

SECTION 270526

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL GUIDELINES

1.1 SUMMARY

- A. This Section defines the general design requirements for a uniform Telecommunications Grounding and Bonding infrastructure that shall be followed for all OFCC Technology construction projects.
 - 1. Refer to Section 8500, Technology Systems, and Section 8600, Electrical Systems, for additional information.

1.2 SECTION INCLUDES

- A. Telecommunications Main Grounding Busbar (TMGB)
- B. Telecommunications Grounding Busbar (TGB)
- C. Telecommunications Bonding Backbone (TBB) – **optional**.

1.3 QUALITY ASSURANCE

- A. All equipment shall be UL listed.
- B. All equipment and Installation Practices shall comply with the latest ANSI/NFPA-70 National Electric Code.
- C. All equipment Installation Practices shall comply with the Local Electric Code.
- D. All equipment Installation Practices shall comply with the latest ANSI/TIA/EIA-758 Customer Owned Outside Plant Standard.
- E. All equipment shall comply with the latest ANSI-J-STD-607 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications Standard.
- F. All equipment and Installation Practices shall comply with the latest BICSI Telecommunications Distribution Methods Manual (TDMM).

1.4 TELECOMMUNICATIONS BONDING AND GROUNDING (EARTHING)

- A. **All telecommunications spaces to be provided with the required bonding and grounding equipment including Entrance Facility (EF), Main Equipment Room (MER), Telecommunication Rooms (TR) and Telecommunications Enclosure (TE).**
- B. **Provide complete systems including ground bars, bonding backbones, bonding conductors, termination hardware and labeling.**
- C. **Grounding system to be tested and documented per manufacturer's instructions.**
- D. **Telecommunications Grounding shall be employed to include the following at a minimum:**
 - 1. **Primary and secondary entrance protectors.**
 - 2. **Cable Trays**

3. **Ladder rack and other metallic cable management systems within telecommunications spaces.**
4. **Equipment racks and cabinets**
5. **Conduit/firestop assemblies penetrating telecommunications spaces wall and floors.**

1.5 TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB)

- A. Provide Telecommunications Main Grounding Busbar (TMGB) in Main Equipment Room (ER).
- B. All TMGB Connections to be made with double-bolted, Compression style, Grounding Lugs.

1.6 TELECOMMUNICATIONS GROUNDING BUSBAR (TGB)

- A. Provide Telecommunications Grounding Busbar (TGB) in all Telecommunications Rooms (TRs) and AV Equipment Cabinets.
- B. All TGB Connections to be made with double-bolted, Compression style, Grounding Lugs.

1.7 TELECOMMUNICATIONS BONDING BACKBONE (TBB) – OPTIONAL

- A. Provide Telecommunications Bonding Backbone (TBB) between all TGBs and the TMGB.
- B. All TBB Connections to be made with double-bolted, Compression style, Grounding Lugs.
- C. **Where a TBB is provided, install in accordance with BICSI Telecommunications Design Method Manual.**

1.8 GROUNDING/BONDING CONDUCTORS

- A. All Grounding and bonding conductors shall be copper and may be insulated. When Conductors are insulated, they shall be listed for the application. The minimum bonding conductor shall be No. 6 AWG.

1.9 INSTALLATION

- A. As a minimum, Bond TMGB to following:
 1. Building Steel, (minimum No. 2 AWG insulated copper bonding conductor). CAD Weld Bonding Conductors to Building Steel.
 2. Main Electrical Service Grounding Electrode System (minimum No. 2 AWG insulated copper bonding conductor).
 3. Local Service Panel Ground (minimum No. 6 AWG insulated copper bonding conductor).
 4. Telecommunications Bonding Backbone (TBB) that connects TMGB to other TGBs (**size per BICSI TDMM**) – optional.
 5. Associated Telecommunications Cable Tray(s) (continuous No. 6 AWG bare copper bonding conductor connecting all Cable Tray Sections).
 6. Telecommunications Conduit(s) Entering TR (minimum No. 6 AWG insulated copper bonding conductor).
- B. As a minimum, Bond TGB to following:
 1. Building Steel, (minimum No. 2 AWG insulated copper bonding conductor). CAD Weld Bonding Conductors to Building Steel.
 2. Local Service Panel Ground (minimum No. 6 AWG insulated copper bonding conductor).
 3. Telecommunications Bonding Backbone (TBB) that connects TGB to other TGBs and TMGB (**size per BICSI TDMM**) - Optional.

4. Associated Telecommunications Cable Tray(s) (continuous No. 6 AWG bare copper bonding conductor connecting all Cable Tray Sections).
5. Telecommunications Conduit(s) Entering TR (minimum No. 6 AWG insulated copper bonding conductor).

END OF SECTION

SECTION 271100

COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL GUIDELINES

1.1 GENERAL

- A. This Section defines the general design requirements for a uniform Communications Room Infrastructure that shall be followed for all OFCC Technology construction projects.
 - 1. Communications Rooms consist of:
 - a. Entrance Facility (EF)
 - b. Main Equipment Room (MER)
 - c. Telecommunication Rooms (TR)
 - d. Telecommunications Enclosure (TE)
- B. Refer to Section 8500, Technology Systems, and Section 8600, Electrical Systems, for additional information.

1.2 SECTION INCLUDES

- A. Entrance Facility (EF)
- B. Main Equipment Room (MER)
- C. Telecommunication Rooms (TR)
- D. Telecommunications Enclosure (TE)
- E. Equipment Backboards
- F. Equipment Racks and Cabinets
- G. Cable Ladder and Cable Tray
- H. QUALITY ASSURANCE

- 1. All equipment shall be UL listed.
- 2. All equipment and Installation Practices shall comply with the latest ANSI/NFPA-70 National Electric Code.
- 3. All equipment Installation Practices shall comply with the Local Electric Code.
- 4. All equipment shall comply with the latest ANSI-J-STD-607 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications Standard.
- 5. All equipment and Installation Practices shall comply with the latest BICSI Telecommunications Distribution Methods Manual (TDMM).
- 6. All equipment Racks and Cabinets shall comply with the latest ANSI/EIA-310 Cabinets, Racks, Panels and Associated Equipment Standard.

I. MAIN EQUIPMENT ROOM (MER) GENERAL

- 1. Each Building shall be equipped with a MER.
- 2. Location of MER to be determined with the goal of minimizing backbone cabling runs, providing accessibility to cabling pathways, serving as a TR for a large quantity of local outlets, and being able to incorporate incoming service entrance conduits.
- 3. Extend Service Entrance Conduits from the Entrance Facility (EF) to the MER
 - a. Note – To control costs, consider incorporating the EF into the MER overall space.

4. The MER shall be adequately sized to house the core networking, telephony, security, and distributed services equipment, along with provisions for local TR functionality, with sufficient clearances around racks and cabinets to meet BICSI standards, and floor space for 20% future growth.
5. Orientation and configuration of room shall accommodate required airflow and cooling requirements as dictated by rack/cabinet design.
6. Room shall include sufficient horizontal and vertical cable management systems (cable tray, ladder rack, fiber duct, etc.).
7. Provide fixed cabling pathways (cable tray or conduit) from the MER to the EF and each TR/TE. Cabling pathways to be sized based upon the cable requirements and a 50% utilization factor for the completed design.

J. TELECOMMUNICATION ROOM (TR)/(TE) GENERAL

1. Provide TR/TE as required to serve local outlets and maintain no more than 90m maximum cable lengths to all Category rated cabled outlets. TR/TE locations should be chosen to minimize total number of spaces required.
2. The preference is to utilize full TR spaces with building walls and a secure door. Where space is not available, a TE may be utilized within a shared space such as a storage room or mechanical space. Careful consideration must be given to security, cooling, power, and accessibility to cabling pathways when utilizing TE for cabling connectivity.
3. BICSI standards suggest providing a minimum of at least 1 TR per floor, with stacking preferred in multi-story buildings.
4. The TR/TE shall be adequately sized to house the local cabling termination, security, network and telephony equipment, with sufficient clearances around racks and cabinets to meet BICSI standards.
5. Orientation and configuration of room shall accommodate required airflow and cooling requirements as dictated by rack/cabinet design.
6. Room shall include sufficient horizontal and vertical cable management systems (cable tray, ladder rack, fiber duct, etc.).
7. Provide fixed cabling pathways (cable tray or conduit) to the MER and to adjacent TR/TE spaces within the same floor. Cabling pathways to be sized based upon the cable requirements and a 50% utilization factor for the completed design.

K. MER AND TR REQUIREMENTS

1. ***Discuss design requirements and space allocation during initial programming meetings with Architect and Owner.***
2. All Telecommunications Rooms are to be open to the deck above.
3. The MER and TR shall be rectangular in shape and shall avoid curved surface or non-perpendicular angled walls. Walls shall be constructed to be continuous up to the deck.
4. Consolidate multiple floors and serving areas into a single TR whenever possible. For example, a centrally located TR on the 2nd floor could also serve the 1st and 3rd floor.
5. The MER and TR shall have floor finishes that are statically neutral (such as polished concrete)
6. The MER and TR shall have at least one lockable door that opens outward and has minimum dimensions of 3 feet (0.91 m) wide by 6.7 feet (2.0 m) tall.
7. Provide each MER and TR with an HVAC system that maintains continuous environmental control 24 hours per day, 365 days per year. Mechanical system shall provide slight positive pressure to room to avoid collection of duct/debris from building spaces surrounding the TR/MER. Maintain temperature between 64° F (18° C) to 75° F (24° C). Maintain relative humidity between 30% and 55% -- non-condensing.
8. Arrange lighting to provide adequate illumination levels in vertical footcandles on the front and rear of the rack mounted equipment. Avoid lighting designs that place fixtures directly over the racks/cabinets. Provide a minimum of 500 lux (50-foot candles of uniform lighting when measured at 3 feet AFF with vertical footcandles no less than 40% of the horizontal. Provide 10% minimum uplighting in the space.

9. Provide Telecommunications Grounding Systems
10. Provide the following minimum clearances:
 - a. Minimum of 40 in. (1 m) between equipment racks and the front of cross-connect fields.
 - b. Allow a minimum of 6 in. (150 mm) from the wall for wall-mounted equipment.
 - c. Minimum of a 40 in. (1 m) aisle in front of and behind all equipment racks and cabinets.
 - d. Minimum of 36 in. (0.91 m) floor area depth for equipment racks and cabinets.
11. Provide sufficient Generator Electrical circuits to service the associated UPS units.
12. Power all active devices from UPS units, which are connected to the Building generator.
13. Use light colored walls to enhance lighting.
14. MER and TR spaces to be free from water piping (with the exception of sprinkler branches feeding heads within the room). This includes no water, drain, storm, sanitary, waste, condensate, steam, sprinkler mains, etc.

L. EQUIPMENT BACKBOARDS

1. Cover at least two (2) walls with AC grade or better, void free $\frac{3}{4}$ in. (19 mm) plywood at least 8 feet (2.4 m) high.
2. Place the grade C surface towards the wall and coat the plywood with two coats of fire-retardant white paint or provide FT plywood with paint not covering the FT label.

M. EQUIPMENT RACKS

1. Utilize a combination of server grade cabinets, deep equipment cabinets, 4-post racks and 2-post relay racks as required to support the telecommunications equipment.
2. Equipment racks and cabinets shall have full height vertical cable organizers on both the left and right sides.
3. Equipment racks and cabinets shall be provided with rear vertical cable organizers on both the left and right sides.
4. Consider the use of horizontal cable manager panels to organize and route associated patch cabling.
5. 4-post Equipment racks are the preferred enclosure for equipment that is deep, heavy, or requires additional security.
6. Equipment racks and cabinets are to be configured with appropriate ventilation options to accomplish the designed cooling configuration for the space.
7. All equipment racks and cabinets shall be UL listed, and where required, seismically braced.
8. All racks/cabinets shall be provided with labeling including name of MER/TR, Room number, and an identifier to indicate position within room.

N. CABLE LADDER AND CABLE TRAY

1. Utilize overhead cable management systems in the MER and each TR. Cable management system can consist of any combination of ladder rack, wire mesh cable tray per fiber duct.
2. Overhead cable management shall include wall mounted and over racks/cabinets.
3. **All locations where cabling transitions out to wall mounted or rack mounted equipment, provide waterfall support structure to assure proper cable bend radius.**

O. GENERAL

1. All racks/cabinets, patch panels, cables, jacks, system components, etc. shall be labeled according to ANSI/EIA/TIA-606 specifications and in coordination with the District/Architect.
2. Coordinate the location of lighting equipment so that fully loaded cable trays and ladder do not impede or obstruct the lighting.

3. Coordinate the location of the HVAC equipment to avoid the following:
 - a. No water piping or drip pans located over racks/cabinets or active electronics that are wall mounted.
 - b. No mechanical equipment which requires servicing located over racks/cabinets where access to equipment would be compromised.

END OF SECTION

SECTION 271313

COMMUNICATIONS COPPER BACKBONE CABLING

PART 1 - GENERAL GUIDELINES

1.1 GENERAL

- A. This Section defines the general design requirements for a uniform Intra and Inter-Building Communications Copper Backbone Cabling Infrastructure that shall be followed for all OFCC Technology construction projects.
1. Refer to Section 8500, Technology Systems, and Section 8600, Electrical Systems, for additional information.

1.2 SECTION INCLUDES

A. INTRA-BUILDING COPPER BACKBONE CABLE SYSTEMS

1. Main Equipment Room (MER) to Telecommunication Rooms (TR) Voice Backbone Cable System.
2. Main Equipment Room (MER) to Telecommunication Rooms (TR) Data Backbone Cable System.
3. Entrance Facility (EF) to Main Equipment Room (MER) Voice Backbone Cable System.
4. Entrance Facility (EF) to Main Equipment Room (MER) Data Circuit Backbone Cable System.

B. INTER-BUILDING COPPER BACKBONE CABLE SYSTEMS

1. Main Equipment Room (MER) to Main Equipment Room (MER) Voice Backbone Cable System.

1.3 QUALITY ASSURANCE

- A. All equipment shall be UL listed.
- B. All equipment and Installation Practices shall comply with the latest ANSI/NFPA-70 National Electric Code.
- C. All equipment Installation Practices shall comply with the Local Electric Code.
- D. All equipment shall comply with the latest ANSI-J-STD-607 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications Standard.
- E. All equipment and Installation Practices shall comply with the latest BICSI[®] Telecommunications Distribution Methods Manual (TDMM) and BICSI[®] Customer-Owned Outside Plant Design Manual.
- F. All equipment shall comply with the latest ANSI TIA/EIA-568, 569, 606, 607, Standards.
- G. All Inter-Building cabling shall comply with the latest ANSI/TIA/EIA-758. Customer-Owned Outside Plant Telecommunications Cabling, Standard, as applicable.
- H. All Inter-Building cabling shall comply with the latest ANSI/ICEA S-98-688. Broadband Twisted-Pair, Telecommunications Cable Aircore, Polyolefin Insulated Copper Conductors, Standard, as applicable.

- I. All Inter-Building cabling shall comply with the latest ANSI/ICEA S-99-689. Broadband Twisted-Pair, Telecommunications Cable Filled, Polyolefin Insulated Copper Conductors, Standard, as applicable.

1.4 WARRANTY

- A. ***Voice grade backbone shall carry a standard contractors 3 year warranty. Data grade backbone system shall carry an industry standard, performance based warranty, by the manufacturer and contractor, for a period of at least 20 years on the complete cabling system; including patch panels, patch cables, terminations and labor. The remaining portions of the system shall be warranted for a period of three (3) years from date of substantial completion.***

1.5 INTRA-BUILDING COPPER BACKBONE CABLE SYSTEMS

A. MAIN EQUIPMENT ROOM (MER) TO TELECOMMUNICATION ROOMS (TR) VOICE BACKBONE CABLE SYSTEM

1. For projects with full IP telephony, voice backbone cabling shall be minimal to support the small number of analog phone devices that may be served from TR/TE spaces. The designer shall size voice grade backbone cabling based upon the realistic needs of the equipment being provided.
2. Terminate voice grade backbone cables on either wall mounted 110 Blocks using C-4 Clips or **Cat-6**, rack-mounted, patch panels.

B. MAIN EQUIPMENT ROOM (MER) TO TELECOMMUNICATION ROOMS (TR) DATA CIRCUIT BACKBONE CABLE SYSTEM – OPTIONAL

1. Where cabling distance is under the 90m length limitation for category rated cabling, consider an option to provide four-pair, **Cat-6/6A** cables for extension of data grade circuits in lieu of utilizing fiber optics.
2. Terminate the cables on **Cat-6/6A**, rack-mounted, Patch panels at each end.

C. ENTRANCE FACILITY (EF) TO MAIN EQUIPMENT ROOM (MER) VOICE BACKBONE CABLE SYSTEM

1. Separate Entrance Facilities (EF) are generally encountered during renovations to existing buildings and are not recommended for new construction. For new construction, co-locate the Entrance Facility (EF) in the Main Equipment Room (ER).
2. When the Entrance Facility is not co-located in the Main Equipment Room (ER), provide a multi-pair CAT-3 Voice Backbone system between the EF and the ER, for the extension of voice, FAX and alarm circuits provided by the Service Provider (SP).
3. Designer to review the phone company cable plant and match pair count.
4. Terminate LEC Feeder, cables on wall mounted 110 Blocks using C-5 Clips or Category 6 rated rack mounted patch panel in the MER.

D. ENTRANCE FACILITY (EF) TO MAIN EQUIPMENT ROOM (MER) DATA CIRCUIT BACKBONE CABLE SYSTEM

1. When the Entrance Facility is not co-located in the Main Equipment Room (MER), consider providing data grade four-pair, **Cat-6/6A** cables between the EF and the MER for the extension of special circuits (T-1, PRI, etc.) provided by the Service Provider (SP).
2. Terminate the cables on a **Cat-6/6A**, wall-mounted, Patch panel at the EF end and on a **Cat-6**, wall-mounted or rack-mounted patch panel at the MER end.

1.6 INTER-BUILDING COPPER BACKBONE CABLE SYSTEMS

- A. MAIN EQUIPMENT ROOM (MER) TO MAIN EQUIPMENT ROOM (MER) VOICE BACKBONE CABLE SYSTEM
 - 1. When multiple School Buildings are located on the same campus, and served by a common IP-Enabled Phone System, provide a multi-pair, under-ground or aerial telecommunications cable between the MER or EF of the building containing the common Phone System and the MER or EF of each of the associated satellite buildings.
 - 2. Pair count of voice grade backbone to be determined by services required in each building.
 - 3. When the School has an all-IP Phone System, the multi-pair inter-building Voice Backbone is optional. In cases where only one Service Provider DEMARC is provided per campus, provide an inter-building Voice Backbone cable for 911 backup and alarm circuits.
 - 4. Terminate the inter-building cables on Protected Entrance Terminals (PETs) / at both ends.
 - 5. Provide Gas-Tube Protector Modules for all pairs at both ends.
 - 6. Ground the Cable sheath and the PET to the associated Telecommunications Main Grounding Bus (TMGB) at both ends.
 - 7. Depending on the application, provide metal protective sheaths and appropriate rodent protection devices for aerially installed Telecommunications cables.

1.7 INSTALLATION

- A. All cabling shall be installed according to ANSI/EIA/TIA specifications and BISCII standards.
- B. All **Cat-6/6A** cabling shall be terminated on **Cat-6/6A** patch panels and jacks as noted above.
- C. All system multi-pair voice backbone cabling shall be terminated on **Cat-6** (minimum) patch panels or 110 style punch blocks as noted above.
- D. Provide designated space on Telecommunications Backboard for location of Access Provider's (AP's) Service Entrance Cable Termination and Protection Point.

1.8 LABELING

- A. All racks, patch panels, cables, jacks, system components, etc. shall be labeled according to ANSI/EIA/TIA-606 specifications and in coordination with the District/Architect.
- B. All cables shall be equipped with a self-laminating, wrap-around, machine printed label at both ends of the cable.
- C. All Patch Panels shall be equipped with pre-printed, cable identification designation strips installed behind clear plastic label holders on the front of the patch panel.

1.9 TESTING

- A. All **Cat-6/6A** backbone cables shall be tested to **Cat-6/6A** performance levels in accordance with ANSI/TIA/EIA-568-B.2 (or latest) specifications, using a Level III compliant tester.
- B. All multi-pair, backbone cables shall be tested to Cat-3 (minimum) performance levels in accordance with ANSI/TIA/EIA-568-B.2 (or latest) specifications, using a Level III compliant tester.
- C. All multi-pair, inter-building backbone cables shall be tested to Cat-3 (minimum) performance levels in accordance with ANSI/TIA/EIA-568-B.2 (or latest) specifications, using a Level III compliant tester.

- D. All Cable test results shall be stored and presented to the Architect in both hard copy and electronic format for approval.
- E. All Cable Tester record designations shall match the associated cable label, and associated patch panel or 110-block label designation.

END OF SECTION

SECTION 271323

COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL GUIDELINES

1.1 GENERAL

- A. This Section defines the general design requirements for a uniform Intra and Inter-Building Communications Optical Fiber Backbone Cabling Infrastructure that shall be followed for all OFCC Technology construction projects.
 - 1. Refer to Section 8500, Technology Systems, and Section 8600, Electrical Systems, for additional information.

1.2 SECTION INCLUDES

- A. INTRA-BUILDING OPTICAL FIBER BACKBONE CABLE SYSTEMS
 - 1. Main Equipment Room (MER) to Telecommunication Rooms (TR) Fiber Optic Backbone Cable System
- B. INTER-BUILDING OPTICAL FIBER BACKBONE CABLE SYSTEMS
 - 1. Main Equipment Room (MER) to Main Equipment Room (ER) Optical Fiber Backbone Cable System
- C. OPTICAL FIBER PATCH PANEL SYSTEMS
 - 1. Optical Fiber Patch Panels
 - 2. Optical Fiber Connectors
 - 3. Optical Fiber Splice Trays

1.3 QUALITY ASSURANCE

- A. All equipment shall be UL listed.
- B. All equipment and Installation Practices shall comply with the latest ANSI/NFPA-70 National Electric Code.
- C. All equipment installation practices shall comply with the local electric code.
- D. All equipment shall comply with the latest ANSI-J-STD-607 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications Standard.
- E. All equipment and Installation Practices shall comply with the latest BICSI[®] Telecommunications Distribution Methods Manual (TDMM) and BICSI[®] Customer-Owned Outside Plant Design Manual.
- F. All equipment shall comply with the latest ANSI TIA/EIA-568, 569, 606, 607, standards.
- G. All 62.5 micron, multi-mode fiber equipment shall comply with the latest American National Standards Institute/Telecommunications Industry Association/Electronic Industries Alliance Specification ANSI/TIA/EIA-492AAAA. Detail Specification for 62.5- μ m Core Diameter/125- μ m Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers. Note: 62.5 micron is only for legacy systems.

- H. All 50 micron, multi-mode equipment shall comply with the latest American National Standards Institute/Telecommunications Industry Association/Electronic Industries Alliance Specification ANSI/TIA/EIA-492AAAB. Detail Specification for 50- μ m Core Diameter/ 125- μ m Cladding Diameter Class 1a Multimode Graded-Index Optical Waveguide Fibers. 50 micron fiber shall be OM4 laser optimized with support for 10 GB serial at 500m.
- I. All single-mode equipment shall comply with the latest American National Standards Institute/Telecommunications Industry Association/Electronic Industries Alliance Specification ANSI/TIA/EIA-492CAA. Detail Specification for Class IVa Dispersion—Unshifted Single-Mode Optical Fibers.

1.4 SYSTEM WARRANTY

- A. System shall carry an industry standard, performance based warranty, by the manufacturer and contractor, for a period of at least 20 years on the Optical Fiber cabling; including patch panels, patch cables, terminations and labor. The remaining portions of the system shall be warranted for a period of **three (3) years** from date of substantial completion.

1.5 INTRA-BUILDING OPTICAL FIBER BACKBONE CABLE SYSTEMS

A. MAIN EQUIPMENT ROOM (MER) TO TELECOMMUNICATION ROOMS (TR) OPTICAL FIBER BACKBONE CABLE SYSTEM

1. GENERAL

- a. Provide a multi-mode and single-mode Optical Fiber Backbone System for all new and renovated Buildings when the building contains more than one (1) Telecommunications Closet.
- b. Replace or supplement existing Optical Fiber Backbone Systems to the requirements contained herein.
- c. New Buildings and Building Additions - All new fiber backbone cabling to be routed in fixed communications raceways (cable tray or conduit) from MER to each TR/TE. Fiber to be either armored or run in an innerduct. Riser or plenum rated as required.
 - 1) Cabling run in underground pathways to be dual indoor/outdoor, and plenum/riser as required.
- d. Existing Buildings – Where existing fixed pathways are not available and new fixed pathways will not be installed, utilize armored fiber.

2. MULTI-MODE OPTICAL FIBER CABLE

- a. Provide a Multi-Mode, Optical Fiber Cable between the Main Equipment Room and each associated Telecommunications Room (TR/TE).
- b. The Multi-Mode, Optical Fiber cable shall be 50/125, OM4 micron laser optimized fiber.
- c. The Optical Fiber cable shall be sized so that the strand usage at the completion of the project is no more than 50%.The fiber count shall be no less than 6 strand.
- d. The Multi-Mode fibers shall be terminated with fusion-spliced, factory-polished, SC or LC Pigtails or pre-terminated backbone fiber with associated fiber cassettes.
- e. Classroom fibers are not supplied for new construction; however, for existing construction (renovations), the fibers may be terminated with epoxy cured, field-terminated, SC or LC Connectors.

3. SINGLE-MODE OPTICAL FIBER CABLE

- a. Provide a Single-Mode, Optical Fiber Cable between the Main Equipment Room (MER) and each associated Telecommunications Room (TR/TE).
- b. The Single-Mode, Fiber Optic cable shall be **OS2** 8/125 micron fiber.
- c. The Optical Fiber cable shall be sized so that the strand usage at the completion of the project is no more than 50%.The fiber count shall be no less than 6 strand.
- d. The Single-mode fibers shall be terminated with fusion-spliced, factory-polished, SC or LC Pigtails or pre-terminated backbone fiber with associated fiber cassettes capable of 10 Gbps operation.

- e. Angle-Polished Connectors (APC) shall be utilized on all Single-mode fibers used to support broadband RF (CATV, DAS, etc.) applications.

1.6 INTER-BUILDING OPTICAL FIBER BACKBONE CABLE SYSTEMS

A. MAIN EQUIPMENT ROOM (ER) TO MAIN EQUIPMENT ROOM (ER) INTER-BUILDING OPTICAL FIBER BACKBONE CABLE SYSTEM

1. GENERAL

- a. Provide a single-mode Optical Fiber Backbone System between all buildings on the same campus.
- b. Provide an optional, multi-mode Optical Fiber Backbone System between all buildings on the same campus that are less than 250 meters between building MERs.
- c. Utilize indoor/outdoor rated fiber to eliminate the need for transition points. Utilize armored fiber for any runs which have a segment not installed in a fixed pathways (cable tray or conduit).
- d. Upgrade existing Optical Fiber Backbone Systems to the following requirements.

2. MULTI-MODE OPTICAL FIBER CABLE – OPTIONAL

- a. Provide an optional Multi-Mode, Optical Fiber Cable between the Main Equipment Room (MER) of the Network Center and each associated Building's Main Equipment Room (ER).
- b. The Multi-Mode, Optical Fiber cable shall be 50/125, OM4 micron laser optimized fiber.
- c. The Multi-Mode, Optical Fiber cable shall be a minimum 12 strands between buildings -- MER to MER.
- d. The Multi-Mode fibers shall be terminated with fusion-spliced, factory-polished, SC or LC Pigtails or pre-terminated backbone fiber with associated fiber cassettes.

3. SINGLE-MODE OPTICAL FIBER CABLE

- a. Provide a Single-Mode, Optical Fiber Cable between the Main Equipment Room (MER) of the Network Center and each associated Building's Main Equipment Room (MER).
- b. The Single-Mode, Fiber Optic cable shall be an **OS2** 8/125 micron fiber.
- c. The Single-Mode, Optical Fiber cable shall be a minimum 12 strands between buildings -- MER to MER.
- d. The Single-mode fibers shall be terminated with fusion-spliced, factory-polished, SC or LC Pigtails or pre-terminated backbone fiber with associated fiber cassettes capable of 10 Gbps operation.
- e. Angle-Polished Connectors (APC) shall be utilized on all Single-mode fibers used to support broadband RF (CATV, DAS, etc.) applications.

1.7 OPTICAL FIBER PATCH PANEL SYSTEMS

A. OPTICAL FIBER PATCH PANELS

- 1. Rack mounted fiber shall utilize panels with integral splice storage shelves.

B. OPTICAL FIBER CONNECTORS

- 1. Terminate Multi-Mode fibers with factory-terminated SC or LC multi-mode fusion splice pigtails. Match fiber cable type provided.
- 2. Terminate Single-Mode fibers with factory-terminated SC or LC single-mode fusion splice pigtails. Match fiber cable type provided.

C. OPTICAL FIBER SPLICE TRAYS (Fusion Splice Pigtails)

1. Provide Optical Fiber Fusion Splice Trays for connecting the factory-terminated, SC or LC pigtails to the associated Multi-Mode and Single-Mode fibers.

1.8 INSTALLATION

- A. All cabling shall be installed according to ANSI/EIA/TIA specifications and BISCII standards.
- B. Provide space in rack (min 3 units) for possible District or DA-Site-provided, inter-building Optical Fiber Cable Patch Panel.

1.9 LABELING

- A. All racks, patch panels, cables, jacks, system components, etc. shall be labeled according to ANSI/EIA/TIA-606 specifications and in coordination with the District/Architect.
- B. All Optical Fiber cables shall be equipped with a self-laminating, wrap-around, machine printed label at both ends of the cable.
- C. All Optical Fiber Patch Panels shall be equipped with pre-printed, cable identification designation strips installed behind clear plastic label holders on the front of the patch panel.

1.10 TESTING

- A. Utilize OLTS (Optical Loss Test Set) fiber testing for Intra-Building backbone cabling. Utilize OTDR (Optical Time Domain Reflectometer) bi-directional testing for OSP Inter-Building backbone cabling.
- B. All Cable test results shall be stored and presented to the Architect in both hard copy and electronic format for approval.
- C. All Cable Tester, Record designations shall match the associated cable label, and associated patch panel label designation.

END OF SECTION

SECTION 271513

COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL GUIDELINES

1.1 GENERAL

- A. This Section defines the general design requirements for a uniform Communications Copper Horizontal Cabling System Infrastructure that shall be followed for all OFCC Technology construction projects.
 - 1. Refer to Section 8500, Technology Systems, and Section 8600, Electrical Systems, for additional information.

1.2 SECTION INCLUDES

- A. COMMUNICATIONS COPPER HORIZONTAL CABLING SYSTEM SYSTEMS
 - 1. Modular Jacks
 - 2. Modular Cover Plates
 - 3. Horizontal Cable
 - 4. Modular Patch Panels

1.3 QUALITY ASSURANCE

- A. All equipment shall be UL listed.
- B. All equipment and Installation Practices shall comply with the latest ANSI/NFPA-70 National Electric Code.
- C. All equipment Installation Practices shall comply with the Local Electric Code.
- D. All equipment shall comply with the latest ANSI-J-STD-607 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications Standard.
- E. All equipment and Installation Practices shall comply with the latest BICSI[®] Telecommunications Distribution Methods Manual (TDMM).
- F. All equipment shall comply with the latest ANSI TIA/EIA-568, 569, 606, 607, 862, standards.
- G. All connecting equipment shall be from the same manufacturer.

1.4 SYSTEM WARRANTY

- A. System shall carry an industry standard, performance based warranty, by the manufacturer and contractor, for a period of at least 20 years on the horizontal cabling; including patch panels, patch cables, terminations and labor. The remaining portions of the system shall be warranted for a period of **three (3) years** from date of substantial completion.

1.5 MODULAR JACKS

- A. Each 4-pair 100-ohm twisted pair data cable shall be terminated in a matching category rated modular jack at the Telecommunications Outlet (TO). Shielded solutions shall be continuous through the jack.

- B. The data cable shall be terminated directly to the modular jack with insulation displacement connectors.
- C. The modular jack pair/pin assignments shall be as coordinated with the Owner.

1.6 COVER PLATES

- A. Cover plates for voice/data connectivity shall be modular plates with snap-in connectors, field removable, front loading. The use of straps under standard faceplates is not acceptable.
- B. Faceplates should be of same material and finish as adjacent electrical outlet faceplates.
- C. Wall mounted phones shall utilize faceplates with wall phone mounting provisions.
- D. Faceplates shall have permanent locations for label strips and jack icons.

1.7 HORIZONTAL CABLE

- A. In accordance with ANSI/EIA/TIA 568B & C all horizontal data cable shall be:
 - 1. UL listed, 4-pair 100 ohm, twisted pair Category 6 / Category 6A compliant. Category 6A is recommended for wireless WAP locations only.
 - 2. Cable shall be CMP rated.
 - 3. Consider use of shielded cable based upon application and Owner preference.
- B. Designer to meet with Owner and determine specific needs for structured cabling during programming phase. Wired drop locations should be specifically targeted for discussion. Typical wired drop locations should be considered for the following applications:
 - 1. Fixed walled offices with fixed Computers, copiers, and fax machines.
 - 2. Outlets supporting video displays.
 - 3. IP based CCTV Cameras.
 - 4. Media Presentation Station in Classrooms and Educational Spaces consisting of a fixed Workstation and/or printer.
 - 5. Locations supporting desk top or wall mounted phones.
 - 6. Electrical and Mechanical spaces with monitoring and control equipment.
 - 7. Administrative spaces with fixed multifunction copiers, faxes, printers, etc.
 - 8. Miscellaneous Network Attached Devices
 - 9. Point of Sale Terminals (as required)
 - 10. Wall and ceiling mounted Projectors
 - 11. Security and Access Control Systems
- C. Consider the use of Category 6A cable drops for wireless access points. Single or dual drops to be evaluated based upon requirements of wireless systems being implemented.
- D. Telecommunication outlet/connectors that serve an individual work area may be located in multiple faceplates.

1.8 MODULAR PATCH PANELS

- A. All patch panels shall be in accordance with ANSI/EIA/TIA 568B/C (or latest) and shall be equipped with modular jacks with insulation displacement connectors, rear cable-management bars/standoffs and front label designation strips.
- B. Provide 24 or 48 port, Category rated patch panels for termination of horizontal cabling. Consider the additional configurations:

1. When the Equipment Room (MER) or Telecommunications Room (TR/TE) serves more than one floor, sequentially group the cables by floor on separate patch panels.
 2. Terminate CCTV, WAP and Security data drops on dedicated patch panels.
- C. Provide color-coded patch cords for all connections (WA outlet and patch panel port) (plus 10% spare).

1.9 INSTALLATION

- A. All cabling shall be installed according to ANSI/EIA/TIA specifications and BISCII standards.
- B. All horizontal voice / data cabling shall be terminated on patch panels and jacks as noted above.
- C. Consider providing cable slack at both ends of the horizontal cables to accommodate future cabling system changes.

1.10 LABELING

- A. All patch panels, cables, jacks, system components, etc. shall be labeled according to ANSI/EIA/TIA-606 specifications and in coordination with the Owner/Architect.
- B. All horizontal cables shall be equipped with a self-laminating, wrap-around, machine printed label at both ends of the cable.
- C. All Patch Panels shall be equipped with pre-printed, cable identification designation strips installed behind clear plastic label holders on the front of the patch panel.
- D. All Modular Plates shall be equipped with a pre-printed, cable identification strip, installed behind a clear plastic label holder.

1.11 TESTING

- A. All horizontal cabling shall be tested to Category performance levels in accordance with ANSI TIA/EIA-568-B/C (or latest) specifications, using a Level III compliant tester.
- B. All Cable test results shall be stored and presented to the Architect in both hard copy and electronic format for approval.
- C. All Cable Tester Record designations shall match the associated cable label, patch panel label and faceplate label.

END OF SECTION

SECTION 271543

AUDIO-VIDEO COMMUNICATIONS HORIZONTAL TRANSPORT SYSTEM

PART 1 - GENERAL GUIDELINES

1.1 GENERAL

- A. The baseline A/V system shall utilize digital sources and a mixture of wired and wireless digital transport medium, to various display devices. The Technology Designer shall consider both wired and wireless technologies when developing the A/V transport system design. Coordinate box/conduit infrastructure sizes and routing with the Electrical Designer to support components of the wired A/V transport system.
- B. The use of analog sources and transport medium shall be **legacy only**.
- C. **All new work shall be digital systems.** This Section defines the general design requirements for a uniform Wired Audio-Video Horizontal Transport System Infrastructure that shall be followed for all OFCC Technology construction projects.
- D. Refer to Section 8500, Technology Systems, and Section 8600, Electrical Systems, for additional information.

1.2 SECTION INCLUDES

- A. AUDIO-VIDEO COMMUNICATIONS HORIZONTAL TRANSPORT SYSTEM
 - 1. **General Classroom**
 - 2. **Non-standard Educational Space (ELA, Outdoor Learning Center)**
 - 3. **Public Assembly Space**
 - 4. **Staff Workrooms/Conference Rooms/Collaboration Rooms**

1.3 QUALITY ASSURANCE

- A. All equipment shall be UL listed.
- B. All equipment and Installation Practices shall comply with the latest ANSI/NFPA-70 National Electric Code.
- C. All equipment Installation Practices shall comply with the Local Electric Code.
- D. All equipment shall comply with the latest ANSI-J-STD-607 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications Standard.
- E. All equipment and Installation Practices shall comply with the latest BICSI[®] Telecommunications Distribution Methods Manual (TDMM).
- F. All equipment shall comply with the latest ANSI TIA/EIA-568, 569, 606, 607, 862, standards.

1.4 A/V INTERFACE OUTLETS

- A. Each space with a fixed A/V display shall be provided with a minimum of one (1) wired A/V system input outlet to transport digital and analog (if system design requires) media to the fixed A/V display within that space.

1. Option – Where supported by system design, A/V sources can connect via wireless technologies.
- B. Each space with a fixed A/V display shall be provided with wired A/V digital and analog (if the system design requires) media to the fixed A/V display within that space.
 1. Option – Where supported by system design, A/V displays can connect via wireless technologies.
- C. The A/V wired transport cabling shall utilize the appropriate media to transport digital signals including HDMI, DVI and USB. In addition, where required by Owner/user requirements, the cabling shall be provided to transport analog media such as VGA, RS-232 controls and IR controls.
- D. A/V wired outlets can consist of either direct pass-through A/V cables with modular couplers in a faceplate or electronic outlets which convert the A/V signals for use over a specialized digital A/V cable or HDBaseT format.

1.5 A/V INTERFACE CABLES

A. Digital Video Cables

1. Provide listed factory terminated cabling to support digital format such as DVI, HDMI, Display port and analog formats such as VGA, etc. Cables run exposed above ceilings to be plenum rated.
Note The use of HDMI cables may present specific challenges due to the limited bending radius of the cables, the depth of the outlet boxes, the conduit installation requirements to pull the pre-terminated cables through, and distance limitations on cable performance.

B. Twisted Pair Digital Media Cables

1. Provide listed Category rated, shielded cables per manufacturer's requirements for HDBASET type digital media transport system. Overall system design will determine the termination configuration for the cabling. Consider making terminations modular and quick disconnect should the A/V equipment need to be replaced.

C. Analog Audio and Video Cables

1. Audio - Provide cable as recommended by the manufacturer/solution being specified.
2. Video – Provide as required VGA, Composite, Component video cables along with appropriate connectors.

D. USB Cable

1. Provide either USB or Twisted Pair (based upon length and application) cabling solutions to connect interactive equipment with Teacher Workstation.

1.6 VIDEO COVER PLATES

- A. Plates for outlets with modular connectors shall hA/Ve material and finish match the adjacent electrical outlets.
- B. Custom plates shall be stamped stainless steel, custom engrA/Ved.

1.7 INSTALLATION

- A. Contractor shall provide and install A/V Interface Wiring System.

- B. Cables and associated connectors shall be terminated in accordance with industry standards.

1.8 LABELING

- A. Cables, jacks, system components, etc. shall be labeled according to ANSI/EIA/TIA-606 specifications and in coordination with the District/Architect.
- B. All Audio-Video Cables shall be equipped with a self-laminating, wrap-around, machine printed label at both ends of the cable.

1.9 TESTING

- A. Audio-video Wiring system and associated systems shall be tested end-to-end complete. A record of the testing shall be required to include information about who tested the cable, when it was tested, and a pass/fail result.

END OF SECTION

SECTION 272100

DATA COMMUNICATIONS NETWORK EQUIPMENT

PART 1 - GENERAL GUIDELINES

1.1 GENERAL

- A. This Section defines the general design requirements for a uniform wired Data Communications Network Infrastructure that shall be followed for all OFCC Technology construction projects.
 - 1. Refer to Section 8500, Technology Systems, and Section 8600, Electrical Systems, for additional information.

1.2 SECTION INCLUDES

- A. DATA COMMUNICATIONS NETWORK EQUIPMENT
 - 1. File/Building Server – optional.
 - 2. Network Edge Switches.
 - 3. Network Core Switch.
 - 4. Network Security Equipment.
 - 5. Uninterruptible Power Supplies (UPSs).

1.3 QUALITY ASSURANCE

- A. All equipment shall be UL listed.
- B. All equipment and Installation Practices shall comply with the latest BICSI[®] Telecommunications Distribution Methods Manual (TDMM).

1.4 SYSTEM WARRANTY

- A. ***The Local Area Network Electronics and software shall be fully warranted for three (3) years from date of substantial completion by the contractor and manufacturer. If any defects are found within this warranty period, the defective system component shall be replaced at no extra cost to the Owner for parts or labor. Provide a statement of this warranty with the O&M manuals and to the Director of IT. Make available a service contract offering continuing factory authorized service of this system after the initial warranty period.***

1.5 GENERAL

- A. Each Building shall be provided with a wired Local Area Network (LAN) System and access to the District Wide Area Network (WAN).
- B. Existing Facilities that are being remodeled shall be upgraded to the current requirements stated herein.
- C. Single Building projects shall be compatible with the existing District Network infrastructure.
- D. Wide Area Network (WAN) Interfaces shall be provided to interface the District's WAN provider. Coordinate WAN requirement with the District's fiber provider or DA-Site as applicable.

- E. Buildings shall be designed as to minimize the quantity of Telecommunications Rooms and to centralize as much of the Data Network Equipment as possible.
 - F. Multiple buildings on the same campus should be designed to share common Data Network Electronics and equipment wherever possible.
 - G. Districts should design their Data Networks to take advantage of Centralization of Common Network Equipment at a Network Operations Center(s).
 - H. Items that should be centralized include:
 - 1. File/Building Servers.
 - 2. Layer 3 Routing Devices.
 - 3. Network Management Equipment.
 - 4. Network Security Devices, Radius Servers, etc.
 - 5. WAN access equipment.
 - 6. Wireless Management Equipment.
 - I. The Network design professional is encouraged to consider the following minimum list of systems to support on a Local and Wide Area basis:
 - 1. Automation Systems.
 - 2. Clock Systems.
 - 3. Control Systems.
 - 4. Data Networking.
 - 5. Security Systems (Access Control, CCTV, Alarms).
 - 6. Video Conferencing.
 - 7. Video Streaming/Media Retrieval/Digital Signage.
 - 8. VoIP Telecommunications.
 - 9. Wireless Access Points.
- 1.6 FILE/BUILDING SERVER – Optional (Coordinate need with district)
- A. Provide Network File/Building Server for the central administration and storage of computer files and information. The Networked Server shall be of a current design criteria, and provided with resources appropriate for its task.
 - B. Provide Operating System and virtualization platform based on District requirements.
- 1.7 NETWORK EDGE SWITCHES
- A. Provide Layer 2, IPv4/6 Manageable Ethernet Switches with ports in a quantity to support full number of terminated cables within each TR, with 10% spare ports (no less than 24 spare ports in any given telecommunications room).
 - B. Switches shall utilize minimum 1GB ports for work area connectivity. Provide a configuration of switch ports utilizing either stackable edge switches or a modular chassis with single engine and dual PS.
 - 1. Chassis mounted units are acceptable for Edge Switches, provided that dual power supplies and equivalent uplink bandwidth is supplied.
 - C. The switches shall be “non-blocking” and support a minimum forwarding bandwidth equal to the number of switch ports x 1 Gbps.
 - D. Utilize minimum 10GB uplinks for all uplinks.

1. Switch Stacks – Provide uplink capable of supporting full capacity of stacking backplane.
 2. Switch Chassis – Provide uplink capable of supporting full capacity of switch backplane.
- E. The Network switches shall support advanced services such as:
1. IP Telephony.
 2. Wireless Access Points.
 3. Building Management Systems.
 4. Video Streaming.
 5. IP CCTV/Access Control.
- F. All workgroup switch ports shall be rated to provide POE+. Designer to select switch power supplies based upon port utilization of PoE terminal devices.
- G. The switches shall support the following minimum features and specifications:
1. Access Control Lists (ACL).
 2. Advanced QoS.
 3. IEEE 802.1D Spanning Tree Protocol.
 4. IEEE 802.1p CoS Prioritization.
 5. IEEE 802.1Q VLAN.
 6. IEEE 802.1s.
 7. IEEE 802.1w.
 8. IEEE 802.1x.
 9. IPv6.
 10. Rapid Spanning Tree.
 11. Rate Limiting.
 12. RMON I and II standards.
 13. SNMPv1, SNMPv2c, and SNMPv3.

1.8 NETWORK CORE SWITCH

- A. Provide a Layer-3 ethernet routing switch with advanced QoS to serve the entire building or campus. The Core switch shall be provided with backplane capacity to provide full non-blocking support of all installed line cards plus 15% growth.
- B. Equip the Central Layer-3 switch with a minimum of two (2) Power Supplies. Where core switch is a modular chassis with removable processing engines, provide as Redundant Central Control/Supervisor Unit.
- C. For modular chassis based switches, switch blades must support full line speed and shall not be over-subscribed.
- D. Provide sufficient Ports on the Layer-3 Core Switch, as a minimum, for the following devices:
1. Provide Network Switch uplink ports to support all edge switches plus 15% spare. The switch shall have at least one spare uplink card for redundancy.
 2. Building Automation Systems, as required (typically TX).
 3. CCTV DVR System (typically TX).
 4. File Servers (typically TX, 10GB).
 5. Firewall, as required (typically TX).
 6. Media Distribution Servers & Controllers (typically TX).
 7. Radius Authentication Server, as required, (typically TX).
 8. WAN Connectivity (typically LX or CWDM).
 9. Wireless Controllers (typically TX, 10GB).
 10. Wireless Phone Controller (typically TX).
 11. Wireless Control Console (typically TX).

- E. In addition to the above listed features and specifications for the Network Switches, the Network Core Switch shall support the following Features and Specifications:
 - 1. Minimum 40 Gbps Support capabilities.
 - 2. BGP4 and Multicast Border Gateway Protocol (MBGP).
 - 3. Full Internet Control Message Protocol (ICMP) support.
 - 4. Hot Standby Router Protocol (HSRP).
 - 5. ICMP Router Discovery Protocol.
 - 6. IGMP filtering.
 - 7. IGMP v1, v2, and v3.
 - 8. IP Multicast routing protocols.
 - 9. IP routing protocols: EIGRP, OSPF, Routing Information Protocol (RIP), and RIP2.
 - 10. Non-Blocking GBE Ports.
 - 11. NSF awareness.
 - 12. Policy-based routing (PBR).
 - 13. Virtual Router Redundancy Protocol (VRRP).

1.9 NETWORK SECURITY EQUIPMENT

A. RADIUS SERVER

- 1. If the District does not have a Central Radius Server, provide a Radius Server for Network Authentication, VLAN Assignment and Policy Assignment for IP Network Attached Devices.

B. FIRE WALL

- 1. If the District does not have a Central Firewall and Intrusion Detection Device for connection to the Wide Area Network and Internet, provide a Firewall and Intrusion Detection Device for Protection and Security. Establish all Internet Connections via a Firewall.
- 2. Size the Firewall based on planned Network throughput, available WAN bandwidth and attached IP Devices.
- 3. Provide VPN services in the Firewall for remote access and network maintenance services.
- 4. Coordinate requirements with District Technology Department.

1.10 UNINTERRUPTIBLE POWER SUPPLIES (UPSs)

- A. Provide Dual Conversion UPS units for MER and TR/TE Local area Network Electronics and File Server, providing sufficient protection from power anomalies.
- B. Provide Power strips, connected to the UPS Unit via twist-lock plugs. Locate the power strips in the equipment racks and on the equipment backboards for powering all electronics systems in the ER and TRs.
- C. Provide multiple UPS Units based on expected power load or a single large UPS Unit. Locate the multiple UPS units in the associated equipment racks or locate a larger central UPS unit in the Room.
- D. Connect the UPS Units to Building Emergency Generator when available.
- E. For buildings without a Generator, supply a two-hour (2) standby.
- F. Provide shutdown connections from the UPS to servers for graceful power down in the event of a power failure.

- G. Equip the UPS Units with a twist-Lock Power cable and SNMP Management Card.
- H. Connect the UPS SNMP Management to the Management VLAN.
- I. Coordinate UPS voltage, circuit size, and connection requirements with the Electrical Design Professional.

1.11 INSTALLATION

- A. Install File Server (optional) and setup basic user accounts and network configuration.
- B. Install Data Network Ethernet Switches and validate connectivity throughout. Establish all VLANs, QoS, IP Routing and IP Subnets.
- C. Consult with the District and consider providing the following VLANs as a minimum:
 - 1. Administration.
 - 2. HVAC.
 - 3. Management.
 - 4. Point of Sale.
 - 5. Student.
 - 6. Video.
 - 7. Voice.
 - 8. Wireless.
 - 9. Security, CCTV.
- D. Coordinate network installation and integration with other systems connected to the network with District's and applicable DA-Site's technical and operational requirements.
- E. Install and setup UPS units and establish power down procedures.
- F. Connect System to DA-Site WAN Links and configure as per DA-Site requirements, when applicable.
- G. Program and configure any State of Ohio Educational Network ATM switches required to access the DA-Site or the State of Ohio IVDL Network.

1.12 LABELING AND MARKING

- A. Provide a typed schedule of all data ports according to each related room jack designation for all TRs, and ER, in accordance with District's requirements.

1.13 TESTING

- A. Test the system "end-to-end" (from TR to ER, and from TR to station jack) at the direction of the Design Professional and verify, in writing, that the data network system is in proper working condition.
- B. Verify and demonstrate proper operation of all switches, Access Points, VLANs, Routing, WAN Connectivity and possible ATM Connectivity with District and DA-Site representative, if applicable.

1.14 TRAINING

- A. New projects only - Provide a minimum of forty (40) hours of training to the District's personnel. Plan for multiple training trips to the site. Training session(s) shall cover the following topics at a minimum:

1. System Equipment Connectivity
 2. Device Configurations
 3. Operation, maintenance, and upgrade procedures.
- B. Renovation/Expansion Projects - Provide hours of training to the District's personnel as required to facilitate the new equipment installed.
- C. Training to be arranged with District personnel. Training hours should be spread out over multiple sessions, with no session lasting for more than 4 hours.
- D. Optional - Contractor to provide manufacturer training vouchers for a portion of the training, which are valid during the warranty period.
- E. Training shall be by certified manufacturer instructor.
- F. Training schedule shall be coordinated with District personnel and their needs.
- G. Training plan, time line, and agenda shall be provided to District IT personnel and signed off by District and Contractor.
- H. Warranty certificate and agreement shall be provided to District IT personnel at initial training session.
- I. Provide a digital video copy of the training sessions.

END OF SECTION

SECTION 272133

DATA COMMUNICATIONS WIRELESS ACCESS POINTS

PART 1 - GENERAL GUIDELINES

1.1 GENERAL

- A. This Section defines the general design requirements for a uniform Data Communications Wireless Network Infrastructure that shall be followed for all OFCC Technology construction projects.
- B. Refer to Section 8500, Technology Systems, and Section 8600, Electrical Systems, for additional information.

1.2 SECTION INCLUDES

- A. DATA COMMUNICATIONS WIRELESS ACCESS POINTS
 - 1. Wireless Controllers
 - 2. Wireless Software Management
 - 3. Wireless Access Points

1.3 QUALITY ASSURANCE

- A. All equipment shall be UL listed.
- B. All equipment and Installation Practices shall comply with the latest ANSI/NFPA-70 National Electric Code.
- C. All equipment Installation Practices shall comply with the Local Electric Code.
- D. All equipment shall comply with the latest ANSI-J-STD-607 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications Standard.
- E. All equipment and Installation Practices shall comply with the latest BICSI[®] Telecommunications Distribution Methods Manual (TDMM).
- F. All equipment shall comply with the latest ANSI TIA/EIA-568, 569, 606, 607, 862, standards.
- G. All equipment shall provide protection and containment of unwanted wireless signals and prevent student access to unwanted networks and content, in accordance with CIPA requirements.
- H. All equipment shall meet or exceed **802.11ac** wave 2 requirements.

1.4 SYSTEM WARRANTY

- A. The Wireless Network Electronics and software shall be fully warranted for three (3) years from date of substantial completion by the contractor and manufacturer. If any defects are found within this warranty period, the defective system component shall be replaced at no extra cost to the Owner for parts or labor. Provide a statement of this warranty with the O&M manuals and to the Director of IT. Make available a service contract offering continuing factory authorized service of this system after the initial warranty period.

1.5 WIRELESS NETWORKING

A. GENERAL

1. Design shall provide for multi-state radios that can be switched from 2.4GHz to 5GHz, 802.11ac.
2. Refer to section 271513 for cabling guidelines for WAP installations.
3. Connect the AP to the IP Network via an IEEE **802.3at** Power Over Ethernet (**POE+**) 1/10 Gbps Switch Port, utilizing CAT 6A cabling.
4. CHANNEL SUPPORT 2.4GHz
 - a. 1 2 3 4 5 6 7 8 9 10 11 12 13 14
5. CHANNEL SUPPORT 5GHz
 - a. All UNII-1, 2/2e and 3 channel bands
6. Design to include spare APs with cabling to be utilized after site validation survey to supplement coverage if required. Spare APs not utilized to be turned over to Owner at end of project.

B. Design

1. Designer shall utilize an RF modeling software to provide a predictive analysis based upon the actual building construction including wall types, door types, window types, floor types, and estimated AP orientations and elevations.
2. The predictive analysis shall be utilized for the initial layout of the AP locations/quantities required to support the design coverage criteria.
3. The designer shall incorporate the site specific wireless requirements supplied by the school including number and type of devices likely to be utilized on the network.
4. The design shall include additional APs with cabling in the scope of work which can be utilized by the contractor after the validation survey to correct areas where coverage did not perform as per the predictive analysis.
5. As a minimum, the predictive analysis shall indicate coverage, SNR, Co-Channel interference, Number of AP, protocol, through-put and client density throughout the coverage area in a graphical map format.
 - a. The WAP quantity and layout shall be based on this modeling.
 - b. ***Predictive analysis survey modeling shall be performed for 2.4 Ghz and 5 Ghz. Include both results in the submittal.***

C. Coverage

1. Designer shall set minimum coverage requirements for each defined coverage area consisting of the following:
 - a. Signal Strength (recommend minimum -75dB)
 - b. Signal-to-noise ratio (SNR) (recommend -20dB)
 - c. Number of APs at a minimum signal level (important when system is to support wireless VoIP) (recommend minimum 2)
 - d. Maximum channel overlap at a minimum signal level (Recommend no more than 4)
 - e. Number of clients per AP
 - f. Minimum bandwidth in the coverage area.
2. Design based upon the following basic coverage areas, determining specific coverage requirements for given areas:
 - a. Academic (Places utilized for student instruction such as Classrooms, ELA, Labs, etc.)
 - b. Administrative (Offices, Conference Rooms, Workrooms)
 - c. Athletics (Weight Rooms, Training Rooms, Lockers, etc.)
 - d. Assembly (Competition Gym, Cafeteria, Auditorium)
 - e. Support Spaces (Mechanical, Electrical, Janitorial, Reception, Corridors, Kitchen, Storage, etc.)
 - f. Exterior

3. AP coverage design to accommodate a minimum of 30-40 users per AP.

D. Security

1. Coordinate 802.31x, VLAN and Security Settings/Requirements with the District.
2. Provide proper network authentication and authorization
3. Security shall have the ability to check antivirus software
4. Dedicated 24/7 threat sensor radio
5. Firewall
6. Integrated RADIUS
7. Integrated ACLs, 802.11i, 802.1
8. Line rate encryption, no matter the traffic volume of encryption protocol in use.

E. Management

1. System shall provide the following minimum management features:
 - a. RF Management
 - b. In-band per IAP Spectrum Analysis
 - c. Dynamic Channel Configuration
 - d. Dynamic Cell Size Configuration
 - e. Monitor radio for threat assessment and mitigation
 - f. Wired and Wireless Packet Captures (including all 802.11 headers)
 - g. Radio Assurance for radio self-test and healing
 - h. RF Monitor
 - i. High Availability Supports Hot Stand-By for mission critical areas
 - j. Supports ability to turn off radios based on schedule configuration
2. System shall allow bandwidth limits and time of day restrictions to be placed on particular users or particular device types.
3. System shall allow network administrators to set QoS parameters for different traffic types.
4. Provide **802.11ac** Wireless Access Points, management software and associated Wireless Network Controller(s), to support wireless Network Devices and Phones throughout the building and the associated campus.
5. System shall provide device fingerprinting identifying devices operating systems such as iOS, Microsoft Windows, Blackberry, or Android and shall classify the device type such as tablet, laptop, or smartphone.
6. Once the system has identified the device, a policy can be applied to control a device's reach and behavior.
7. Wireless network management shall utilize the same firewall, NAC, and RADIUS as the LAN.
8. System shall allow different user groups to be created with each group mapped to specific VLANS, access control list, and QoS parameters.

F. Optional Services

1. GUEST SERVICES
 - a. Browser welcome screen before gaining access to the wireless network.
 - b. Directory Integration – Shall integrate with the same systems used for the wired network.
 - c. Policy Management – Bandwidth limits can be configured to ensure guest users do not overrun educational staff and student traffic usage. Restrictions can be placed on time of day access and day of the week access. Policies can be set to enforce use policies for different device types. Policies can be set and enforced on a user, role, device, and time basis.
2. VOICE AND MULTI-MEDIA SUPPORT (QoS)
 - a. Optimize application support so all standard QoS (802.11e) and Wireless Multi-Media (WMM) features including multiple traffic queues (4) and packet level

- identification of voice traffic. Wired to wireless QoS mapping (802.11p/q) support. Separate protocol support for the leading providers of 802.11 handsets.
 - b. Enable end-to-end QoS support and tag 802.1P packets.
 - c. Shall have multicast-to-unicast conversion and IGMP snooping to optimize the performance of multicast in a Wi-Fi environment. IGMP (Internet Group Management Protocol) is used to establish and manage the membership of multicast groups. The following configuration options are available:
 - d. Send multicasts unmodified.
 - e. Convert to unicast and send unicast packets to all stations.
 - f. Convert to unicast, snoop IGMP, and only send to stations subscribed (send as multicast if no subscription).
 - g. Convert to unicast, snoop IGMP, and only send to stations subscribed (don't send packet if no subscription).
 - h. Each SSID can define separate traffic controls based on business requirements, including QoS (VoIP) and QoS tags can also be updated based on policy rules via the integrated Stateful firewall.
3. MOBILE DEVICE MANAGEMENT
- a. Provide a high level of flexibility in allocating Wi-Fi users and devices among system resources to optimize overall performance.
 - b. Wi-Fi devices shall be identified by type upon connecting to the network (e.g. laptop, tablet, smartphone, gaming device).
 - c. Dedicated radios and wireless networks (SSIDs) can be assigned to devices that need high bandwidth or are operating in a specific mode. Coordinate with Owner.
 - d. Based on device type, specific policies can be applied such as bandwidth restrictions, application types, and time restrictions. Coordinate with Owner.
 - e. Resources can also be allocated based on device performance ensuring the performance of faster device types (e.g. 802.11ac) are not negatively impacted by slower device types (e.g. 802.11b). Coordinate with Owner.
 - f. Users can be assigned to specific resources based on not just login information, but also client type and class. Identify the devices' operating systems such as iOS®, Microsoft® Windows®, BlackBerry®, or Android™ and can then classify the device type such as tablet, laptop, or smartphone. Once the device has been identified, a policy can then be applied to control a user's reach and behavior. The device ID, along with the user ID, can be used together to map that instance to a specific user group.
 - g. Allow different user groups to be created with each group being mapped to specific VLANs, access control list, and QoS parameters.
- 1.6 Coordinate with local Law Enforcement and Safety Forces regarding their requirements for remote and wireless access into building Security and Energy Management Systems.
- A. Law Enforcement and Safety Forces shall be responsible for providing their own remote access equipment.
- 1.7 INSTALLATION
- A. Prior to installation of cabling for Access Points, the contractor shall perform an on-site Validation Survey. This survey shall be utilized to obtain actual site conditions including RF environment and RF properties of the construction. Prepare an AP placement plan utilizing the Validation Survey information and using the AP controllers "planning" tools. Provide a report to the Owner and Technology Designer for review and approval.
 - B. After complete install of all AP's, perform a final survey and tune/optimize the system, **while the building is occupied**, to verify coverage. Move any AP's required to guarantee that coverage and performance requirements are met. Provide final report to the Owner and Technology Designer for review and approval.

- C. Contractor shall provide and install Wireless System and associated cabling, POE devices, Central Controllers and Console.
- D. The Building Floor Plans and Site Plans shall be entered into the Central Wireless Control Console.
- E. The Central Wireless Control Console floor and site plans shall be calibrated after the installation has been performed.
- F. Access Point cables and associated connectors shall be terminated in accordance with industry standards.
- G. Balance Wireless Access Points to insure complete coverage with minimal service degradation.
- H. Setup Wireless Access Security and provide for CIPA Compliance.
- I. Determine the optimum location of all devices in the wireless LAN coverage areas and consider the access point density and location.
- J. Locate all internal Access Points above the ceiling tile grid wherever possible.
- K. Provide Antennas mounted external to the building for coverage of areas surrounding the building such as: playgrounds, parking lots, athletic fields, etc.
- L. Connect the external antennas to APs mounted inside of the building.

1.8 LABELING

- A. Cables, jacks, system components, etc. shall be labeled according to ANSI/EIA/TIA-606 specifications and in coordination with the District requirements.
- B. All AP Cables shall be equipped with a self-laminating, wrap-around, machine printed label at both ends of the cable.

1.9 TESTING

- A. Perform complete site survey after system placement and verify coverage and throughput to comply with the specifications and to optimize the system.

1.10 TRAINING

- A. Provide a minimum of **forty (40)** hours of training to the District's personnel and/or designated representative. Plan for multiple training trips to the site. Training session(s) shall cover the following topics at a minimum:
 - 1. System Equipment Connectivity
 - 2. Device Configurations
 - 3. Operation, maintenance, and upgrade procedures.
- B. ***Training to be arranged with District personnel. 40 hours should be spread out over the length of the warranty (Ex: 8 hours at project turnover/completion, 8 hours at 3 months, 8 hours at 6 months, 8 hours at 1 year, 4 hours at 2 years, 4 hours at 3 year).***
- C. ***Training to occur in maximum of 2 hour increments per personnel or groups of personnel.***

- D. *Consider requiring Contractor to provide manufacturer training vouchers for a portion of the training, which are valid during the warranty period.*
- E. *Training shall be by certified manufacturer instructor.*
- F. *Training schedule shall be coordinated with District personnel and their needs.*
- G. *Training plan, time line, and agenda shall be provided to District IT personnel and signed off by District and Contractor.*
- H. *Warranty certificate and agreement shall be provided to District IT personnel at initial training session.*
- I. *Provide a digital video copy of the training session.*

END OF SECTION

SECTION 273123

IP TELEPHONE SYSTEM

PART 1 - GENERAL GUIDELINES

1.1 GENERAL

- A. This Section defines the general design requirements for a uniform IP ONLY telephone System that shall be followed for all OFCC Technology construction projects.
- B. Refer to OSDM Section 8500, Technology Systems, 27 13 13, Copper Back Bone Systems and 27 31 13.

1.2 SECTION INCLUDES

- A. Central IP PABX.
- B. Attendant Console Terminal.
- C. Executive Display Voice Terminal.
- D. Standard Display Voice Terminal.
- E. Single Line Voice Terminal.
- F. Voice Mail with Automated Attendant.
- G. E-911 Console.
- H. Uninterruptible Power Supply (UPSs).

1.3 QUALITY ASSURANCE

- A. All equipment shall be UL listed.
- B. Compliance with the National Electric Code.
- C. Compliance with FCC rules.
- D. Comply with latest NENA E-911 requirements.

1.4 SYSTEM WARRANTY

- A. ***The IP PABX System and software shall be fully warranted for three (3) years from date of substantial completion by the contractor and manufacturer. If any defects are found within this warranty period, the defective system component shall be replaced at no extra cost to the Owner for parts or labor. Provide a statement of this warrant with the O&M manuals and to the Director of IT. Make available a service contract offering continuing factory authorized service of this system, after the initial warranty period.***

1.5 GENERAL REQUIREMENTS

- A. Each Building's telephone system must provide the following minimum requirements:
 - 1. Support for E-911.

- a. **Allow the caller to be located down to the specific office/room on a particular floor of a building.**
 2. Support for the following carrier and Inter-switch interfaces as required based upon the district's telecommunications services:
 - a. Digital (T-1, PRI)
 - b. Session Initiation Protocol (SIP)
 - c. Analog (POTS) lines
 - d. Provide carrier circuit interfaces adequate to handle ALL incoming and outgoing calls.
 3. Support for Direct inward Dialing (DID).
 4. Support for the following various types of endpoints (phones/devices):
 - a. Digital (TDM)
 - b. IP (must support non-proprietary H.323 and SIP-compliant devices)
 - c. Analog (phones/faxes etc.)
 - d. "Full duplex speakerphone" capability.
 5. Provide system with capacity for all endpoints required plus 10% spare.
 6. Provide main system components with UPS and building generator power.
- B. System to have maintenance and administration terminal and remote access capabilities.
- C. A common Telephone Switching Platform shall be used across the District to insure interoperability. In the event that the District already has an established Telephone System that meets OFCC requirements, additional buildings may be added to the District, specifying existing Vendor's system.
- D. In the event that no standard system exists for the District, then the OFCC PA shall decide if the first systems bid establish a critical mass and if the multiple vendor requirement can be waived.
- 1.6 WORK BY LOCAL UTILITIES
- A. Coordinate all work with the local and long-distance Service Providers (SPs).
- 1.7 IP PABX
- A. The Central Switching Exchange shall be a fully-digital, IP Based PBX Telephone Switch.
- B. The IP PABX must be modular in design.
- C. The IP PABX shall be sized according to student population and traffic requirements and shall be equipped with carrier circuit interfaces for incoming/outgoing call lines.
1. The use of an analog central office (CO) line interface is acceptable if system is supporting existing analog phone service and as long as adequate line capacity is provided to support call traffic. System must still include digital carrier interface for future growth.
- D. The IP PABX shall be equipped with full Name and Number Caller ID functions for incoming and outgoing calls.
- E. The IP PABX must be equipped with a minimum of three (3) analog lines to the local Service Provider for E-911 services and PRI backup.
1. **Allow the caller to be located down to the specific office/room on a particular floor of a building.**

- F. Connect the Analog Lines to a Power Failure Transfer (PFT) Unit and supply a minimum of three (3) analog phones, located in the Central Office Area for emergency operation.
- G. The common control units for the IP PABX shall be fully duplicated.
- H. The media gateways and other ancillary devices shall be distributed across a minimum of at least two (2) units for redundancy. For example, analog interfaces, PRI interfaces, etc. shall be duplicated.
- I. For single building configurations, the duplicate Common Control Units, media gateways and other common devices shall all be located in the Main Equipment Room.
- J. For multiple building configurations, consideration shall be given to distributing the common control units and media gateways between two buildings.
- K. When an IP PABX system is deployed across the District, all carrier circuits and Voice mail and other common Services shall be centralized – a minimum of two central locations is required.
- L. Design the District-Wide system to provide for Least-Cost Routing and Toll-Bypass when applicable. Supply additional PRI circuits as required.
- M. All buildings shall be equipped with a survivable remote unit that shall continue to provide basic call processing for users via the back-up analog lines. Voice mail will not be required during a WAN Link cut between a remote building and a Core Building.
- N. When the Wide Area Network permits, remote buildings shall be configured in such a fashion as to “dual-home” on the two, distributed Central Processing units.
- O. All IP Phone instruments shall be 802.3af powered from POE Ethernet switches.
- P. Due to the advanced features available on some IP Phones, consideration shall be given to locating selected IP instruments on desktops rather than wall mounting the units.
- Q. Consideration shall be given to supplying additional call processing software to enable user desk-top PCs to interoperate with the IP PABX advanced SIP based presence features (audio and video conferencing, integrated messaging, etc.).
- R. Connections between the Data Network and the voice network shall be made via a vendor supplied firewall device.
- S. As a minimum, the Call Accounting shall include date, time, duration of call, extension number, account code (if applicable) and number dialed along with software export features to standard spread sheets.
- T. The IP PABX telephone system must have the following minimum features:
 - 1. Attendant’s Console.
 - 2. Automatic Location Identifier (ALI).
 - 3. Automatic Number Identification Support (ANI).
 - 4. Call Accounting Software and Hardware.
 - 5. Call Conferencing.
 - 6. Call Forwarding on Busy.
 - 7. Call Forwarding External Calls.
 - 8. Call Forwarding Internal Calls.
 - 9. Call Hold.
 - 10. Call Pickup.

11. Call Screening.
 12. Dialed Number Identification Service (DNIS).
 13. Direct Inward Dialing (DID).
 14. Do Not Disturb.
 15. E-911 and latest NENA support. **Allow the caller to be located down to the specific office/room on a particular floor of a building.**
 16. E-911 Call Recording and Bridging to E-911 Central Console.
 17. FCC Registration.
 18. Full Caller ID – Incoming/Outgoing.
 19. Full duplex, Digital Display, Speaker Phones.
 20. Hands Free Intercom – Phone-to-Phone.
 21. IEEE 802.3af compliant VoIP Power Least Cost Routing.
 22. Maintenance and Administration Terminal.
 23. Malicious Call Trace/Hold.
 24. Message Waiting Lamp.
 25. Paging Interface.
 26. PRI/T-1 Trunking.
 27. Remote diagnostics.
 28. SIP Signaling Protocol.
 29. Standards Based, VoIP Phone Support.
 30. Support wireless 802.11 VoWLAN phones.
 31. System Speed Dial.
 32. Unified Messaging.
 33. VoIP Trunking – H.323 and SIP.
- U. When a high-speed WAN connection exists, use a VoIP connection between buildings.
- V. Each District Building's IP PABX shall be capable of complete stand-alone operation (with the exception of centralized voicemail) in the event that the Inter-Building Trunks (Links) are not operational. Calling operation shall be limited only by the external links (trunks) available.
- W. District-Wide Systems shall function as a single system with Common Features, Centralized Voice Mail, and Centralized Call Detail Recording with a single record per call and the ability for Centralized Attendant Service for the entire District.
- X. When more than one building per District is involved, all incoming and outgoing calls shall be routed over PRI Line(s) connected to a Central IP-Enabled PABX. The Central IP-ENABLED PABX capacity shall be dimensioned to handle all current and planned District buildings.
- Y. IP PABX units shall employ a hardened Operating System that is not susceptible to Internet Computer Viruses.
- Z. IP PABX units shall be provided with a minimum of 10% spare line/station capacity at initial installation.
- AA. The all IP Based system shall maintain the same high level of functionality, redundancy and programmable features as originally specified. Any all-IP system shall employ standards based signaling, instrument powering and redundant call servers in each District Building served by the system.
- BB. Provide centralized PABX and phone instrument power with a minimum of two (2) Busy-Hour standby capabilities for all PABX equipment. IP Based systems shall also be provided with two (2) Busy-Hour standby capabilities for all powered Switches or Patch Panels located in each Telecommunications Room (TR). Connect the Central Power Supplies to Building Emergency Power when available.

- CC. All PABX systems shall support IP Inter-building trunking (H.323 or SIP) and the attachment of IP Instruments such as IP Phones, PDAs, Soft Phones and 802.11 Phones.

1.8 TELEPHONE TERMINAL DEVICES

- A. ***The designer shall work with the district to design a phone system implementation that includes the following terminal devices at a minimum.***
1. ATTENDANT CONSOLE TERMINAL (fixed desk top devices or virtual computer based type) – To be located at each grade level office Reception Area.
 2. Enhanced Office Phone (desk top) – To be located in all administration areas where the Owner requires a deskphone.
 3. Computer Based Softphone with wired/wireless handset/headset – To be located in all administration areas where the Owner prefers the use of softphones to fixed deskphones.
 4. ***Basic Office Phone (desk or wall mounted)*** – To be located in all Educations/Classroom spaces.
 5. Mobile Phone App – Provide licensing as required for the implementation of cell phone APPs on select district owned phones or staff personal cell phones.
 6. Conference Room phone – To be provided in Administration area conference rooms, and each grade level Principal's Office.
 7. VoFi Wireless phones – Provide quantity of devices as required.

1.9 VOICE MAIL SYSTEM

- A. System shall have the following number of voice ports:
1. Minimum of 4 ports (450 students).
 2. Minimum of 8 ports (650 students).
 3. Minimum of 12 ports (850 students).
- B. System shall have the following capacity:
1. One voice mailbox per user (fixed, soft, and mobile) plus 20% minimum spares.
- C. System shall have an automated attendant for each building and/or grade level main office within multi-grade buildings.
- D. System shall have Integrated Messaging capability. Supply based on District's requirements. Verify E-Mail Server compatibility (Exchange, Notes, Groupwise, etc.).

1.10 E-911 CONSOLE

- A. System shall support Call Bridging at Console for all E-911 calls.
- B. System shall provide Call Recording for E-911 Calls.
- C. System shall support full NENA Compliant ANI and ALI data transmission from local Data Base to PSAP. ***Allow the caller to be located down to the specific office/room on a particular floor of a building.***

1.11 UNINTERRUPTIBLE POWER SUPPLIES (UPS)

- A. Provide Dual Conversion UPS units for call processing equipment, providing sufficient protection from power anomalies for two (2) busy hours.

- B. Provide multiple UPS Units based on expected power load or a single large UPS Unit. Locate the multiple UPS units in the associated equipment racks or locate a larger central UPS unit in the Room.
- C. Connect the UPS Units to Building Emergency Generator when available.
- D. For buildings without a Generator, supply a four-hour (4) standby.
- E. Provide shutdown connections from the UPS for graceful power down in the event of a power failure.
- F. Equip the UPS Units with a twist-Lock Power cable and SNMP Management Card.
- G. Connect the UPS SNMP Management to the Management VLAN.
- H. Coordinate UPS voltage, circuit size, and connection requirements with the Electrical Design Professional.

1.12 INSTALLATION

- A. Coordinate complete system installation, and Technology Headend Integration with District and other Technology Trades.
- B. Coordinate installation and interconnect with local and long-distance Service Provider (SP). Contractor shall be responsible for all final cross connects and system Data Base loading and verification.
- C. Contractor shall connect to, and interface with the in-house paging system and provide paging from any telephone handset.
- D. Connect system to IP Data Network and program required VLANs, Firewall and 803.11e support.
- E. Interconnect with existing systems via VoIP trunking.
- F. Integrate system with District's Numbering Plan.

1.13 SYSTEM PROGRAMMING

- A. Contractor shall provide the District/Architect with a complete set of forms for the entire system and extension features for final programming.
- B. Final programming of the system shall be co-developed between the District/Architect and the contractor and must be approved prior to being implemented for system start-up.
- C. Contractor shall supply the "latest" software updates as part of the system configuration for **three (3)** years after system acceptance.

1.14 TRAINING

- A. ***Provide a minimum of forty (40) hours of training to the District's personnel. Plan for multiple training trips to the site. Training session(s) shall cover the following topics at a minimum:***
 - 1. ***System Equipment Connectivity***
 - 2. ***Device Configurations***
 - 3. ***Operation, maintenance, and upgrade procedures.***

- B. *Training to be arranged with District personnel. 40 hours should be spread out over the length of the warranty (Ex: 8 hours at project turnover/completion, 8 hours at 3 months, 8 hours at 6 months, 8 hours at 1 year, 4 hours at 2 years, 4 hours at 3 year).*
- C. *Training to occur in maximum of 2 hour increments per personnel or groups of personnel.*
- D. *Consider requiring Contractor to provide manufacturer training vouchers for a portion of the training, which are valid during the warranty period.*
- E. *Training shall be by certified manufacturer instructor.*
- F. *Training schedule shall be coordinated with District personnel and their needs.*
- G. *Training plan, time line, and agenda shall be provided to District IT personnel and signed off by District and Contractor.*
- H. *Warranty certificate and agreement shall be provided to District IT personnel at initial training session.*
- I. *Provide a digital video copy of the training sessions.*

END OF SECTION

SECTION 274119

VIDEO DISPLAY EQUIPMENT

PART 1 - GENERAL GUIDELINES

1.1 GENERAL

- A. This Section defines the general design requirements for uniform Interactive Video Display Equipment that shall be followed for all OFCC Technology construction projects.
- B. Refer to OSDM Section 8500, Technology Systems, and Section 8600, Electrical Systems, for additional information.

1.2 SECTION INCLUDES

A. VIDEO DISPLAY EQUIPMENT

- 1. Flat panel monitors with mounts
- 2. Ceiling Mounted projectors with mounts
- 3. Wall mounted short/ultra-short throw projectors with mounts
- 4. Specialized projector lifts
- 5. Projection Screens
- 6. ***Interactive options for the above listed displays.***

B. Audio Visual Distribution and Control Equipment

- 1. Video switchers
- 2. Control panels/touch screens
- 3. Signal Distribution Equipment
- 4. Distribution equipment control systems

C. CLASSROOM INTERACTIVE EQUIPMENT

- 1. Interactive Tablets
- 2. Student Response System
- 3. Document Camera
- 4. Webcam

1.3 QUALITY ASSURANCE

- A. All equipment shall be UL listed.
- B. All equipment and Installation Practices shall comply with the latest ANSI/NFPA-70 National Electric Code.
- C. All equipment and Installation Practices shall comply with the Local Electric Code.
- D. All equipment and Installation Practices shall comply with the latest InfoComm International Installation Handbook.
- E. All equipment and Installation Practices shall comply with the latest BICSI[®] Telecommunications Distribution Methods Manual (TDMM).
- F. All equipment shall comply with the latest ANSI TIA/EIA-568, 569, 606, 607, 862, standards as applicable.

1.4 SYSTEM WARRANTY

- A. The Video Display Equipment Systems and associated software shall be warranted by the contractor for a period of three (3) years from date of substantial completion.

1.5 Flat Panel Displays

- A. Displays shall be provided in locations and sizes as determined by technology design meetings. Display sizing is recommended to be determined in accordance with ANSI/INFOCOMM V202.01:2016 Display Image Size for 2D Content in Audiovisual Systems.
- B. Consider the inclusion of advanced features such as ATSC tuners, wireless connectivity and interactive surfaces.
- C. Displays to be a minimum of “prosumer” grade, rated for the expected duty cycle and equipped with RS-232 control options.
- D. Review the use of 4K resolution displays based upon budgetary factors and anticipated use.
- E. Consider the use of fixed, tilting and swivel mounts at each location as required by the anticipated use.

1.6 Projectors – Fixed, Cafeteria/Auditorium

- A. Ambient light considerations shall be coordinated with the Architect and Electrical Engineer/Lighting Designer to produce a minimum contrast ratio of 10:1. This often requires blocking of daylighting and dimming of electric lights to produce no more than 10-14 vertical foot candles (108-151 lux) on the projection surface.
- B. Minimum 6000 lumen rated projectors.
- C. Support for 1080 resolution with 16:9 and 16:10 aspect ratios supported.
- D. Review desired light source – LCD, DLP, Laser, LED, Hybrid based upon requirements for color depth, brightness, and budget.
- E. Provide connection to control system for local and/or centralized control. Provide all projectors with an Ethernet control interface, either through direct connection or via Ethernet-to-RS-232 adaptor. Provide global central management control/tracking software.
- F. Consider configuring for rear projection.
- G. Include proper mounting options; fixed ceiling, ceiling lift, fixed wall.
- H. Projection Screen - Display sizing is recommended to be determined in accordance with ANSI/INFOCOMM V202.01:2016 Display Image Size for 2D Content in Audiovisual Systems. Consider the use of a high contrast, high definition screen surface and tab tensioning.

1.7 Projectors – Fixed, wall mount short throw

- A. Short-throw/Ultra-short throw interactive projectors. They shall be capable of being interfaced with any interactive technology in the classrooms.
- B. Minimum 3000 lumen rated, aspect ratio of projectors shall be 16:9 or 16:10, 1080 resolution.
- C. Provide all projectors with an Ethernet control interface, either through direct connection or via Ethernet-to-RS-232 adaptor. Provide global central management control/tracking software.

- D. The use of IR controls for the projector and for any interactive components (such as pens) shall be coordinated with all other technology devices in the same and adjacent areas with “line of sight” to avoid conflicts in system operations due to overlapping IR communications.

1.8 OPTIONAL EQUIPMENT AND SYSTEMS (not baseline)

A. DOCUMENT CAMERA

1. Minimum full 1080 HD camera
2. Full autofocus lens
3. 12x optical zoom
4. Up to 30 fps live video capture
5. USB 2.0 and wireless minimum interface
6. Windows and Mac compatible
7. Capture both digital and printed material

B. WEBCAM

1. Full 1080p live video
2. Minimum of 2 Mbps upload/download
3. H.264 video compression
4. Autofocus lens
5. Built-in mic with auto noise reduction
6. Automatic low-light correction
7. USB 2.0 interface
8. Tri-pod ready

C. A/V CONTROL SYSTEM

1. Full user control of program source device(s), projector, and lights through either web-based application or touch panel/button control panel.
2. System diagnostics and scheduled operation of media devices via web-based application.

1.9 INSTALLATION

- A. Mount Projectors and Flat Panel TV/Monitors using manufacturer’s recommended hardware. Designer to coordinate with structural wall/ceilings for any additional support required.
- B. Connect Devices to IP Network for Central Control.
- C. Adjust all Projectors for proper focus, keystone correction and display size.
- D. Install all associated software monitoring and control programs.

1.10 TESTING

- A. Verify picture and sound quality on all A/V inputs.
- B. Test all associated software control programs.
- C. The devices and associated software systems shall be tested end-to-end complete.

1.11 TRAINING

- A. Provide a minimum of forty (40) hours of training to the District's personnel. Plan for multiple training trips to the site. Training session(s) shall cover the following topics at a minimum:
 - 1. System Equipment Connectivity
 - 2. Device Configurations
 - 3. Operation, maintenance, and upgrade procedures.
- B. Training to be arranged with District personnel. 40 hours should be spread out over the length of the warranty (Ex: 8 hours at project turnover/completion, 8 hours at 3 months, 8 hours at 6 months, 8 hours at 1 year, 4 hours at 2 years, 4 hours at 3 year).
- C. Training to occur in maximum of 2 hour increments per personnel or groups of personnel.
- D. Consider requiring Contractor to provide manufacturer training vouchers for a portion of the training, which are valid during the warranty period.
- E. Training shall be by certified manufacturer instructor.
- F. Training schedule shall be coordinated with District personnel and their needs.
- G. Training plan, time line, and agenda shall be provided to District IT personnel and signed off by District and Contractor.
- H. Warranty certificate and agreement shall be provided to District IT personnel at initial training session.
- I. Provide a digital video copy of the training sessions.

END OF SECTION

SECTION 274125

DIGITAL MEDIA MANAGEMENT SYSTEM

PART 1 - GENERAL GUIDELINES

1.1 GENERAL

- A. This Section defines the general design options for a uniform Digital Media Management System.
- B. Refer to OSDM Section 8500, Technology Systems, and Section 8600, Electrical Systems, for additional information.
- C. The designer shall carefully consider the District's wireless device standards (Chromebook, Surface, iPad, etc.) and select systems which are fully and completely compatible with the District's wireless devices and network platforms.

1.2 SECTION INCLUDES

- A. System components for various aspects of digital video distribution and control including the following:
 - 1. Digital Video On-Demand System.
 - 2. Digital Video Control and Scheduling System.
 - 3. Digital Signage.
 - 4. Digital Video Broadcast System.
 - 5. Digital Media Broadcast System.
- B. The intent of this section is to provide options for various digital video technologies to be incorporated into the project to meet the operational and budgetary requirements of the district.

1.3 QUALITY ASSURANCE

- A. All equipment shall be UL listed.
- B. All equipment and Installation Practices shall comply with the latest ANSI/NFPA-70 National Electric Code.
- C. All equipment Installation Practices shall comply with the Local Electric Code.
- D. All equipment shall comply with the latest ANSI-J-STD-607 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications Standard.
- E. All equipment and Installation Practices shall comply with the latest BICSI[®] Telecommunications Distribution Methods Manual (TDMM).
- F. All equipment shall comply with the latest ANSI TIA/EIA-568, 569, 606, 607, 862, standards.

1.4 SYSTEM WARRANTY

- A. The Digital Media Management System and software shall be fully warranted for three (3) years from date of substantial completion by the contractor and manufacturer. If any defects are found within this warranty period, the defective system component shall be replaced at no extra cost to the Owner for parts or labor. Provide a statement of this warrant with the O&M

manuals and to the Director of IT. Make available a service contract offering continuing factory authorized service of this system, after the initial warranty period.

- B. Provide advanced replacement for all Digital Media Management Equipment for the three (3) year-period.

1.5 Module 1 - DIGITAL VIDEO ON DEMAND SERVER

- A. The system shall consist of a centrally based media content creation, storage, and distribution server(s) along with required hardware and software.
- B. The Digital Media Management System shall provide remote access to centrally stored digital video sources and live video sources via the LAN/WAN connectivity within the district.
- C. Classrooms may be equipped with Set-Top-Box (STB) for receiving streamed and pre-recorded Digital Video Signals. The STB shall be connected to the associated Classroom Projector/Video Display and Audio System.
- D. The Digital Video Server shall support True Video-on-Demand (VOD), Near-Video-on-Demand (NVOD), and Subscription-Video-on-Demand (SVOD).
- E. Hosted service can be utilized as long as all required features are provided.

1.6 Module 2 - DIGITAL VIDEO CONTROL AND SCHEDULING SYSTEM

- A. The Video Control and Scheduling System shall provide a simple interface to easily locate available Live and On Demand media assets on Windows PCs, Macs, and Set Top Boxes.
- B. Users shall be able to navigate and search for specific videos, select the video, and it immediately begins playing. For On Demand videos, users shall have full Fast Forward and Rewind capabilities.
- C. The Video Control and Scheduling System shall provide a calendar-based scheduling system that shall allow users to quickly and easily schedule Live Broadcasts from MPEG encoders, Stored Broadcasts from Video on Demand servers, Recordings, and Conferences. Scripting functionality shall also allow users to set up custom schedules.

1.7 Module 3 – DIGITAL SIGNAGE

- A. System includes a digital signage source server which includes the necessary control, administration, content creation, encoding and network distribution services for a comprehensive digital signage system.
- B. System size/scale and configuration is based upon the operating requirements.
- C. System to include digital signage players at displays and/or digital signage software players at workstations connected to displays.

1.8 Module 4 - DIGITAL VIDEO BROADCAST SYSTEM

- A. System to include a completed assembly of digital Video HD Camera, tripod, wheeled cart with required control/distribution equipment, for remote origination of video broadcasts, and announcements.
- B. It shall be possible to broadcast the portable camera signal across the IP Network to Monitors, Projectors and/or PCs in the school or any of the other schools within the District, and simultaneously record the signal if desired. The Camera can be used for Video

Announcements, recording of lessons and/or events or as a point-to-point link between any two (2) schools.

1.9 Module 5 - DIGITAL BROADCAST MEDIA SOURCE SYSTEM

- A. Where included in the technology systems plan, provide channels of digital broadcast media sources including Cable TV, Off-air TV, and local media sources. Connect sources to A/V MPEG-4/H.264 encoder input for streaming to the network.
- B. The Technology Designer shall coordinate with the District to determine applicable digital broadcast media sources, such as specific CATV channels, off-air channels and satellite channels, as can be incorporated within the budget.

1.10 INSTALLATION

- A. Contractor shall install and program all Digital Video Distribution Equipment and establish all necessary VLANs as required.

1.11 LABELING

- A. Cables, jacks, system components, etc. shall be labeled according to ANSI/EIA/TIA-606 specifications and in coordination with the District.
- B. All Video Cables shall be equipped with a self-laminating, wrap-around, machine printed label at both ends of the cable.

1.12 TESTING

- A. Video Wiring system and associated systems shall be tested end-to-end complete.

1.13 TRAINING

- A. Provide a minimum of forty (40) hours of training to the District's personnel. Plan for multiple training trips to the site. Training session(s) shall cover the following topics at a minimum:
 - 1. System Equipment Connectivity.
 - 2. Device Configurations.
 - 3. Operation, maintenance, and upgrade procedures.
- B. Training to be arranged with District personnel. 40 hours should be spread out over the length of the warranty (Ex: 8 hours at project turnover/completion, 8 hours at 3 months, 8 hours at 6 months, 8 hours at 1 year, 4 hours at 2 years, 4 hours at 3 year).
- C. Training to occur in maximum of 2 hour increments per personnel or groups of personnel.
- D. Consider requiring Contractor to provide manufacturer training vouchers for a portion of the training, which are valid during the warranty period.
- E. Training shall be by certified manufacturer instructor.
- F. Training schedule shall be coordinated with District personnel and their needs.
- G. Training plan, time line, and agenda shall be provided to District IT personnel and signed off by District and Contractor.
- H. Warranty certificate and agreement shall be provided to District IT personnel at initial training session.

- I. Provide a digital video copy of the training sessions.

END OF SECTION

SECTION 275121

AUDITORIUM SOUND REINFORCEMENT SYSTEM – HIGH SCHOOL

PART 1 - GENERAL GUIDELINES

1.1 GENERAL

- A. This section defines the general performance requirements for an Auditorium Sound Reinforcement System that shall be followed for all OFCC Technology construction projects – High School.
- B. Refer to OSDM Section 8500, Technology Systems, for additional information.

1.2 QUALITY ASSURANCE (Designer to utilize the most current version of)

- A. NFPA 70 - National Electrical Code.
- B. Underwriter's Laboratory.
- C. TIA/EIA-607 Telecommunications Grounding.
- D. BICSI Telecommunications Distribution Methods Manual (TDMM).
- E. Americans with Disabilities Act (ADA).
- F. Federal Communications Commission Part 15.
- G. Sound System Engineering (Davis Patronis & Brown) – 4th Edition 2013.
- H. Audio Systems Design and Installation (Giddings) 2013.

1.3 SYSTEM WARRANTY

- A. The Sound Reinforcement System shall be warranted by the Contractor for a period of **three (3)** years from date of training and turn over to Owner.

1.4 RELATED SECTIONS

- A. Specification section 271543 – Audio-Video Communications Horizontal Transport System
- B. Specification section 274119 – Video Display Equipment

1.5 MATERIALS

- A. Provide a fixed, secure location and equipment mounting cabinet for the installation and protection of all permanently installed sound reinforcement equipment that provides adequate power, ventilation and protection of the equipment contained therein. Rack shall incorporate front/rear locking doors, equipment drawers, equipment shelves, etc.
- B. The sound reinforcement system shall provide for audio input locations, audio source equipment, audio control and processing, amplification and sound distribution for the Student Dining/Auditeria Space. The actual system configuration shall be established by the use requirements of the space.
- C. Audio inputs can include any one or more of the following:

1. Microphone and auxiliary input outlets within the space.
 2. Local Building paging system
 - a. Used for signal to mute the Sound System upon building page when paging is delivered through a separate speaker system. Consider the use of local override when this option is utilized to prevent pages during actual performances.
 - b. Used for local area paging when the Sound System components are used to deliver the audio pages.
 3. Used for local area paging when the Sound System components are used to deliver the audio pages.
 4. Fire alarm notification - Used for signal to mute the Sound System upon fire alarm activation.
- D. Audio Sources can include any one or more of the following:
1. Wireless microphone systems (true diversity, UHF, multi-channel).
 - a. Consider the use of remote antennas for optimal reception when receiver is not within line of sight of microphones during normal use.
 - b. Consider the use of antenna combiners and distribution when using multiple wireless receivers.
 2. Combo CD/MP3/Bluetooth Player.
 3. Digital Media Player/Network Audio Player.
 4. AM/FM/Satellite Radio (including required antennas).
 5. Push-to-talk microphone.
 6. Wired microphone with cable and stand.
 7. Audio input jack for portable MP3 player.
 8. Input from adjacent space sound reinforcement system (e.g. Gymnasium) where spaces are separated by non-fixed walls.
 - a. Consider a similar output from the Sound System to a sound system in an adjacent space separated by non-fixed walls.
- E. Signal Processing must provide one of the following at a minimum:
1. Digital Signal Processor(s)
 - a. Equalization Filters – graphic and/or parametric
 - b. Compressor/Limiter
 - c. Feedback Suppression (may be incorporated in DSP or a standalone unit)
 2. Speaker Processing (Front of House and Monitor)
 - a. Where required by the use of tuned speakers/arrays, units to be matched to the speaker system).
 - b. Delay where utilizing distributed speaker system to reduce/eliminate comb filtering.
 3. Sequencing AC Power Control System
- F. System Controls shall include one or more of the following:
1. User control stations for volume/source selection located within the space and/or at the main equipment rack.
 2. Ethernet connected systems with remote PC/laptop/tablet operation.
 3. Mobile device APP control.
- G. Amplification and Sound Distribution must include the following at a minimum:
1. Rack mounted Mixer/Preamplifier – Utilized for fixed audio components within the system rack which require mixing and insertion into the amplifier chain after the house mixing console.
 2. House Mixing Console – Provide a live sound mixing console with appropriate quantity of channels, sends, returns, FX, EQ, etc. as required by the program requirements. Digital

- consoles are recommended. Final console style, type, and capabilities are to be discussed with the Owner.
3. Power Amplifier(s)
 4. Speaker System (Front of House) – Can be a combination of any of the following:
 - a. Distributed
 - b. Cluster/Array Speaker System
 - c. Subwoofer
 5. Speaker System (Monitor)
 - a. Dedicated monitor speakers with wedge boxes, connecting cables.
 6. Assistive Listening Transmitter (provide with ADA-compliant quantity and type of receivers)
 - a. Systems may utilize infra-red, RF or Induction technology. Verify code requirements for system design and configuration.
 - b. Consider placement of antennas/transmitters within the space for optimal coverage.
 7. Green Room/Cue system
 - a. Provide audio monitor tie when facility contains a dedicated Green Room and/or Dressing Rooms.
 8. Line and microphone level cabling, balanced.
 - a. Include multi-pair (analog) or fiber/UTP (digital) snake for remote connectivity of mixing console to sound system cabinet. Include break-out boxes.
 9. Speaker level cabling shall be designed based upon overall system design parameters, power handling, frequency response and distance.
 10. Control cabling to be provided as required by the system control devices and manufacturer's recommendations.
- H. Mobile Equipment Cabinet, if provided, can include any of the audio sources listed above. In addition, the following can be provided with the mobile equipment rack:
1. Rack drawer for storage of loose items such as cables, microphones, batteries, etc.
 2. Power strip with single on/off button for all equipment in mobile cabinet.
- I. Provide Ethernet connectivity at the main equipment rack where required by network enabled system components.

1.6 INSTALLATION

- A. Provide specifications for the proper installation of all components of the sound system, observing code requirements, industry standards and "best practices".
- B. Provide specifications covering the complete system testing, balancing, and start-up.
- C. Provide specifications covering the proper grounding of the equipment cabinet and associated equipment to cabinet-mounted telecommunications grounding buss bar in accordance with NEC and TIA/EIA-607.

1.7 PERFORMANCE TESTING

- A. The system shall provide the following minimum performance criteria:
 1. Frequency response: 80Hz – 14kHz +/- 3 dB.
 2. Loudness: At least 96dB-SPL program level with an additional 6 dB Crest factor.
 3. Evenness of coverage: Variation of less than +/- 3dB (400Hz to 4000Hz) at all seats.
 4. Intelligibility – Average STI not less than 0.6 in 90% of the coverage area.
- B. Specifications shall require installer to provide testing equipment and testing to verify system performs to the stated minimum performance criteria. Provide certified test report to the Owner or Engineer for review and approval, before final acceptance is given to the system.

1.8 TRAINING

- A. Provide an appropriate amount of training for District's personnel on the operation and maintenance of the system. Consider the complexity of the system and the number/skill level of staff who will be utilizing the system. A minimum of eight (8) hours of training is required.
- B. Provide **a digital video** copy of all training.

END OF SECTION

SECTION 275122

STUDENT DINING / CAFETERIA SOUND REINFORCEMENT SYSTEM

PART 1 - GENERAL GUIDELINES

1.1 GENERAL

- A. This section defines the general performance requirements for a Student Dining/Cafeteria Sound Reinforcement System that shall be followed for all OFCC Technology construction projects –Middle School, and Elementary School facilities.
- B. Refer to OSDM Section 8500, Technology Systems, for additional information.

1.2 SECTION INCLUDES

- A. Student Dining Sound Reinforcement System and all related components

1.3 QUALITY ASSURANCE (utilize most current versions)

- A. NFPA 70 - National Electrical Code.
- B. Underwriter's Laboratory.
- C. TIA/EIA-607 Telecommunications Grounding.
- D. BICSI Telecommunications Distribution Methods Manual (TDMM).
- E. Americans with Disabilities Act (ADA).
- F. Federal Communications Commission Part 15.
- G. Sound System Engineering (Davis Patronis & Brown) – 4th Edition 2013.
- H. Audio Systems Design and Installation (Giddings) 2013.

1.4 SYSTEM WARRANTY

- A. The Student Dining/Cafeteria Sound Reinforcement System shall be warranted by the contractor for a period of **three (3)** years from date of training and turn over to Owner.

1.5 RELATED SECTIONS

- A. Specification Section 271543 – Audio-Video Communications Horizontal Transport System
- B. Specification Section 274119 – Video Display Equipment

1.6 MATERIALS

- A. Provide a fixed, secure location and equipment mounting cabinet for the installation and protection of all permanently installed sound reinforcement equipment that provides adequate power, ventilation and protection of the equipment contained therein. Rack shall incorporate front/rear locking doors, equipment drawers, equipment shelves, etc.
- B. The sound reinforcement system shall provide for audio input locations, audio source equipment, audio control and processing, amplification and sound distribution for the Student

Dining Space. The actual system configuration shall be established by the use requirements of the space.

- C. Audio inputs can include any one or more of the following:
1. Microphone and auxiliary input outlets within the space.
 2. Local Building paging system
 - a. Used for signal to mute the Sound System upon building page when paging is delivered through a separate speaker system. Consider the use of local override when this option is utilized to prevent pages during actual performances.
 - b. Used for local area paging when the Sound System components are used to deliver the audio pages.
 3. Fire alarm notification - Used for signal to mute the Sound System upon fire alarm activation.
- D. Audio Sources can include any one or more of the following:
1. Wireless microphone systems (true diversity, UHF, multi-channel).
 - a. Consider the use of remote antennas for optimal reception when receiver is not within line of sight of microphones during normal use.
 - b. Consider the use of antenna combiners and distribution when using multiple wireless receivers.
 2. Combo CD/MP3/Bluetooth Player.
 3. Digital Media Player/Network audio player.
 4. AM/FM/Satellite Radio (including required antennas).
 5. Push-to-talk microphone.
 6. Wired microphone with cable and stand.
 7. Audio input jack for portable MP3 player.
 8. Input from adjacent space sound reinforcement system (e.g. Gym Sound System) where spaces are separated by non-fixed walls.
 - a. Consider a similar output from the Sound System to a sound system in an adjacent space separated by non-fixed walls.
- E. Signal Processing must provide one of the following at a minimum:
1. Digital Signal Processor(s)
 - a. Equalization Filters – graphic and/or parametric
 - b. Compressor/Limiter
 - c. Feedback Suppression (may be incorporated in DSP or a standalone unit)
 2. Speaker Processing
 - a. Where required by the use of tuned speakers/arrays.
 - b. Delay where utilizing distributed speaker system to reduce/eliminate comb filtering.
 3. Sequencing AC Power Control System
- F. System Controls can include any one or more of the following:
1. User control stations for volume/source selection located within the space and/or at the main equipment rack.
 2. Ethernet connected systems with remote PC/laptop/tablet operation.
 3. Mobile device APP control.
- G. Amplification and Sound Distribution must include the following at a minimum:
1. Multi-channel Mixer/Preamplifier
 2. Power Amplifier(s)
 3. Speaker System – Can be a combination of any of the following:
 - a. Distributed

- b. Cluster/Array Speaker System
 - c. Subwoofer
 4. Assistive Listening Transmitter (provide with ADA-compliant quantity of receivers)
 - a. Systems may utilize infra-red, RF or Induction technology. Verify code requirements for system design and configuration.
 - b. Consider placement of antennas/transmitters within the space for optimal coverage.
 5. Line and microphone level cabling, balanced.
 - a. Include multi-pair (analog) or fiber/UTP (digital) snake for remote connectivity of mixing console to sound system cabinet. Include break-out boxes.
 6. Speaker level cabling shall be designed based upon overall system design parameters, power handling, frequency response and distance.
 7. Control cabling to be provided as required by the system control devices and manufacturer's recommendations.
- H. Mobile Equipment Cabinet, if included can include any of the audio sources listed above. In addition, the following can be provided with the mobile equipment rack:
 1. Rack drawer for storage of loose items such as cables, microphones, batteries, etc.
 2. Power strip with single on/off button for all equipment in mobile cabinet.
- I. Provide Ethernet connectivity at the main equipment rack where required by network enabled system components.

1.7 INSTALLATION

- A. Provide specifications for the proper installation of all components of the sound system, observing code requirements, industry standards and "best practices".
- B. Provide specifications covering the complete system testing, balancing and start-up. Provide specifications covering the proper grounding of all system components.

1.8 PERFORMANCE TESTING

- A. Frequency response: 80Hz – 14kHz +/- 3 dB.
- B. Loudness: At least 90 dB-SPL program level with an additional 6 dB Crest factor.
- C. Evenness of coverage: Variation of less than +/- 3dB (400Hz to 4000Hz) at all seats.
- D. The system shall provide the following minimum performance criteria:
 1. Frequency response: 100Hz – 14kHz +/- 3 dB
 2. Loudness: At least 96dB-SPL program level with an additional 6 dB Crest factor.
 3. Evenness of coverage: Variation of less than +/- 3 dB (400Hz to 4000Hz) at all seats.
 4. Intelligibility – Average STI not less than 0.6 in 90% of the coverage area.
- E. Specifications shall require installer to provide testing equipment and testing to verify system performs to the stated minimum performance criteria. Provide certified test report to the Owner for review and approval, before final acceptance is given to the system.

1.9 TRAINING

- A. Provide an appropriate amount of training for District's personnel on the operation and maintenance of the system. Consider the complexity of the system and the number/skill level of staff who will be utilizing the system. A minimum of eight (8) hours of training is required.
- B. Provide **a digital video** copy of all training.

END OF SECTION

SECTION 275123

CENTRAL SOUND AND PAGING SYSTEM

PART 1 - GENERAL GUIDELINES

1.1 GENERAL

- A. This section defines the general design requirements for a uniform Central Sound and Paging System that shall be followed for all OFCC Technology construction projects.
- B. Option 1 - The basis of design is a full-function, microprocessor-based, two-way intercommunications/zoned paging/program distribution system interfaced with and operated by the telephone system (specified elsewhere).
- C. Option 2 - An optional one-way zoned paging system, interfaced and operated by the telephone system (specified elsewhere).
- D. Refer to OSDM Section 8500, Technology Systems, for additional information.

1.2 SECTION INCLUDES

- A. Central Sound and Paging System and all related components.

1.3 QUALITY ASSURANCE (utilize the latest version)

- A. NFPA 70 – National Electrical Code
- B. Underwriter's Laboratory
- C. TIA/EIA-607 Telecommunications Grounding
- D. BICSI Telecommunications Distribution Methods Manual (TDMM)
- E. Americans with Disabilities Act (ADA)
- F. Federal Communications Commission Part 15
- G. Sound Systems Engineering (Davis Patronis & Brown) – 4th Edition 2013
- H. Audio Systems Design and Installation (Giddings) 2013

1.4 SYSTEM WARRANTY

- A. ***The Central Sound and Paging System shall be fully warranted for three (3) years from date of substantial completion by the contractor and manufacturer. If any defects are found within this warranty period, the defective system component shall be replaced at no extra cost to the Owner for parts or labor. Provide a statement of this warrant with the O&M manuals and to the Director of IT. Make available a service contract offering continuing factory authorized service of this system, after the initial warranty period.***

1.5 RELATED SECTIONS

- A. Specification section 275313 – Clock Systems
- B. Specification section 273123 – IP-Only PABX System

- 1.6 MICROPROCESSOR-BASED TWO-WAY INTERCOM / PAGING / PROGRAM DISTRIBUTION SYSTEM
- A. PABX System Interface
 - B. Main system cabinet to be located in the MER and powered by generator circuit and include UPS for local power conditioning.
 - C. Administrative communications console – located in main office and at equipment headend.
 - D. Consider the use of user interface station including background music source (FM radio, CD player, MP3 player, etc.), push to talk microphone for all call, and switch bank for activation of emergency alert tones.
 - E. Microprocessor-based with RS-232 Interface for setup and/or control.
 - F. Quantity of paging and time tone distribution zones as required.
 - G. Internal time-tone schedule programming and software
 - H. Synchronization with clock system
 - I. Input signal prioritization
 - J. Speakers
 - 1. 2-way capable speaker circuits from each classroom and other areas where 2-way talk-back is required.
 - 2. Standard overhead and wall mounted speakers in all other areas including Education, Administrative, Building Support, Dining, Athletics, Commons, Public, multi-occupant Restrooms, and Building Exterior.
 - K. When utilizing a 2-way talk back system, Call origination switches in each classroom and other areas where 2-way talk-back is required.
 - L. Consider the use of a wall mounted Annunciator display in central school reception office when using a 2-way call back system.
- 1.7 ONE-WAY ZONED PAGING SYSTEM
- A. PABX System Interface.
 - B. Microprocessor-based, zoned paging/program distribution system.
 - C. Paging and class change zones as required.
 - D. Distribution of class-change time tones as scheduled by Clock System.
 - E. Input signal prioritization.
 - F. Standard overhead and wall mounted speakers in all areas including Education, Administrative, Building Support, Dining, Athletics, Commons, Public, Restrooms, and Building Exterior.
 - G. Central paging power supplies based on system load. Connect to Main Equipment Room (ER) UPS unit, powered by building emergency generator circuit(s).

1.8 COMPONENTS COMMON TO ALL SYSTEMS:

- A. PROGRAM SOURCE CABINET – Consider the use of a wall-mounted or desktop cabinet in the central school reception office area and place within the cabinet:
 - 1. Audio input/sources including MP3 player, FM radio, CD player, etc.
 - 2. Weather radio and associated antenna
 - 3. Monitor speaker panel for program cueing and preview
 - 4. Connect audio outputs to audio inputs on the paging adapter (when applicable)
- B. EMERGENCY/EVACUATION ALARM TONE PANEL
 - 1. Locate in central school reception office area – either as a stand-alone wall-mounted device or within Program Source Cabinet.
 - 2. Minimum of three (3) clearly labeled switches to activate distinct tones: EMERGENCY, EVACUATION, ALL-CLEAR.
 - 3. Assign highest priority level.
 - 4. Available through a phone system interface.
- C. ALL-CALL PAGING MICROPHONE
 - 1. Locate in central school reception office area. Use of receptionist's telephone handset is permissible, if acceptable to the school.
- D. Locate a minimum of one (1) paging speaker or horn in all building rooms, including Mechanical areas. Base the quantity of speakers/horns on the required signal level and the size of the area to be covered.
- E. Speaker and horn types:
 - 1. Flush-mounted ceiling speakers with all metal protective dome enclosures and ceiling bridge support. Consider the use of tile bridge direct lay-in speakers as well.
 - 2. Surface-mount wall or ceiling speakers
 - 3. Compression driver paging horns in gymnasiums, shop areas, mechanical rooms, exterior of building (weather-proof type) and other areas with high ambient sound levels.
 - 4. Wall mounted volume controls in meeting rooms and other District specified areas.

1.9 INSTALLATION

- A. Install and balance the paging system volume levels according to ambient noise levels.
- B. Integrate with Telephone System PABX for access to zone paging and intercom (if applicable) functions.
- C. Establish building paging zones as directed by the School District.
- D. Provide programming and setup of paging zones, signal priorities, and bell (time tone) schedule.
- E. Connect to building antenna (if applicable) and ground in accordance with NEC and TIA/EIA-607.
- F. Install in accordance with manufacturer's installation instructions and recommendations.

1.10 TRAINING

- A. ***Provide a minimum of forty (40) hours of training to the District's personnel. Plan for multiple training trips to the site. Training session(s) shall cover the following topics at a minimum:***
 1. ***System Equipment Connectivity***
 2. ***Device Configurations***
 3. ***Operation, maintenance, and upgrade procedures.***
- B. ***Training to be arranged with District personnel. 40 hours should be spread out over the length of the warranty (Ex: 8 hours at project turnover/completion, 8 hours at 3 months, 8 hours at 6 months, 8 hours at 1 year, 4 hours at 2 years, 4 hours at 3 year).***
- C. ***Training to occur in maximum of 2 hour increments per personnel or groups of personnel.***
- D. ***Consider requiring Contractor to provide manufacturer training vouchers for a portion of the training, which are valid during the warranty period.***
- E. ***Training shall be by certified manufacturer instructor.***
- F. ***Training schedule shall be coordinated with District personnel and their needs.***
- G. ***Training plan, time line, and agenda shall be provided to District IT personnel and signed off by District and Contractor.***
- H. ***Warranty certificate and agreement shall be provided to District IT personnel at initial training session.***
- I. ***Provide a digital video copy of the training sessions.***

END OF SECTION

SECTION 275124

GYMNASIUM SOUND REINFORCEMENT SYSTEM

PART 1 - GENERAL GUIDELINES

1.1 GENERAL

- A. This section defines the general performance requirements for a Gymnasium Sound Reinforcement System that shall be followed for all OFCC Technology construction projects – High School, Middle School, and Elementary School facilities.
- B. Refer to OSDM Section 8500, Technology Systems, for additional information.

1.2 SECTION INCLUDES

- A. Gymnasium Sound Reinforcement System and all related components.

1.3 QUALITY ASSURANCE (utilize most current versions)

- A. NFPA 70 - National Electrical Code.
- B. Underwriter's Laboratory.
- C. TIA/EIA-607 Telecommunications Grounding.
- D. Most current version of the BICSI Telecommunications Distribution Methods Manual (TDMM).
- E. Americans with Disabilities Act (ADA).
- F. Federal Communications Commission Part 15.
- G. Sound System Engineering (Davis, Patronis & Brown) – 4th Edition 2013.
- H. Audio Systems Design and Installation (Giddings) 2013.

1.4 SYSTEM WARRANTY

- A. The Gymnasium Sound Reinforcement System shall be warranted by the contractor for a period of *three (3)* years from date of training and turn over to Owner.

1.5 MATERIALS

- A. Provide a fixed, secure location and equipment mounting cabinet for the installation and protection of all permanently installed sound reinforcement equipment that provides adequate power, ventilation and protection of the equipment contained therein. Rack shall incorporate front/rear locking doors, equipment drawers, equipment shelves, etc.
- B. The sound reinforcement system shall provide for audio input locations, audio source equipment, audio control and processing, amplification and sound distribution for the Gymnasium Space. The actual system configuration shall be established by the use requirements of the space.
- C. Audio inputs can include any one or more of the following:
 - 1. Microphone and auxiliary level outlets within the space.
 - 2. Local Building paging system.

- a. Used for signal to mute the Sound System upon building page when paging is delivered through a separate speaker system. Consider the use of local override when this option is utilized to prevent pages during actual performances.
 - b. Used for local area paging when the Gym Sound System components are used to deliver the audio pages.
 3. Fire alarm notification - Used for signal to mute the Gym Sound System upon fire alarm activation.
- D. Audio Sources can include any one or more of the following:
 1. Wireless microphone systems (true diversity, UHF, multi-channel).
 - a. Consider the use of remote antennas for optimal reception when receiver is not within line of sight of microphones during normal use.
 - b. Consider the use of antenna combiners and distribution when using multiple wireless receivers.
 2. Combo CD/MP3/Bluetooth Player.
 3. Digital Media Player/Network audio player.
 4. AM/FM/Satellite Radio (including required antennas).
 5. Push-to-talk microphone.
 6. Wired microphone with cable and stand.
 7. Audio input jack for portable MP3 player.
 8. Input from adjacent space sound reinforcement system (e.g. Cafeteria Sound System) where spaces are separated by non-fixed walls.
 - a. Consider a similar output from the Gym Sound System to a sound system in an adjacent space separated by non-fixed walls.
- E. Signal Processing must provide one of the following at a minimum:
 1. Digital Signal Processor(s)
 - a. Equalization Filters – graphic and/or parametric
 - b. Compressor/Limiter
 - c. Feedback Suppression (may be incorporated in DSP or a standalone unit)
 2. Speaker Processing
 - a. Where required by the use of tuned speakers/arrays.
 - b. Delay where utilizing distributed speaker system to reduce/eliminate comb filtering.
 3. Ambient Noise Compensation include ambient noise sensing microphones. System to automatically raise overall system volume to compensate for increased crowd noise.
 4. Sequencing AC Power Control System
- F. System Controls can include any one or more of the following:
 1. User control stations for volume/source selection located within the space and/or at the main equipment rack.
 2. Ethernet connected systems with remote PC/laptop/tablet operation.
 3. Mobile device APP control.
- G. Amplification and Sound Distribution must include the following at a minimum:
 1. Multi-channel Mixer/Preamplifier
 2. Power Amplifier(s)
 - a. Consider arranging system to allow for flexible zoning of speakers to include separate zones for floor coverage and bleacher coverage.
 3. Speaker System – Can be a combination of any of the following:
 - a. Distributed
 - b. Cluster/Array Speaker System
 - c. Subwoofer

4. Assistive Listening Transmitter (provide with ADA-compliant quantity and type of receivers)
 - a. Systems may utilize infra-red, RF or Induction technology.
 - b. Consider placement of antennas/transmitters within the space for optimal coverage.
 5. Line and microphone level cabling, balanced
 6. Speaker level cabling shall be designed based upon overall system design parameters, power handling, frequency response and distance.
 7. Control cabling to be provided as required by the system control devices and manufacturer's recommendations.
- H. Mobile Equipment Cabinet can include any of the audio sources listed above. In addition, the following can be provided with the mobile equipment rack:
1. Rack drawer for storage of loose items such as cables, microphones, batteries, etc.
 2. Power strip with single on/off button for all equipment in mobile cabinet.
- I. Provide Ethernet connectivity at the main equipment rack where required by network enabled system components.

1.6 INSTALLATION

- A. Provide specifications for the proper installation of all components of the sound system, observing code requirements, industry standards and "best practices".
- B. Provide specifications covering the complete system testing, balancing and start-up. Provide specifications covering the proper grounding of all system components.

1.7 PERFORMANCE TESTING

- A. The system shall provide the following minimum performance criteria:
 1. Full range system operating in the frequency response range of: 100Hz – 14kHz +/- 3 dB.
 2. Loudness: High School Varsity Gym: At least 100dB-SPL program level with an additional 6dB Crest factor; Middle, Elementary School and Auxiliary Gym: At least 96dB-SPL program level with an additional 6 dB Crest factor.
 3. Evenness of coverage: Variation of less than +/- 3 dB (400Hz to 4000Hz) at all seats.
 4. Intelligibility – Average STI not less than 0.6 in 90% of the coverage area.
- B. Specifications shall require installer to provide testing equipment and testing to verify system performs to the stated minimum performance criteria. Provide certified test report to the Owner or Engineer for review and approval, before final acceptance is given to the system".

1.8 TRAINING

- A. Provide an appropriate amount of training for District's personnel on the operation and maintenance of the system. Consider the complexity of the system and the number/skill level of staff who will be utilizing the system. A minimum of eight (8) hours of training is required.
- B. Provide **a digital video** copy of all training.

END OF SECTION

SECTION 275125

MUSIC ROOM AUDIO PROGRAM PLAYBACK SYSTEM – MIDDLE SCHOOL

PART 1 - GENERAL GUIDELINES

1.1 GENERAL

- A. This section defines the general performance requirements for a Music Room Sound Reinforcement System that shall be followed for all OFCC Technology construction projects.
- B. Refer to OSDM Section 8500, Technology Systems, for additional information.

1.2 SECTION INCLUDES

- A. Music room sound system and components for playback of audio program material.

1.3 QUALITY ASSURANCE (utilize latest version)

- A. NFPA 70 - National Electrical Code.
- B. Underwriter's Laboratory.
- C. TIA/EIA-607 Telecommunications Grounding.
- D. BICSI Telecommunications Distribution Methods Manual (TDMM).
- E. American with Disabilities Act.
- F. Federal Communications Commission Part 15.
- G. Sound System Engineering (Davis, Patronis & Brown) – 4th Edition 2013.
- H. Audio Systems Design and Installation (Giddings) 2013.

1.4 SYSTEM WARRANTY

- A. The Sound System shall be warranted by the contractor for a period of **three (3)** years from date of training and Owner acceptance.

1.5 MATERIALS

- A. Mobile or permanently mounted main equipment rack to house:
 - 1. Audio input sources and outlets.
 - 2. System mixer.
 - 3. System EQ/DSP.
 - 4. System amplifier(s).
- B. Wall mounted speakers
 - 1. Speaker wiring connection outlets.

1.6 INSTALLATION

- A. Provide specifications for the proper installation of all components of the sound system, observing code requirements, industry standards and “best practices”.
- B. Provide specifications covering the complete system testing, balancing and start-up.

1.7 TRAINING

- A. Provide four (4) hours training for District’s personnel on the operation and maintenance of the system.
- B. Provide **a digital video** copy of all training.

END OF SECTION

SECTION 275126

MUSIC ROOM AUDIO RECORDING/PLAYBACK SYSTEM – HIGH SCHOOL

PART 1 - GENERAL GUIDELINES

1.1 GENERAL

- A. This section defines the general performance requirements for a Music Room Sound Reinforcement System that shall be followed for all OFCC Technology construction projects.
- B. Refer to OSDM Section 8500, Technology Systems, for additional information.

1.2 SECTION INCLUDES

- A. Music room sound system and components for recording and playback of audio program material.

1.3 QUALITY ASSURANCE (utilize latest version)

- A. NFPA 70 - National Electrical Code.
- B. Underwriter's Laboratory.
- C. TIA/EIA-607 Telecommunications Grounding.
- D. BICSI Telecommunications Distribution Methods Manual (TDMM).
- E. American with Disabilities Act.
- F. Federal Communications Commission Part 15.
- G. Sound System Engineering (Davis, Patronis & Brown) – 4th Edition 2013.
- H. Audio Systems Design and Installation (Giddings) 2013.

1.4 SYSTEM WARRANTY

- A. The Sound System shall be warranted by the contractor for a period of **three (3)** years from date of training and Owner acceptance.

1.5 MATERIALS

- A. Mobile or permanently mounted main equipment rack to house.
 - 1. Audio input sources and outlets.
 - 2. System mixer.
 - 3. Digital audio recorder.
 - 4. System EQ/DSP.
 - 5. System amplifier(s).
- B. Wall mounted speakers – stereo pair.
- C. Wall mounted speaker jack plate – for connection of amplifier in mobile rack to permanently mounted speakers.

- D. Ceiling mounted recording microphones.

1.6 INSTALLATION

- A. Provide specifications for the proper installation of all components of the sound system, observing code requirements, industry standards and “best practices”.
- B. Provide specifications covering the complete system testing, balancing and start-up.

1.7 TRAINING

- A. Provide four (4) hours training for District’s personnel on the operation and maintenance of the system.
- B. Provide **a digital video** copy of all training.

END OF SECTION

SECTION 275127

CLASSROOM SOUND REINFORCEMENT SYSTEM

PART 1 - GENERAL GUIDELINES

1.1 GENERAL

- A. This Section defines the general design requirements for a uniform Classroom Sound Reinforcement System that shall be followed for all OFCC Technology construction projects.
- B. Refer to Section 8500, Technology Systems for additional information.

1.2 SECTION INCLUDES

- A. Classroom sound reinforcement system and components.

1.3 QUALITY ASSURANCE

- A. NFPA 70 – National Electrical Code.
- B. Underwriter's Laboratory.
- C. Latest ANSI TIA/EIA-568, 569, 606, 607 Standards and Eleventh Edition (or later).
- D. Eleventh Edition (or latest) BICSI Telecommunications Distribution Methods Manual (TDMM).
- E. American with Disabilities Act.
- F. Federal Communications Commission Part 15.

1.4 SYSTEM WARRANTY

- A. The Sound System shall be warranted by the contractor for a period of **three (3)** years from date of substantial completion.

1.5 CLASSROOM SOUND REINFORCEMENT SYSTEM

- A. IR or RF Receiver/Amplifier, equipped with:
 - 1. Minimum of 30-Watts RMS Watts total output.
 - 2. Minimum of 250-10KHz frequency response.
 - 3. Two (2) wireless microphone input channels with individual volume controls.
 - 4. Tone Controls or Equalizer.
 - 5. Minimum of three (3) auxiliary line inputs with individual volume controls.
 - 6. Minimum of one (1) line output for optional ADA, wireless headphone system.
 - 7. System Power Supply.
 - 8. Power Switch.
 - 9. Minimum of two (2) wireless microphone frequencies.
 - 10. Infrared or RF receivers as required in each space for full area coverage receivers remote from main unit shall be provided with required plenum cabling.
 - 11. One (1) Lavalier/collar/pendant worn microphone, with rechargeable batteries and charger.
 - 12. One (1) Handheld microphone, with rechargeable batteries and charger.
 - 13. Full range speakers, provided in quantities and locations to minimize the direct sound path distance for all students within the space.

14. Receiver/Amplifier must be capable of being placed in a variety of locations with no loss of signal strength.
 15. Unit must provide uniform pickup from the Instructor's microphone throughout the classroom.
 16. Provide means for the central paging system and fire alarm system to mute or override the classroom sound reinforcement system when a central page occurs.
 17. Both IR or encrypted RF technologies are acceptable, providing transmission does not interfere with reception in other rooms. Multi-channel, encrypted RF systems shall provide auto frequency selection.
 - a. Special Note – Systems that utilize IR may be incompatible with interactive projectors/pens and occupancy sensors that also utilize IR.
- B. Optional – Provide quantity of two (2) FM/Bluetooth Assisted Listening Systems interfacing with Classroom Sound Reinforcement System per school building.

1.6 INSTALLATION

- A. Install in accordance with manufacturer's installation instructions.
- B. Per Speaker, provide minimum of 16 AWG, CMP rated speaker wire. Wire gauge based on cable lengths and power ratings.
- C. Provide mounting hardware, where required, for unit within each room.
- D. Provide required quantity of speakers sensors/receivers in large classrooms, as required, to maintain complete coverage.
- E. Classroom Sound Reinforcement system shall be installed in all Educational spaces regularly seating more than 20 students.
- F. Classroom Sound Reinforcement system shall be integrated with the classroom A/V system.

1.7 TRAINING

- A. Provide four (4) hours training for District's personnel on the operation and maintenance of the system.
- B. Provide **a digital video** copy of all training.

END OF SECTION

SECTION 275313

CLOCK SYSTEMS

PART 1 - GENERAL GUIDELINES

1.1 GENERAL

- A. This Section defines the general design requirements for a uniform Building-wide Synchronized Clock System that shall be followed for all OFCC Technology construction projects.
- B. The options are defined in Parts 2 and 3 of this guideline.
- C. Refer to Section 8500, Technology Systems, for additional information.

1.2 SECTION INCLUDES

- A. Master Clocks, Secondary Clocks and accessory components.

1.3 QUALITY ASSURANCE

- A. NFPA 70 – National Electrical Code
- B. Underwriter's Laboratory
- C. TIA/EIA-607 Telecommunications Grounding
- D. *Eleventh* edition (or latest) BICSI Telecommunications Distribution Methods Manual (TDMM)

1.4 SYSTEM WARRANTY

- A. The Clock System shall be warranted by the Contractor for a period of **three (3)** years from date of substantial completion.

1.5 RELATED SECTIONS

- A. Specification Section 275123 - Central Sound and Paging System

1.6 GENERAL

- A. Synchronized with the United States Atomic Clock via GPS receiver with external antenna, NTP Internet connection, or CDMA.
- B. Self-correcting for Daylight Savings Time changes.
- C. Analog Secondary Clocks:
 - 1. 12" diameter minimum, surface-mounted with hour, minute, and second hands in impact resistant molded plastic case.
 - 2. Corridors: Double-faced, securely mounted perpendicular to wall or ceiling mounted.
 - 3. Gymnasiums: 15" diameter minimum. Provide wire guards in gymnasiums, auxiliary gymnasiums, and locker rooms.
- D. Digital Secondary Clocks:
 - 1. 2.3" height minimum, 4-digit, 7-segment LED display.

2. Corridors: Double-faced with perpendicular wall or ceiling mount.
 3. Gymnasiums: 4" height minimum, 4-digit, 7-segment LED display. Provide wire guards or polycarbonate shield in gymnasiums, auxiliary gymnasiums, and locker rooms.
 4. Optional Text Messaging capability and/or class change count down.
- E. Master Clock with software-programmable, integral building bell schedule and audible tone generator with selectable tones to provide class change tones to input of Central Sound System.
1. Minimum of four (4) selectable, pre-programmed class change schedules, easily selectable from the main school office.
 2. Manual activation of audible tone from the main school office.
 3. Permanent or periodic temporary RS-232 connection to PC for data download update of class change schedules.
 4. NOTE: Where Central Sound Systems with built-in tone generator and programmable bell schedule function are utilized, the Master Clock need only to be able to synchronize time with the Central Sound System headend processor.

1.7 WIRELESS CLOCK SYSTEMS

- A. Battery-operated - minimum 5-year battery life
- B. Provide RF transmitters and antennas, as required to provide complete building-wide coverage.

1.8 WIRED CLOCK SYSTEMS

- A. Low-voltage power – 24V or less
- B. Central or distributed power supplies as required
- C. Optional IEEE 802.3af, Power Over Ethernet (POE) connectivity

1.9 INSTALLATION

- A. Securely mount the clocks flush on the walls in classrooms and office areas.
- B. Connect tone generator output to input of Central Sound System if function is not provided by that system.
- C. Synchronize time with the Central Sound System master clock if the tone generation and program schedule functions are provided by that system.
- D. Program initial bell schedules as provided by the Owner.

1.10 TRAINING

- A. Provide four (4) hours training for School/District personnel on the operation, programming, and maintenance of the system.
- B. Provide **a digital video** copy of all training.

END OF SECTION