approved contract using the moveable equipment budget. Designers and General Contractors shall provide infrastructure such as cabling and conduit, power, and data as part of the construction documents and cost.

SECTION 27 53 13 CLOCK SYSTEM

1. GENERAL.
   A. The University operates a Primex Wireless GPS Synchronized Clock System.

   B. Infrastructure for clock system shall be included in renovation and new construction projects where required.

   C. Each classroom, auditorium, and laboratory should have a clock connected to the campus system. Exact location TBD by department.

   D. Existing clocks will be removed and stored by TTU prior to Notice to Proceed.

   E. After project completion, clocks will be reinstalled by TTU.

2. PRODUCTS.
   A. All clocks, either plug-in or battery operated, shall be manufactured by Primex or operational on the Primex Wireless GPS Synchronized System.