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SECTION 270526

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

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 OSFC Technology construction projects.
 - 1. Figure 1 describes the Telecommunications Bonding System
 - 2. 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).

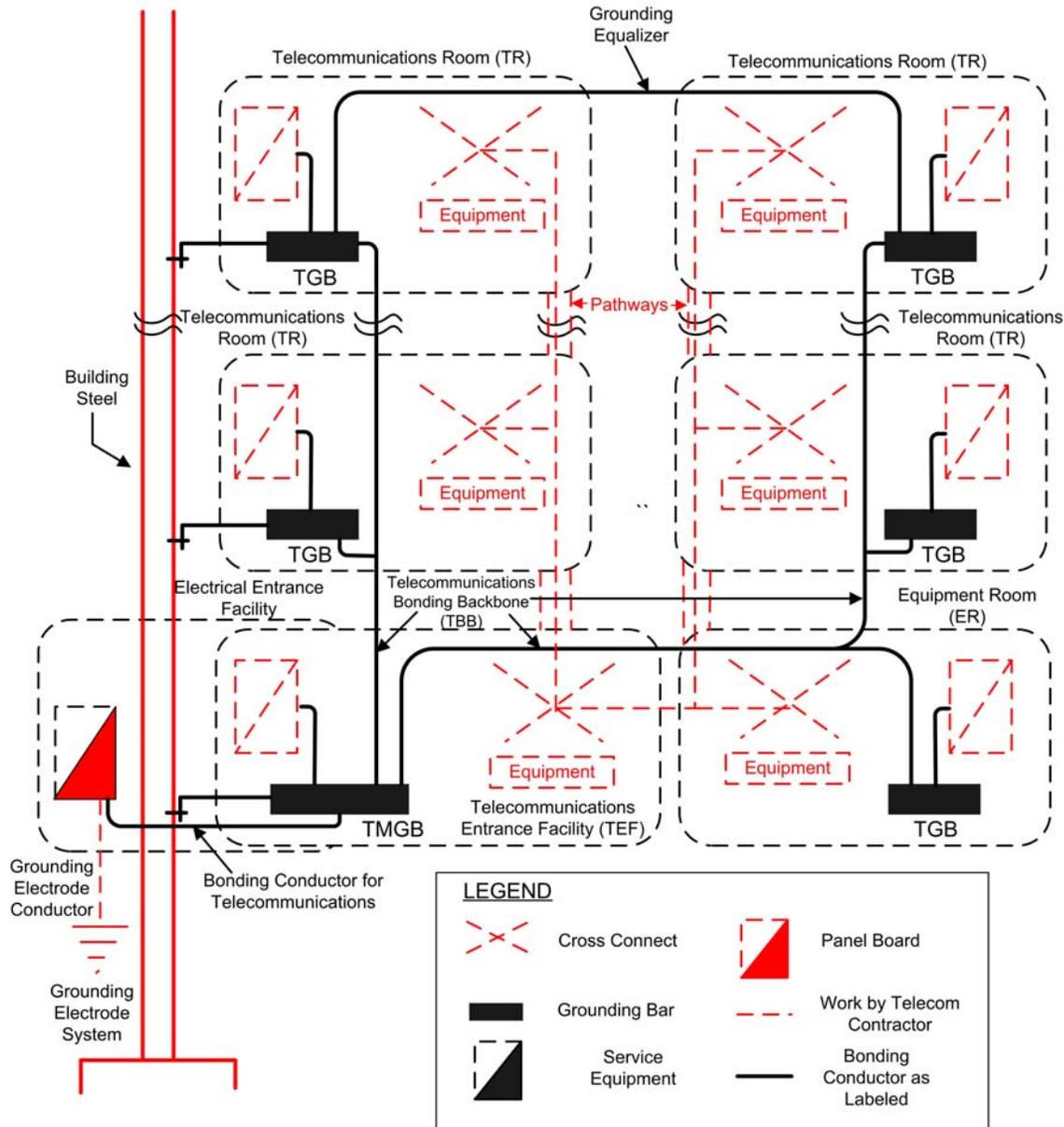


Figure 1 – Telecommunications Bonding System

1.4 TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB)

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

- 1.5 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.
- 1.6 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 chapter 9 (Bonding and Grounding).***
- 1.7 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.
- 1.8 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).

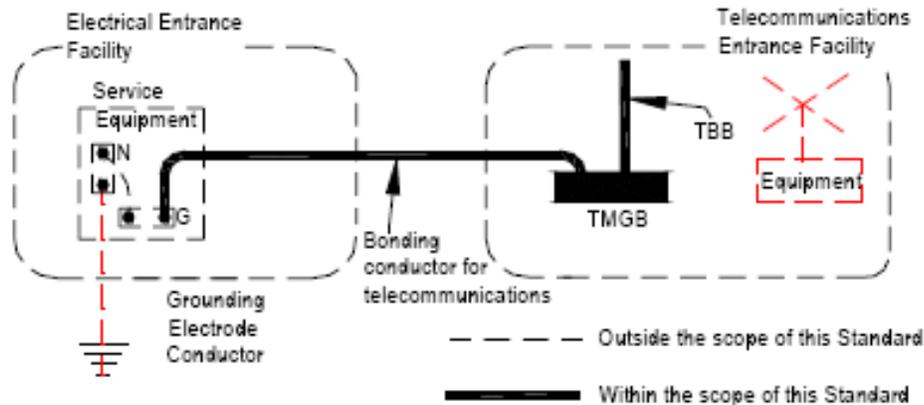


Figure 3 – Connection to Grounding Electrode

- 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).
- C. As a minimum, the Technology Contractor shall bond the following devices to the associated TMGB and TGBs using a minimum No. 6 AWG insulated copper bonding conductor using compression style lugs:
1. Antenna Cable Shields
 2. Backbone Cable Shields
 3. CATV Equipment
 4. Coupled Bonding Conductors (CBCs)
 5. Equipment Racks and Cabinets
 6. Lightning and Surge Protectors
 7. PABX Equipment
 8. Raised Floors
 9. Telecommunication and Fiber Cable Shields
 10. Telecommunications Devices
 11. TR Cable Ladder and Tray

END OF SECTION

SECTION 271100

COMMUNICATIONS EQUIPMENT ROOM FITTINGS

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 OSFC Technology construction projects.
 - 1. Communications Rooms consist of:
 - a. Main Equipment Room (ER)
 - b. Telecommunication Rooms (TR)
 - 2. Figure 1 describes a typical Communications Room
 - 3. Refer to Section 8500, Technology Systems, and Section 8600, Electrical Systems, for additional information.

1.2 SECTION INCLUDES

- A. Equipment Room (ER)
- B. Telecommunication Rooms (TR)
- C. Equipment Backboards
- D. Equipment Racks and Cabinets
- E. Cable Ladder and Cable Tray

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 Racks and Cabinets shall comply with the latest ANSI/EIA-310 Cabinets, Racks, Panels and Associated Equipment Standard.

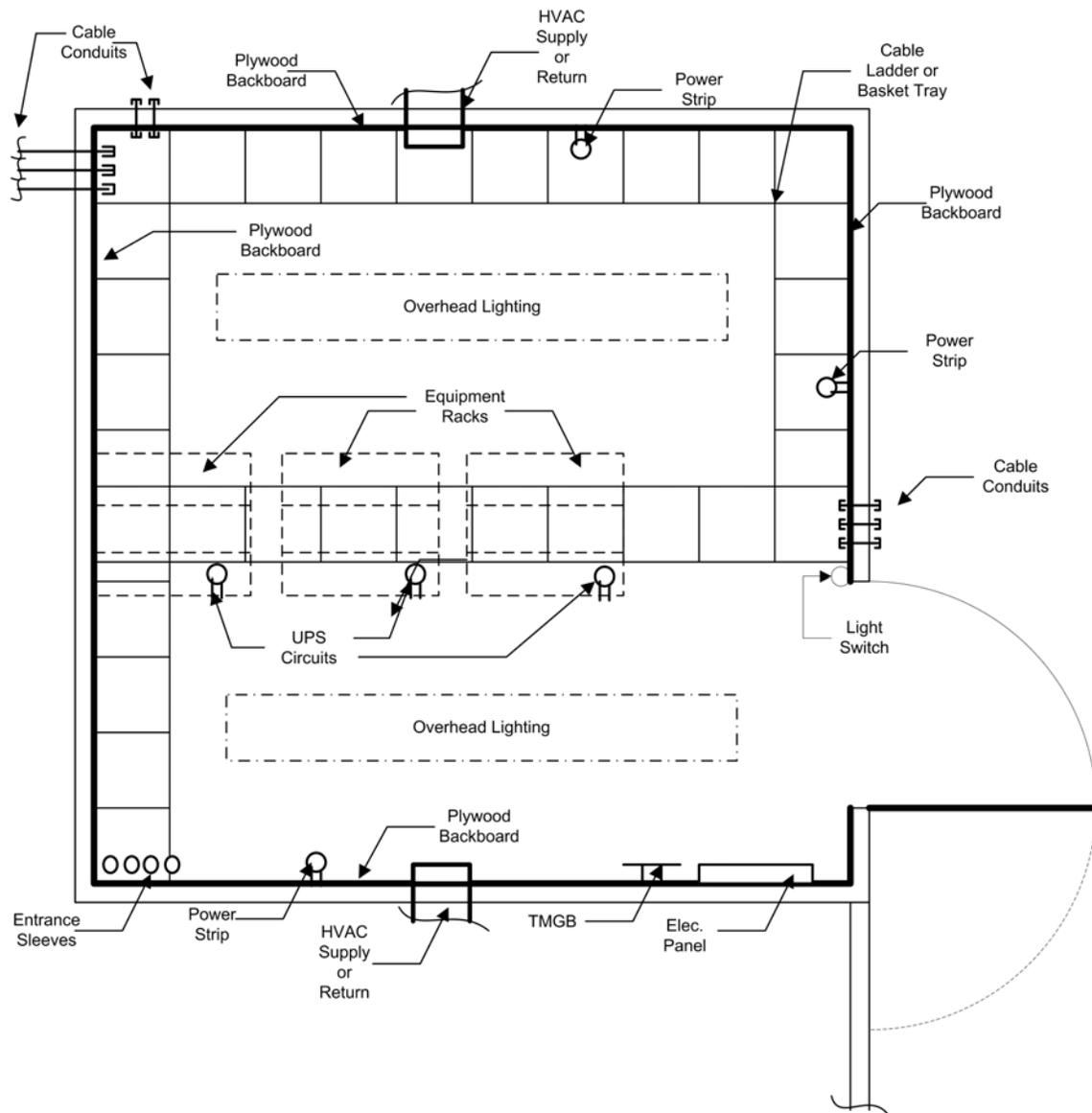


Figure 1 - Typical 10 ft x 10 ft Communications Room

1.4 EQUIPMENT ROOM (ER) GENERAL

- A. Each Building shall be equipped with at least 1 ER
- B. Locate the ER in a Central area of the Building.
- C. For multiple story buildings, consider centrally locating the ER so it can serve multiple floors.
- D. Extend Service Entrance Conduits to the ER
- E. The ER typically contains the following equipment:

1. ACTIVE EQUIPMENT
 - a. Access Control Systems
 - b. CATV Systems
 - c. CCTV Systems
 - d. Clock Systems
 - e. Intercom Systems
 - f. Network Electronics
 - g. Paging Systems
 - h. PBX Equipment
 - i. Security Electronics
 - j. UPS Systems
 - k. Video Systems
 - l. Voice Mail Systems
 - m. Wireless Electronics

2. CROSS-CONNECT EQUIPMENT
 - a. Racks
 - b. Cabinets
 - c. Patch Panels
 - d. Backboards
 - e. 110 Blocks

3. BUILDING FACILITIES EQUIPMENT
 - a. Associated HVAC Equipment
 - b. Associated Electrical Equipment

1.5 TELECOMMUNICATION ROOM (TR) GENERAL

- A. When more than one Equipment Room (ER) is required, additional satellite Telecommunications Rooms (TRs) shall be provided.

- B. Centrally locate the TRs in the areas being served.

- C. For multiple story buildings, consider centrally locating the TRs so they can serve multiple floors.

- D. The TR typically contains the following equipment:
 1. ACTIVE EQUIPMENT
 - a. CATV Systems
 - b. Network Electronics
 - c. UPS Systems
 2. CROSS-CONNECT EQUIPMENT
 - a. Racks
 - b. Cabinets
 - c. Patch Panels
 - d. Backboards
 - e. 110 Blocks
 3. BUILDING FACILITIES EQUIPMENT
 - a. Associated HVAC Equipment
 - b. Associated Electrical Equipment

- E. Fiber and Copper Backbone cables shall be provided to interconnect the TR(s) with the ER.

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1.6 ER AND TR REQUIREMENTS

- A.** *Verify and coordinate ER/TR quantity, size and location with the Design Professional during the programming phase.*
1. *Refer to the OSDM space plates for minimum SF requirements.*
 2. *Consider additional space requirements if district is considering thin client or N.O.C. applications.*
- B.** The minimum ER and TR minimum ceiling heights shall be 8 feet (2.4 m) above finished floor (AFF). Consideration should be given to 10 ft (3 m) ceilings.
- C.** The ER and TR shall be rectangular in shape.
- D.** 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.
- E.** The ER and TR shall have tiled floors.
- F.** The ER 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.
- G.** Provide each ER and TR with an HVAC system that maintains continuous environmental control 24 hours per day, 365 days per year.
- H.** Maintain temperature between 64° F (18° C) to 75° F (24° C).
- I.** Maintain relative humidity between 30% and 55% -- non-condensing.
- J.** Provide Telecommunications Grounding Systems
- K.** Provide the following minimum clearances:
1. Minimum of 40 in. (1 m) between equipment racks and the front of cross-connect fields.
 2. Allow a minimum of 6 in. (150 mm) from the wall for wall-mounted equipment.
 3. Minimum of a 40 in. (1 m) aisle in front of and behind all equipment racks and cabinets.
 4. Minimum of 36 in. (0.91 m) floor area depth for equipment racks and cabinets.
- L.** Provide sufficient Generator Electrical circuits to service the associated UPS units.
- M.** Power all active devices from UPS units, which are connected to the Building generator.
- N.** Provide a minimum of 500 lux (50-foot candles of uniform lighting when measured at 3 feet AFF.
- O.** Use light colored walls to enhance lighting.

1.7 EQUIPMENT BACKBOARDS

- A.** Cover at least two (2) walls with AC grade or better, void free ¾ in. (19 mm) plywood at least 8 feet (2.4 m) high.
- B.** Place the grade C surface towards the wall and coat the plywood with two coats of fire-retardant white paint.

1.8 EQUIPMENT RACKS

- A. Place equipment racks or cabinets in a continuous row.
- B. Equipment racks shall be black, 84 inches high, have 19 inch EIA, pre-tapped, mounting rails and shall have integral, 5 inch minimum, vertical cable organizers on both the left and right of the rack.
- C. Equipment racks shall be provided with rear vertical cable organizers on both the left and right side of the rack.
- D. Provide at least one 4-posted rack or equipment cabinet in the ER for placing file servers and other equipment requiring four-corner mounting.
- E. Equipment racks are the preferred equipment-mounting device.
- F. When equipment cabinets are furnished, they shall be black, have vented side panels and lockable front and back doors. Cabinets shall be a minimum of **24** inches (**610** mm) wide by a minimum of **42** in. (**1.07 m**) deep and 84 in. (2.15 m) high.
- G. All equipment racks and cabinets shall be of the same manufacturer and model type.

1.9 CABLE LADDER AND CABLE TRAY

- A. Line the walls of the ER and TR with a minimum of 12 in (305 mm) wide cable ladder or wire basket cable tray for cable management.
- B. Provide a minimum of 12 in (305 mm) wide cable ladder or wire basket cable tray over the tops of racks and cabinets for cable management.



Figure 2 -- Typical Communications Room Cable Conduits



Figure 3 -- Typical Communications Room Overhead Cable Ladder and Backboard

1.10 GENERAL

- 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. Coordinate the location of lighting equipment so that fully loaded cable trays and ladder do not impede or obstruct the lighting.

END OF SECTION

SECTION 271313

COMMUNICATIONS COPPER BACKBONE CABLING

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 OSFC Technology construction projects.
1. Figures 1, 2 and 3 describe a typical Intra-Building Communications Copper Backbone Cabling Systems
 2. Figure 4 describes a typical Inter-Building Communications Copper Backbone Cabling System
 3. 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 (ER) to Telecommunication Rooms (TR) Voice Backbone Cable System.
 2. Main Equipment Room (ER) to Telecommunication Rooms (TR) Data Backbone Cable System.
 3. Entrance Facility (EF) to Main Equipment Room (ER) Voice Backbone Cable System.
 4. Entrance Facility (EF) to Main Equipment Room (ER) Data Circuit Backbone Cable System.
- B. INTER-BUILDING COPPER BACKBONE CABLE SYSTEMS
1. Main Equipment Room (ER) to Main Equipment Room (ER) 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.

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- 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.

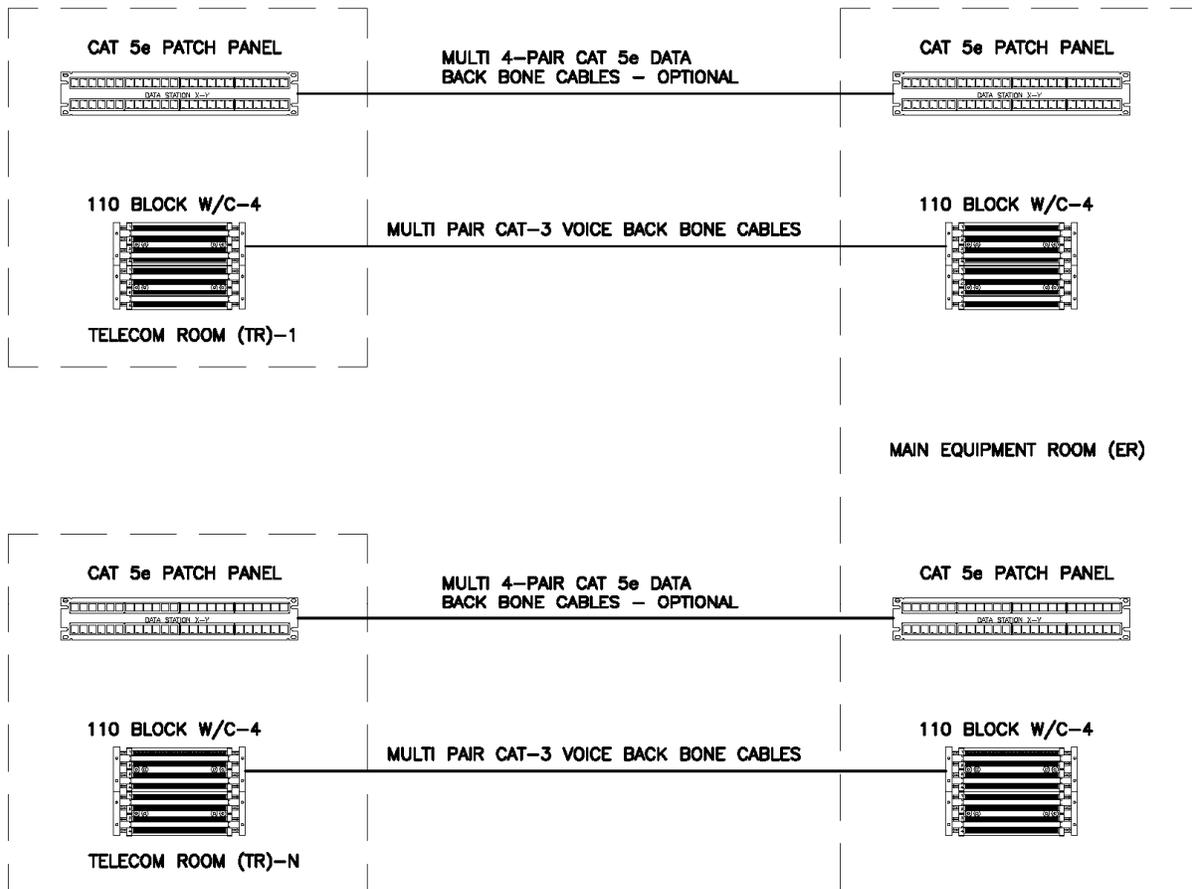


Figure 1 – Main Equipment Room (ER) to Telecommunication Rooms (TRs) Data and Voice Backbone Cable System, Option - 1

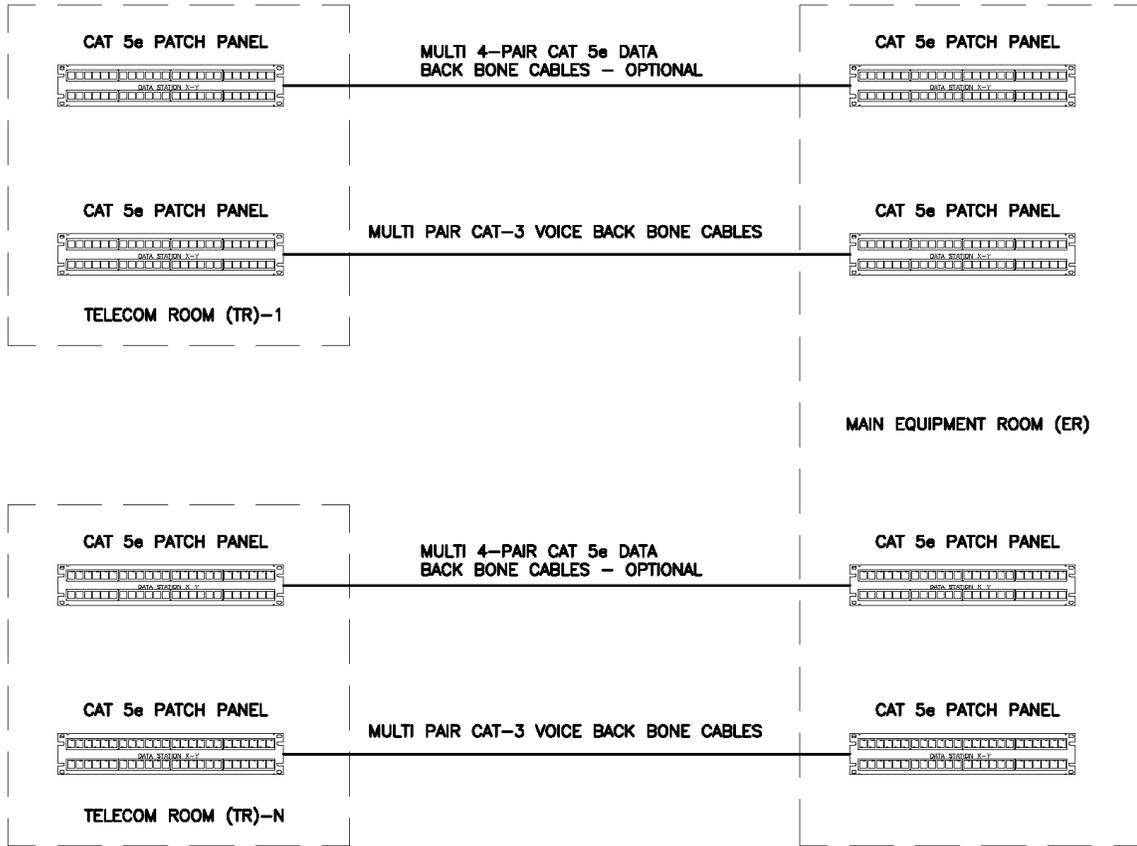


Figure 2 – Main Equipment Room (ER) to Telecommunication Rooms (TRs) Data and Voice Backbone Cable System, Option – 2

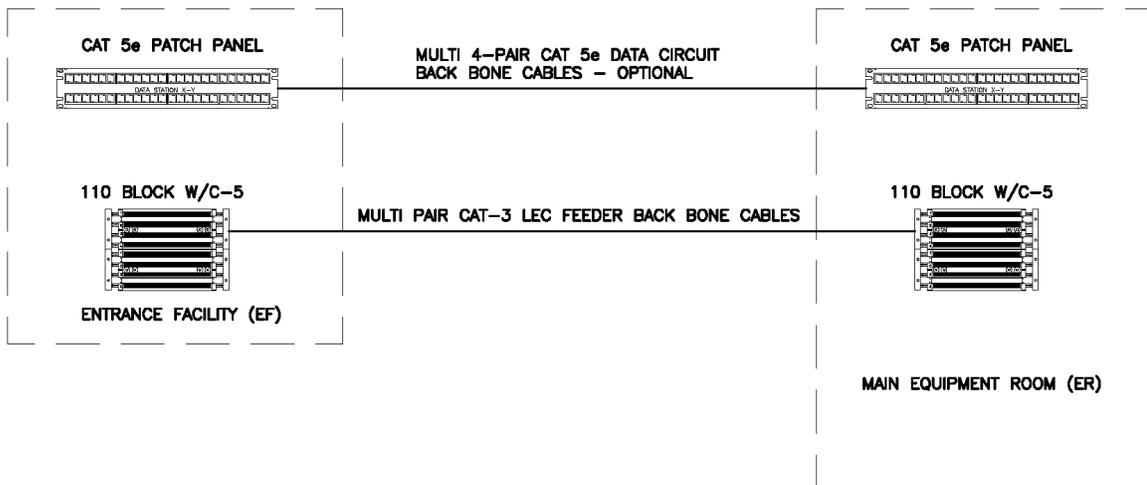


Figure 3 – Entrance Facility (EF) to Main Equipment Room (ER) Data Circuit and Voice Backbone Cable System

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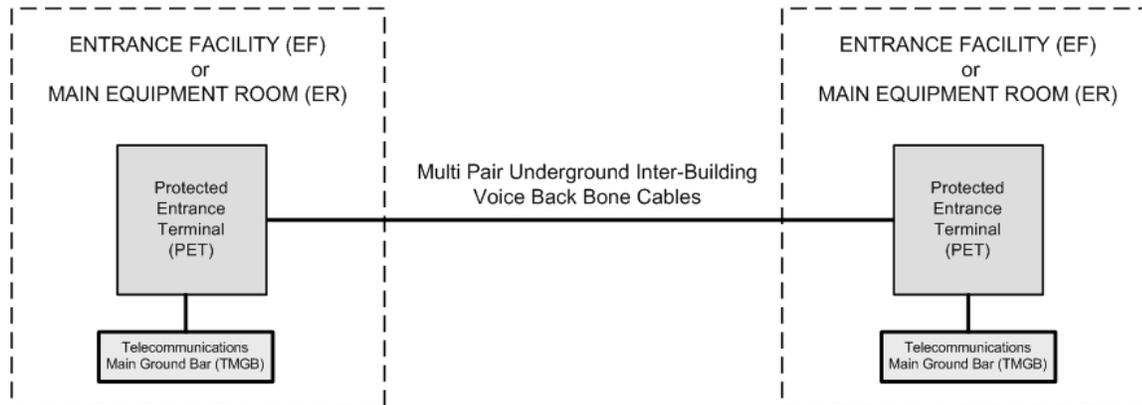


Figure 4 – Main Equipment Room (ER) to Main Equipment Room (ER) Inter-Building Voice Backbone Cable System

1.4 INTRA-BUILDING COPPER BACKBONE CABLE SYSTEMS

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

1. When the School has a Traditional IP-Enabled PBX Phone System, provide a multi-pair CAT-3 Voice Backbone system between the ER and the associated TRs, sufficient to serve all voice stations with 2 pairs in the backbone.
2. When the School has an all-IP Phone System, a minimal 25-pair CAT-3 Voice Backbone is recommended by not required.
3. Provide a minimum of one (1) 100-pair cable between the ER and each associated TR. Equip cables in increments of 100 pairs. **For TE/TR serving less than 24 users, provide a minimum 50 pair cable.**
4. Provide a minimum of **one (1) pair** per associated TR telephone outlet **with 50% spare capacity**.
5. Terminate 100-pair cables on 110 Blocks using C-4 Clips or Cat-5e, rack-mounted, patch panels as minimum 2-pair circuits – See figures 1 and 2 above.

B. MAIN EQUIPMENT ROOM (ER) TO TELECOMMUNICATION ROOMS (TR) DATA CIRCUIT BACKBONE CABLE SYSTEM - **OPTIONAL**

1. Provide a minimum of six (6) four-pair, Cat-5e/6 cables to match category rating of data cables between the ER and each associated TR.
2. Terminate the cables on Cat-5e/6, rack-mounted, Patch panels at each end. – See figures 1 and 2 above.

C. ENTRANCE FACILITY (EF) TO MAIN EQUIPMENT ROOM (ER) 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. Provide a minimum of one (1) 100-pair cable between the EF and each associated ER. Equip cables in increments of 100 pairs.
4. Terminate LEC Feeder, 100-pair cables on 110 Blocks using C-5 Clips at both ends. – See figure 3 above.

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

1. When the Entrance Facility is not co-located in the Main Equipment Room (ER) provide a minimum of six (6) four-pair, Cat-5e cables between the EF and the ER for the extension of special circuits (T-1, PRI, etc.) provided by the Service Provider (SP) - **Optional**.
2. Terminate the cables on a Cat-5e, wall-mounted, Patch panel at the EF end and on a Cat-5e, wall-mounted or rack-mounted patch panel at the ER end. – See figure 3 above.
3. Terminate LEC Feeder, 100-pair cables on 110 Blocks using C-5 Clips at both ends. – See figure 4 above.

1.5 INTER-BUILDING COPPER BACKBONE CABLE SYSTEMS

A. MAIN EQUIPMENT ROOM (ER) TO MAIN EQUIPMENT ROOM (ER) 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, underground or aerial telecommunications cable between the ER or EF of the building containing the common Phone System and the ER or EF of each of the associated satellite buildings.
2. Provide a minimum of 25 pairs.
3. Provide a minimum of one pair for each active telephone outlet in the associated satellite building.
4. Provide a minimum of 25 % spare pairs for growth.

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5. 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.
6. Terminate the inter-building cables on Protected Entrance Terminals (PETs) at both ends. – See figure 4 above.
7. Provide Gas-Tube Protector Modules for all pairs at both ends.
8. Ground the Cable sheath and the PET to the associated Telecommunications Main Grounding Bus (TMGB) at both ends.
9. Depending on the application, provide metal protective sheaths and appropriate rodent protection devices for aerially installed Telecommunications cables.

1.6 INSTALLATION

- A. All cabling shall be installed according to ANSI/EIA/TIA specifications and BISC1 standards.
- B. All Cat-5e cabling shall be terminated on Cat-5e (minimum) patch panels and jacks as noted above.
- C. All system multi-pair voice backbone cabling shall be terminated on Cat-5e (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.

1.7 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.

1.8 TESTING

- A. All Cat-5e (or Cat-6) backbone cables shall be tested to Cat-5e (or Cat-6) 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

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 OSFC Technology construction projects.
1. Figure 1 describes a typical Intra-Building Communications Optical Fiber Backbone Cabling System
 2. Figure 2 describes a typical Inter-Building Communications **Optical Fiber** Backbone Cabling System
 3. 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 (ER) to Telecommunication Rooms (TR) Fiber Optic Backbone Cable System
- B. INTER-BUILDING OPTICAL FIBER BACKBONE CABLE SYSTEMS
1. Main Equipment Room (ER) to Main Equipment Room (ER) Fiber-Optic Backbone Cable System
- C. OPTICAL FIBER PATCH PANEL SYSTEMS
1. Fiber-Optic Patch Panels
 2. Fiber-Optic Connectors
 3. Fiber-Optic 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- μm Core Diameter/125- μm 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- μm Core Diameter/ 125- μm 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 fiber-optic cabling; including patch panels, patch cables, terminations and labor. The remaining portions of the system shall be warranted for a period of one (1) year from date of substantial completion.

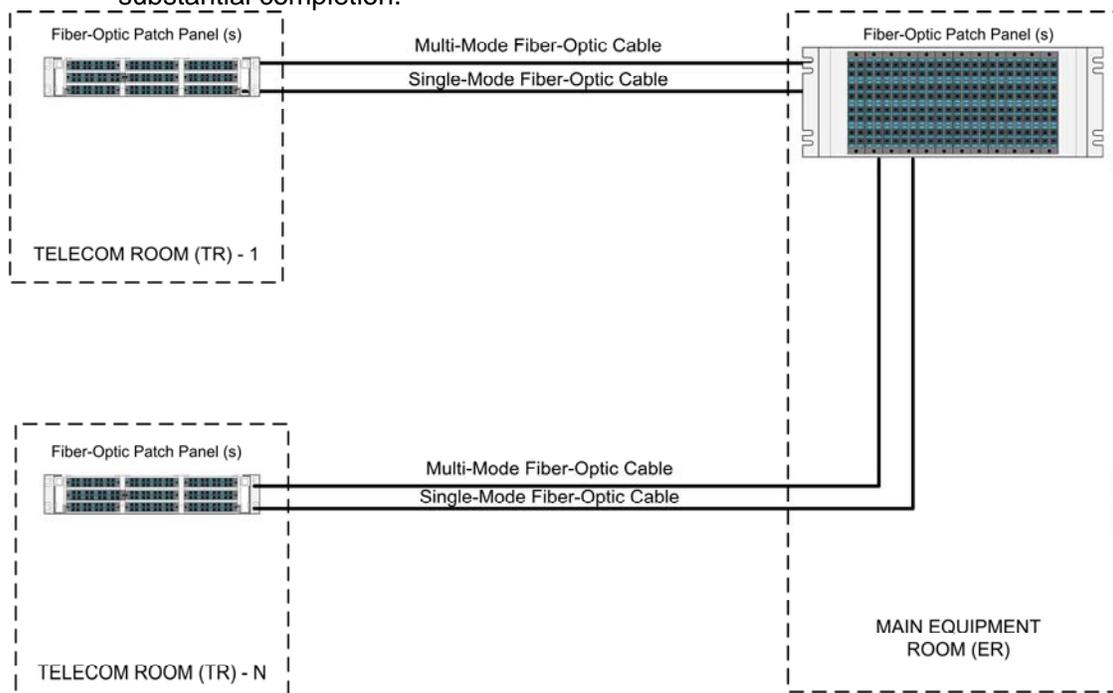


Figure 1 – Main Equipment Room (ER) to Telecommunication Rooms (TRs) Fiber-Optic Backbone Cable System

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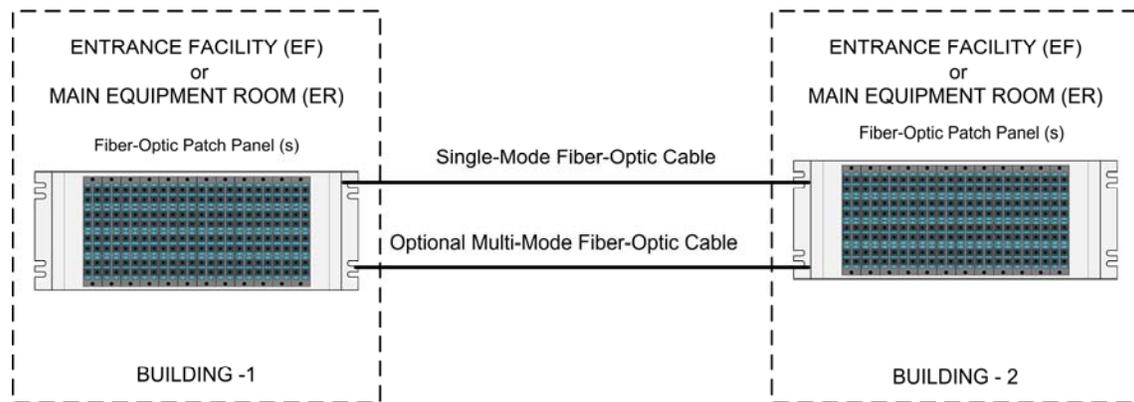


Figure 2 – Main Equipment Room (ER) to Main Equipment Room (ER) Inter-Building Fiber-Optic Backbone Cable System

1.5 INTRA-BUILDING OPTICAL FIBER BACKBONE CABLE SYSTEMS

A. MAIN EQUIPMENT ROOM (ER) TO TELECOMMUNICATION ROOMS (TR) FIBER-OPTIC 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. Upgrade existing Optical Fiber Backbone Systems to the following requirements.
- c. Ground the Cable sheath of aerial fiber-optic cables to the associated Telecommunications Main Grounding Bus (TMGB) at both ends.
- d. Depending on the application, provide metal protective sheaths and appropriate rodent protection devices for aerially installed fiber-optic cables.

2. MULTI-MODE FIBER-OPTIC CABLE

- a. Provide a Multi-Mode, Fiber-Optic Cable between the Main Equipment Room and each associated Telecommunications Room (TR).
- b. The Multi-Mode, Fiber-Optic cable shall be 50/125, **OM4** micron laser optimized fiber. (62.5/125 is acceptable for legacy systems)
- c. The entire District must utilize either 62.5/125 OR 50/125 micron fibers. A combination of both types is not recommended.
- d. The Multi-Mode, Fiber Optic cable shall be OFNP rated, tight-buffered and installed in plenum rated inner-duct.
- e. The Multi-Mode, Fiber-Optic cable shall be sized per the following formula; # strands: 6 strands per 48 ports. TR serving less than 96 users shall be minimum 12 strands.
- f. Provide spare fibers after initial Network Configuration Design.
- g. 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.

- i. 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 FIBER-OPTIC CABLE
- a. Provide a Single-Mode, Fiber-optic Cable between the Main Equipment Room (ER) and each associated Telecommunications Room (TR).
 - b. The Single-Mode, Fiber Optic cable shall be 8.7/125 micron fiber.
 - c. The Single-Mode, Fiber Optic cable shall be OFNP rated, tight-buffered and installed in plenum rated inner-duct.
 - d. The Single-Mode, Fiber Optic cable shall be a minimum 6 strands per TR to ER.
 - e. 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.
 - f. Angle-Polished Connectors (APC) shall be utilized on all Single-mode fibers used to support AM Video (CATV, etc.) applications.

1.6 INTER-BUILDING OPTICAL FIBER BACKBONE CABLE SYSTEMS

A. MAIN EQUIPMENT ROOM (ER) TO MAIN EQUIPMENT ROOM (ER) INTER-BUILDING FIBER-OPTIC 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 ERs.
- c. Upgrade existing Optical Fiber Backbone Systems to the following requirements.

2. MULTI-MODE FIBER-OPTIC CABLE - OPTIONAL

- a. Provide an optional Multi-Mode, Fiber-Optic Cable between the Main Equipment Room (ER) of the Network Center and each associated Building's Main Equipment Room (ER).
- b. The Multi-Mode, Fiber-Optic cable shall be 50/125, **OM4** micron laser optimized fiber. (62.5/125 is acceptable for legacy systems.)
- c. The entire District must utilize either 62.5/125 OR 50/125 micron fibers. A combination of both types is not recommended.
- d. The Multi-Mode, Fiber Optic cable shall be gel-filled or indoor/outdoor rated, tight-buffered cable installed in underground duct banks or aerially between buildings.
- e. If the fiber-optic cable shares the duct bank with other cables, install an inner-duct.
- f. The Multi-Mode, Fiber-Optic cable shall be a minimum 12 strands between buildings -- ER to ER.
- g. Provide a minimum of 25% spare fibers after initial Network Configuration Design.

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- h. 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 FIBER-OPTIC CABLE
- a. Provide a Single-Mode, Fiber-optic Cable between the Main Equipment Room (ER) of the Network Center and each associated Building's Main Equipment Room (ER).
 - b. The Single-Mode, Fiber Optic cable shall be an 8.7/125 micron fiber.
 - c. The Single-Mode, Fiber Optic cable shall be gel-filled or indoor/outdoor rated, tight-buffered cable installed in underground duct banks or aerially between buildings.
 - d. If the fiber-optic cable shares the duct bank with other cables, install an inner-duct.
 - e. The Single-Mode, Fiber-Optic cable shall be a minimum 12 strands between buildings -- ER to ER.
 - f. 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.
 - g. Angle-Polished Connectors (APC) shall be utilized on all Single-mode fibers used to support AM Video (CATV, etc.) applications.

1.7 OPTICAL FIBER PATCH PANEL SYSTEMS

A. FIBER-OPTIC PATCH PANELS

- 1. Fiber-Optic patch panels shall be mounted in equipment racks.
- 2. Fiber-Optic patch panels shall be rack-mounted and shall be 24/48/72/144 port, or as required.
- 3. Provide "Dual SC or LC" type couplers for multi-mode and single-mode cables.

B. FIBER-OPTIC CONNECTORS

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

C. FIBER-OPTIC SPLICE TRAYS (***Fusion Splice Pigtails***)

- 1. Provide Fiber-Optic 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 BISC standards.
- B. All fiber-optic cabling shall be terminated on rack-mounted patch panels using fusion-spliced, pigtails, as noted above, **or pre-terminated connector panel assembly.**
- C. Provide space in rack (min 3 units) for possible District or DA-Site-provided, inter-building Fiber-Optic 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 Fiber-Optic cables shall be equipped with a self-laminating, wrap-around, machine printed label at both ends of the cable.
- C. All Fiber-Optic 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. All Cable test results shall be stored and presented to the Architect in both hard copy and electronic format for approval.
- B. All Cable Tester, Record designations shall match the associated cable label, and associated patch panel label designation.
- C. All Fiber-Optic Cables shall be tested with both a power meter and an OTDR.

END OF SECTION

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SECTION 271513

COMMUNICATIONS COPPER HORIZONTAL CABLING

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 OSFC 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 one (1) year from date of substantial completion.

1.5 MODULAR JACKS

- A. Each 4-pair 100-ohm UTP data cable shall be terminated in an eight position, modular jack at the Work Area (WA).
- B. The data cable shall be terminated directly to the modular jack with insulation displacement connectors.
- C. The modular jack shall be a minimum of Category 5e/Category 6 compliant **and 6a compliant for wireless solution.**
- D. The modular jack pair/pin assignments shall be T568B.

1.6 COVER PLATES

- A. Plates shall be modular, front-loading and colored to match the video/data wall plates.
- B. All plate colors shall be coordinated with the architect to match furnishings and fixtures.
- C. Wall mounted phones shall utilize 630 style faceplates.

1.7 HORIZONTAL CABLE

- A. In accordance with ANSI/EIA/TIA 568B.2 all horizontal data cable shall be:
 - 1. UL listed, 4-pair 100 ohm, UTP, Category 5e / **Category 6 / Category 6a (wireless)** compliant
 - 2. Conductors shall be 24 AWG, solid bare annealed copper.
 - 3. Cable shall be insulated with FEP material.
 - 4. Cable shall be NEC CMP rated.
- B. Cable shall be sequentially marked at 2-foot intervals.
- C. Cable pairs shall be color coded:
 - 1. Pair 1- White/Blue and Blue.
 - 2. Pair 2- White/Orange and Orange
 - 3. Pair 3- White/Green and Green
 - 4. Pair 4- White/Brown and Brown
- D. Provide horizontal voice / data cable drops for:
 - 1. Administrative Computers
 - 2. Bulletin Board System
 - 3. CCTV Cameras (as required)
 - 4. Classroom and Lab Computers
 - 5. Desk top phones
 - 6. Distance Learning Systems
 - 7. Door Phones (as required)
 - 8. Electrical Closets
 - 9. Elevator Phones
 - 10. Energy Management Systems (EMS)
 - 11. Fax Machines
 - 12. Fire Alarm Systems
 - 13. HVAC Equipment

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14. LCD TVs
15. Master Clock System (as required)
16. Mechanical Closets
17. Miscellaneous Network Attached Devices
18. Pay Station Phones (as required)
19. Point of Sale Terminals (as required)
20. Printers
21. Projectors
22. Security and Access Control Systems
23. Set Top Boxes (as required)
24. Teacher Technology Centers
25. Video Conference Units
26. Wall mounted phones

- E. ***Provide horizontal Category 6a cable drops for wireless access points.***
- F. 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.2 (or latest) and shall be equipped with eight position, modular jacks with insulation displacement connectors, rear cable-management bars/standoffs and front label designation strips.
- B. Provide 24 or 48 port, Category 5e / Category 6 rated patch panels for termination of horizontal cabling. When the Equipment Room (ER) or Telecommunications Room (TR) serves more than one floor, sequentially group the cables by floor on separate patch panels.
- C. ***Provide 24 or 48 port, Category 6a rated patch panels for termination of all wireless horizontal cabling. When the Equipment Room (ER) or Telecommunications Rooms (TR) serves more than one floor, sequentially group the cables by floor on separate patch panels.***
- D. Provide color-coded, Category 5e / **Category 6 / Category 6a** (wireless) rated patch cords for all connections (plus 10% spare).

1.9 INSTALLATION

- A. All cabling shall be installed according to ANSI/EIA/TIA specifications and BICSI 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 5e / Category 6 / **Category 6a (for wireless solution)** performance levels in accordance with ANSI TIA/EIA-568-B.2 (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

GENERAL GUIDELINES

1.1 GENERAL

- A. The baseline A/V system shall utilize digital sources and digital transport medium, to all display devices. The Technology Designer shall provide active electronics where required due to cable distance limitations. Coordinate infrastructure sizes and routing with the Electrical Designer.
- 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 Audio-Video Horizontal Transport System Infrastructure that shall be followed for all OSFC Technology construction projects.
- D. Refer to Section 8500, Technology Systems, and Section 8600, Electrical Systems, for additional information.
- E. **Refer to Figure 1 – Typical classroom audio-visual system components for general overview of equipment and interconnectivity**

1.2 SECTION INCLUDES

- A. AUDIO-VIDEO COMMUNICATIONS HORIZONTAL TRANSPORT SYSTEM
 - 1. **Instructor AV interface outlet.**
 - 2. **Guest AV Interface Outlet (optional)**
 - 3. **Wardrobe AV equipment interface outlet**
 - 4. **Instructor AV equipment interface outlet**
 - 5. **Classroom Interactive Projector AV interface outlet**
 - 6. **Public Monitor/TV AV Interface Outlet**

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).

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- F. All equipment shall comply with the latest ANSI TIA/EIA-568, 569, 606, 607, 862, standards.

1.4 SYSTEM WARRANTY

- A. System shall carry an industry standard, performance based warranty, by the contractor, for a period of at least 20 years on the cabling; including patch panels, patch cables, terminations and labor. The remaining portions of the system shall be warranted for a period of **two (2)** years from date of substantial completion.

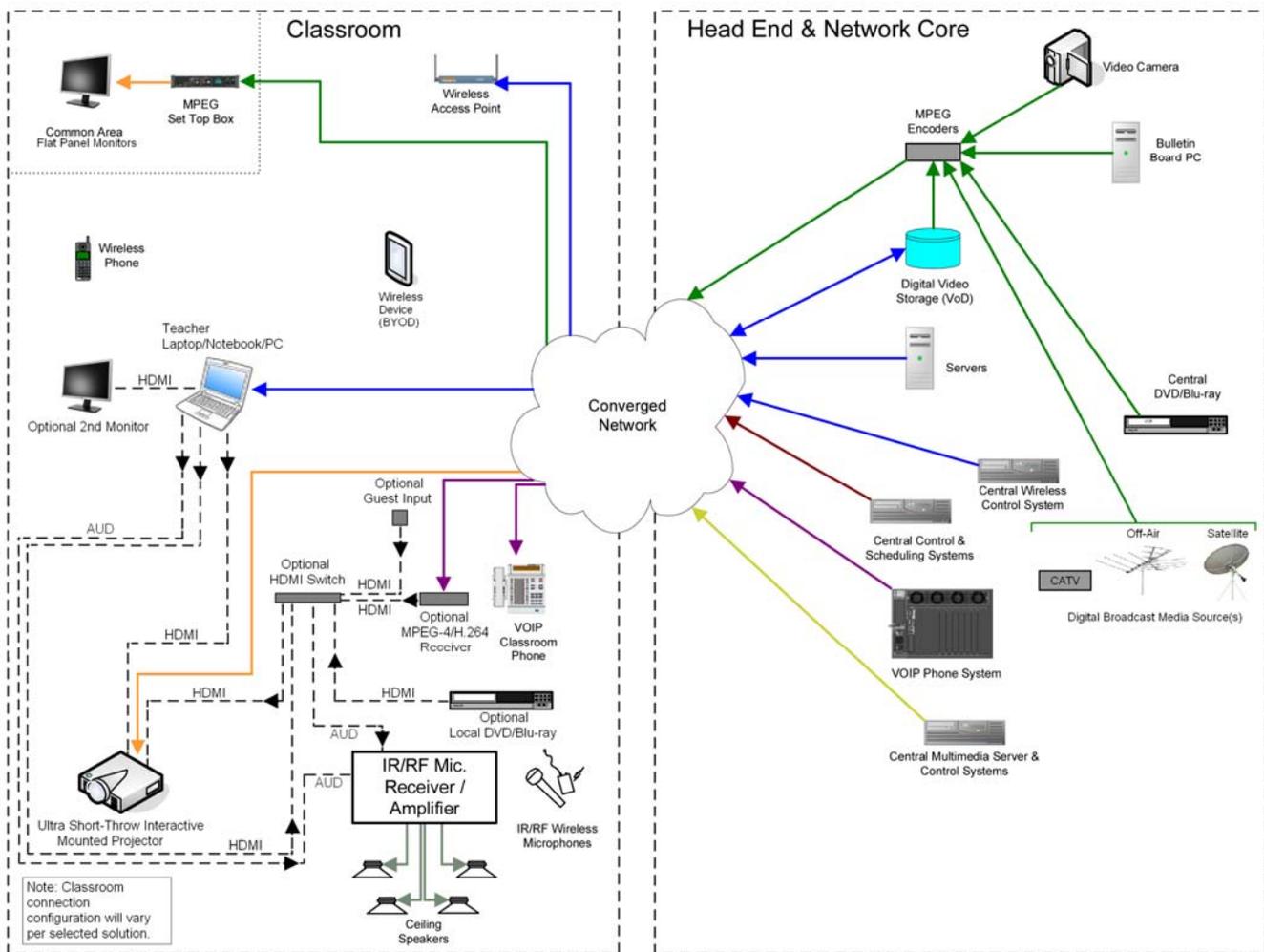


Figure 1 - Typical Classroom Audio-Visual System Components

COMMUNICATIONS**CHAPTER 9: SPECIFICATIONS****1.5 AV INTERFACE OUTLETS**

- A. *Each classroom/lab shall be provided with AV system interface outlets to transport digital media from and to the required AV equipment.*
- B. *The video cabling shall utilize the appropriate media to transport digital signals including HDMI, DVI and USB. In addition, where required the cabling shall be provided to transport analog audio media, RS-232 controls and IR controls.*
- C. **Instructor AV Interface Outlet**
 - 1. *Provide Digital AV interface of HDMI or DVI for connection to the room projector or room HDMI/DVI switch. Utilize either HDMI/DVI cables, shared sheath cabling systems, or an active UTP based solution with appropriate transmitters/receivers based upon cabling distance limitations.*
 - 2. *Where the room sound enhancement system is not co-located at the Instructor location, provide additional analog audio cabling to the sound enhancement system.*
 - 3. *Provide interface for USB cabling to local interactive projector.*
- D. **Guest AV Interface Outlet**
 - 1. *Provide Digital AV interface of HDMI or DVI for connection to the room projector or room HDMI/DVI switch. Utilize either HDMI/DVI cables, shared sheath cabling systems, or an active UTP based solution with appropriate transmitters/receivers based upon cabling distance limitations.*
- E. **Wardrobe AV Equipment Interface Outlet – Provide the following cables as required by room interconnectivity design**
 - 1. **HDMI/DVI switch**
 - a. *Provide Digital AV interface of HDMI or DVI for connection from the Instructor AV Interface, Guest AV Interface, local AV device (BluRay player, Set-top box) and the room projector. Utilize either HDMI/DVI cables, shared sheath cabling systems, or an active UTP based solution with appropriate transmitters/receivers based upon cabling distance limitations*
 - 2. **Sound Enhancement System**
 - a. *Provide speaker, line level audio (from Instructor AV Interface Outlet, HDMI/DVI switch) and IR sensor cabling.*
 - 3. *Provide RS-232 cabling (optional) to projector for remote RS-232 to IP interface device.*
- F. **Instructor AV Equipment Interface Outlet - Provide the following cables as required by room interconnectivity design.**

1. **Provide Digital AV interface of HDMI or DVI for connection from the Guest AV Interface, local AV device (BluRay player, Set-top box) and the room projector. Utilize either HDMI/DVI cables, shared sheath cabling systems, or an active UTP based solution with appropriate transmitters/receivers based upon cabling distance limitations.**
 2. **Sound Enhancement System**
 - a. **Provide speaker, line level audio (from Instructor AV Interface Outlet, HDMI/DVI switch) and IR sensor cabling.**
 3. **Provide RS-232 cabling (optional) to projector for remote RS-232 to IP interface device.**
- G. Classroom Projector AV Interface Outlet**
1. **Provide Digital AV interface of HDMI or DVI for connection to the Instructor AV Interface Outlet, the Wardrobe AV Equipment Interface Outlet and/or the Instructor AV Equipment Interface Outlet. Utilize either HDMI/DVI cables, shared sheath cabling systems, or an active UTP based solution with appropriate transmitters/receivers based upon cabling distance limitations.**
 2. **Provide interface for USB cabling to Instructor AV Interface Outlet**
 3. **Provide RS-232 cabling (optional) to projector for remote RS-232 to IP interface device.**
- H. Public Monitor/TV AV Interface Outlet**
1. **Provide CAT 5e/6 network connectivity as a dual data drop.**
 2. **Where required to have local input - Provide Digital AV interface of HDMI or DVI for connection to the Guest AV Interface Outlet, the Wardrobe AV Equipment Interface Outlet and/or the Instructor AV Equipment Interface Outlet. Utilize either HDMI/DVI cables, shared sheath cabling systems, or an active UTP based solution with appropriate transmitters/receivers based upon cabling distance limitations.**

1.6 AV INTERFACE CABLES

A. Digital Video Cables

1. **Provide listed cabling to support digital format such as DVI, HDMI, etc. Provide active electronics where required for selected cable distance limitations or for UTP based solutions.**
2. **The use of HDMI cables may present specific challenges due to the limited bending radius of the cables, the depth of the outlet boxes, and the conduit installation requirements to pull the pre-terminated cables through.**

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B. Line Level Audio Cable

1. **Provide shielded twisted pair cable connected to Female RCA connectors (White/Red).**

C. Projector Network Cable

1. **Option 1 – Provide one (1) Category-5e/6 UTP cable connected to Category-5e/6 patch panel in associated Telecommunications room.**
2. **Option 2 – Provide one (1) RS-232 cable connected to RS-232 to IP Interface.**

D. Set-Top-Box Network Cable

1. **Provide one (1) Category-5e/6 UTP cable connected to Category-5e/6 patch panel in associated Telecommunications room.**

E. Instructor Technology Center Network Cable

1. **Provide two (2) Category-5e/6 UTP cables connected to the Category-5e/6 patch panel in associated Telecommunications room.**

F. USB Cable

1. **Provide one (1) UTP to USB converter on each end with corresponding cabling to connect interactive projector and Teacher Workstation together through UTP based cabling.**

1.7 VIDEO COVER PLATES

- A. Plates shall be modular to fit all video jack components and shall match the associated voice/data plates.

1.8 INSTALLATION

- A. Contractor shall provide and install **AV Interface** Wiring System.
- B. Cables and associated connectors shall be terminated in accordance with industry standards.
- C. Route the classroom Sound Reinforcement Amplifier IR sensor coax and associated speaker cables **through faceplate** to the Amplifier.

1.9 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.

1.10 TESTING

- A. **Audio-video** Wiring system and associated systems shall be tested end-to-end complete.

END OF SECTION

SECTION 272100

DATA COMMUNICATIONS NETWORK EQUIPMENT

GENERAL GUIDELINES

1.1 GENERAL

- A. This Section defines the general design requirements for a uniform Data Communications Network Infrastructure that shall be followed for all OSFC 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 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 warranted by the contractor for a period of **two (2)** years from date of substantial completion. Provide advanced replacement for all Network Electronics for the **two (2)** year-period.

1.5 GENERAL

- A. Each Building shall be provided with a Local Area Network (LAN) System.
- 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. L-3 Routing Devices.
 3. Network Management Equipment.
 4. Security Devices, Radius Servers, etc.
 5. WAN access equipment.
 6. Wireless Management Equipment.
- I. As a minimum, the Network may be used to support the following applications on a Local and Wide Area basis:
 1. Automation Systems.
 2. Clock Systems.
 3. Control Systems.
 4. Data Networking
 5. Security Systems.
 6. Video Conferencing.
 7. Video Streaming/Media Retrieval.
 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, utilizing dual Processor Architecture, dual 100/1000 Ethernet NIC, Minimum 3.0 GHz, 8 GB RAM, 17 inch color monitor, rack-mounted and RAID level 5 hard drive storage (minimum 2 TB).
- B. Provide Operating System based on District requirements.

1.7 NETWORK SWITCHES

- A. Provide 100/1000 Base T Layer 2 Manageable Ethernet Switches with ports in a quantity to support all initially planned devices with 15% spare.
- B. Provide 100/1000 Base T Layer 2 Manageable Ethernet switch with ports in quantity to support all wireless access point devices with 15% spare.**
- C. Provide a configuration of switch ports utilizing either stackable edge switches or a modular chassis with single engine and dual PS.**
 - 1. Provide dual 10GB uplinks to each switch stack or modular chassis.**

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- D.** The 100/1000 switches shall be “non-blocking” and support a minimum forwarding bandwidth equal to the number of switch ports x 1 Gbps.
- E.** *Utilize 10GB uplinks for all uplinks. Switches may be stacked, but provide each stack with a minimum of two uplinks for redundancy.*
- F.** Chassis mounted units are acceptable for Edge Switches, provided that dual power supplies and equivalent uplink bandwidth is supplied.
- G.** The Network switches shall support advanced services such as:
1. IP Telephony.
 2. Wireless Access Points.
 3. Building Management Systems.
 4. Video Streaming.
- H.** PoE switches shall be rated to provide POE class 3 on all ports simultaneously.
- I.** The 100/1000 switches shall support the following features and specifications:
1. 1000BASE-LX/LH.
 2. 1000BASE-SX.
 3. 1000BASE-X (SFP).
 4. 1000BASE-ZX.
 5. Access Control Lists (ACL).
 6. Advanced QoS.
 7. IEEE 802.1s.
 8. IEEE 802.1D Spanning Tree Protocol.
 9. IEEE 802.1p CoS Prioritization.
 10. IEEE 802.1Q VLAN.
 11. IEEE 802.1s.
 12. IEEE 802.1w.
 13. IEEE 802.1x.
 14. IEEE 802.3 10BASE-T specification.
 15. IEEE 802.3ab 1000BASE-T specification.
 16. IEEE 802.3ad.
 17. IEEE 802.3af and 802.11at POE.
 18. IEEE 802.3u 100BASE-TX specification.
 19. IEEE 802.3x full duplex on 10BASE-T, 100BASE-TX, and 1000BASE-T ports.
 20. IEEE 802.3z 1000BASE-X specification.
 21. IPv6.
 22. Rapid Spanning Tree.
 23. Rate Limiting.
 24. RMON I and II standards.
 25. SNMPv1, SNMPv2c, and SNMPv3.
- J.** Provide sufficient 100/1000 ports to accommodate, as a minimum, the following devices as required:
1. Access Control System.
 2. Admin PCs.
 3. Classroom PC Devices.
 4. Clock Systems.

5. Distant Learning Systems.
6. Instructor PCs.
7. Monitor/TVs, as required.
8. MPEG Encoders.
9. PABX System.
10. Printers.
11. Projectors.
12. Set Top Boxes, as required.
13. UPS Units.

- K.** Provide sufficient 100/1000 PoE ports to accommodate, as a minimum, the following devices as required:
1. IP Phones
 2. IP CCTV Cameras

1.8 NETWORK CORE SWITCH

- A.** Provide a modular chassis-based central 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 and two (2) Redundant Central Control/Supervisor Units.
- C.** All Core 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).
 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).
 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. 10 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.

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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 ER and TR 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.
- 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. Provide a minimum of twenty-four (24) 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

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- 3. Operation, maintenance, and upgrade procedures.
- B. Trainer must be certified by the manufacturer.
- C. Provide a copy of a sign off sheet (signed by District staff) for the completed training with the close-out documents.
- D. Provide a minimum of four (4) hours of follow-up training to the District during the 11 month walk-through period.**
- E. Provide **a digital video** copy of the training sessions.

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SECTION 272133

DATA COMMUNICATIONS WIRELESS ACCESS POINTS

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 OSFC 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. **Network Tracking**
 - 4. 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 802.11n requirements.**

1.4 SYSTEM WARRANTY

- A. The Wireless Network Electronics and software shall be warranted by the contractor for a period of **two (2)** years from date of substantial completion. Provide advanced replacement for all Network Electronics for the **two (2)** year-period.

1.5 WIRELESS NETWORKING

A. GENERAL

1. ***Design Wireless System for full building coverage and to assure coverage for 1:1 and/or BYOD throughout all educational areas as per parameters in this specification.***
2. ***Design Wireless System with 30% growth factored***
3. ***Design shall allow for additional bandwidth growth and shall be capable of limiting the bandwidth used by each device***
4. ***Design shall provide for multi-state radios that can be switched from 2.4GHz to 5GHz***
5. ***System shall allow bandwidth limits and time of day restrictions to be placed on particular users or particular device types***
6. ***System shall allow network administrators to set QoS parameters for different traffic types***
7. ***Provide 802.11n 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.***
8. ***Provide a CAT 6A horizontal data cable drop for each AP. Terminate the AP Cable drop on a Patch Panel at the associated Telecommunication Room (TR).***
9. Connect the AP to the IP Network via an IEEE 802.3af Power Over Ethernet (POE) 1 Gbps Switch Port.
10. Coordinate 802.31x, VLAN and Security Settings/Requirements with the District.
11. ***Shall provide proper network authentication and authorization***
12. ***Security shall have the ability to check antivirus software***
13. ***Wireless network management shall utilize the same firewall, NAC, and RADIUS as the LAN***
14. ***System shall allow different user groups to be created with each group mapped to specific VLANS, access control list, and QoS parameters***
15. ***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***
16. ***Once the system has identified the device, a policy can be applied to control a device's reach and behavior***
17. ***The device ID along with the user ID shall be used together to map that instance to a specific user group***
18. Provide Wireless coverage for the entire building and associated perimeter area.
19. Provide minimum of -65 dB signal level at all locations in building for 802.11n coverage.
20. ***Provide a minimum of 7 Mbps throughput per user.***
21. ***Technology Designer shall verify quantity of users with the District.***

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22. Supply sufficient Access Points to provide for expected throughput and load sharing.
23. For labs and other high-density areas, make sure that the users can “see” at least 3 Access points to provide for load sharing and balancing.
24. **Wireless system shall have full multi-media capabilities by integrating:**
 - a. **802.11e**
 - b. **WMM**
 - c. **QoS**
 - d. **Stateful Firewall**
 - e. **Wired to wireless mapping and traffic management services based on device, user and/or traffic types. This includes priority queuing for multiple traffic types as well as multicast snooping and pruning.**
 - f. **All APs/Arrays shall provide the ability to optimize multicast traffic by converting to unicast and/or optimize multicast traffic transmit rates to better match speeds of connected users.**
25. **Wireless system shall provide the following security functions:**
 - a. **Dedicated 24/7 threat sensor radio**
 - b. **Stateful firewall**
 - c. **Integrated RADIUS**
 - d. **Integrated ACLs, 802.11i, 802.1**
 - e. **Line rate encryption, no matter the traffic volume of encryption protocol in use.**
26. **Wireless Design Validation**
 - a. **During Design Phase, the Technology Designer shall utilize WLAN modeling software to plan the wireless access point deployment in a building and/or campus.**
 - b. **The Technology Designer shall submit a predictive analysis survey via use of WLAN modeling software, along with the OSFC DD and CD technology phase submissions for review.**
 - c. **As a minimum, this analysis shall indicate protocol, through-put and client density.**
 - d. **The WAP quantity and layout shall be based on this modeling.**
27. **Wireless Installation Validation**
 - 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** 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.
28. Coordinate with local Law Enforcement and Safety Forces regarding their requirements for remote and wireless access into building Security and Energy Management Systems.
29. Law Enforcement and Safety Forces shall be responsible for providing their own remote access equipment.

- B. CABLING INFRASTRUCTURE FOR WIRELESS LOCAL AREA NETWORK**
1. *Shall consist of single mode fiber for the backbone to enable 10Gig backbone and provide upgradability for future.*
 2. *Shall utilize CAT 6A horizontal cable solution.*
 3. *Baseline includes CAT6A cable to each classroom. Wireless design will determine quantity and placement of WAP's.*
 4. *Shall utilize 1 Gig uplink to the switch and a 10 Gig uplink to the headend equipment.*
- C. WIRELESS SYSTEM SPECIFICATIONS**
1. *RF Management*
 2. *In-band per IAP Spectrum Analysis*
 3. *Dynamic Channel Configuration*
 4. *Dynamic Cell Size Configuration*
 5. *Monitor radio for threat assessment and mitigation*
 6. *Wired and Wireless Packet Captures (including all 802.11 headers)*
 7. *Radio Assurance for radio self test and healing*
 8. *RF Monitor*
 9. *High Availability Supports Hot Stand-By for mission critical areas*
 10. *Supports ability to turn off radios based on schedule configuration*
- D. WIRELESS PROTOCOLS**
1. *IEEE 802.11*
 2. *IEEE 802.11 a*
 3. *IEEE 802.11 b*
 4. *IEEE 802.11 d*
 5. *IEEE 802.11 e*
 6. *IEEE 802.11 g*
 7. *IEEE 802.11 h*
 8. *IEEE 802.11 i*
 9. *IEEE 802.11 j*
 10. *IEEE 802.11 n*
- E. WIRED PROTOCOLS**
1. *IEEE 802.1p – Layer 2 Traffic Prioritization*
 2. *IEEE 802.1q – VLAN Tagging*
 3. *RFC Support*
 4. *RFC 768 UDP*
 5. *RFC 791 IP*
 6. *RFC 2460 IPV6 (Bridging only)*
 7. *RFC 792 ICMP*
 8. *RFC 793 TCP*
 9. *RFC 1122 Requirements for Internet Hosts – Communication Layers*
 10. *RFC 1542 BOOTP*
 11. *RFC 2131 DHCP*
- F. SECURITY**
1. *IEEE 802.11iWPA2, RSN*
 2. *RFC 1321 MD5 Message-Digest Algorithm*
 3. *RFC 2246 TLS Protocol Version 1.0*
 4. *RFC 3280 Internet X.509 PKI Certificate and CRL Profile*

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5. ***RFC 4347 Datagram Transport Layer Security***
 6. ***RFC 4346 TLS Protocol Version 1.1***
 7. ***WEP***
 8. ***WPA™ – Personal***
 9. ***WPA™ – Enterprise***
 10. ***WPA2™ – Personal***
 11. ***WPA2™ – Enterprise***
 12. ***EAP Type(s)***
 13. ***EAP-TLS***
 14. ***EAP-TTLS/MSCHAPv2***
 15. ***PEAPv0/EAP-MSCHAPv2***
 16. ***PEAPv1/EAP-GTC***
 17. ***Encryption Type***
 18. ***Open***
 19. ***WEP***
 20. ***TKIP-MIC: RC4 40, 104 and 128 bits***
 21. ***SSL and TLS: RC4 128-bit and RDA 1024 and 2048 bit***
- G. AUTHENTICATION**
1. ***IEEE 802.1x***
 2. ***RFC 2548 Microsoft Vendor-Specific RADIUS Attributes***
 3. ***RFC 2716 PPP EAP-TLS***
 4. ***RFC 2865 RADIUS Authentication***
 5. ***RFC 2866 RADIUS Accounting***
 6. ***RFC 2867 Tunnel Accounting***
 7. ***RFC 2869 RADIUS Extensions***
 8. ***RFC 3576 Dynamic Authorizations Extensions to RADIUS RFC 3579 RADIUS Support for EAP***
 9. ***RFC 3748 Extensible Authentication Protocol***
 10. ***Web Page Authentication***
 11. ***WPR, Landing Page, Redirect***
 12. ***Support for Internal WPR Landing Page and Authentication***
 13. ***Support for External WPR, Landing Page, and Authentication***
- H. CHANNEL SUPPORT 2.4GHz**
1. ***1 2 3 4 5 6 7 8 9 10 11 12 13 14***
- I. CHANNEL SUPPORT 5GHz**
1. ***Uni 1 – Non-DFS Channels***
 2. ***36 40 44 48***
 3. ***UNI I DFS Channels***
 4. ***52 56 60 64***
 5. ***UNI II DFS Channels***
 6. ***100 104 108 112 116 120 124 128 132 136 140***
 7. ***UNI III Non-DFS Channels***
 8. ***149 153 157 161 165***
- J. MANAGEMENT INTERFACES**
1. ***Command Line Interface via serial console, SSHv2, Telnet***
 2. ***Web interface (http / https)***

K. MANAGEMENT

1. **SNMP v1, v2c, v3**
2. **RFC 854 Telnet**
3. **RFC 1155 Management Information for TCP/IP Based Internets**
4. **RFC 1156 MIB**
5. **RFC 1157 SNMP**
6. **RFC 1213 SNMP MIB II**
7. **RFC 1350 TFTP**
8. **RFC 1643 Ethernet MIB**
9. **RFC 2030 Simple Network Time Protocol Sntp**
10. **RFC 2616 HTTP 1.1**
11. **RFC 3636 Definitions of Managed Objects for IEEE**
12. **RFC 2674 Definitions of Managed Objects for Bridges with Traffic Classes, Multicast Filtering, and Virtual LAN Extensions**
13. **RFC 2819 Remote Network Monitoring Management Information Base**
14. **RFC 2863 The Interface Group MIB**
15. **RFC 3164 BSD Syslog Protocol**
16. **RFC 3414 User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3)**
17. **RFC 3418 Management Information Base (MIB) for the Simple Network Management protocol (SNMP)**

L. RADIO OPTIMIZATION MANAGEMENT

1. **Shall individually control band selection (2.4GHz or 5GHz), transmit power, and channel allocation.**
2. **Shall have option of controlling band selection either automatically or manually.**
3. **Shall support Auto Channel which provides an automatic means of allocating Wi-Fi channels between radios in a deployment.**
4. **Shall provide Auto Channel. System scans the RF environment on a radio-by-radio basis, coordinated among all AP's/Arrays in the network, to determine the best channel of operation per radio.**
5. **Auto Channel function shall be scheduled periodically to tune the design in response to potential environmental changes.**
6. **Shall support Auto Cell – an automatic, self-tuning mechanism that balances cell size between AP's/Arrays. Shall ensure sufficient coverage while limiting the RF energy that would extend beyond the organizational boundary between AP's/Arrays.**

M. RESOURCE ASSURANCE MANAGEMENT

1. **Shall continuously monitor wireless client behavior for potential issues.**
2. **If a client is detected encountering connectivity or performance issues, a notification is logged.**
3. **Elements to be monitored:**
 - a. **Authentication failures**
 - b. **Packet error rates**
 - c. **Packet retry rates**
 - d. **Data rates**
 - e. **Signal strength**
 - f. **Signal-to-noise ratio**

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4. *Shall execute local testing of radio resources and self-healing to ensure wireless service availability.*
5. *The monitor radio shall periodically function as a wireless client and connect to each of the user servicing radios. If a problem is detected, multiple options for action may be taken, including logging a notification or resetting the radio itself.*
6. *Network Assurance shall actively monitor the status of key network elements, including the Gateway, RADIUS servers, NTP servers, SNMP trap hosts, and DNS servers. If any of these are unreachable, a notification is logged.*
7. *The System shall be optionally configured to disassociate users proactively if network resources are not available so that clients do not remain connected wirelessly with no network service.*

N. DEVICE OPTIMIZATION MANAGEMENT

1. *Wi-Fi devices shall be identified by type upon connecting to the network, e.g. laptop, tablet, smartphone, gaming device, etc.*
2. *This information is then used to map the device to specific resources as desired. Dedicated radios and wireless networks (SSIDs) can be assigned to devices that need high bandwidth or are operating in a specific mode.*
3. *Shall provide Station Load Balancing.*

O. SECURE WIRELESS NETWORK

1. *Shall perform packet encryption and decryption. All encryption processes are performed at line-rate in hardware.*
2. *Wireless encryption supported shall include the standard three encryption options:*
 - a. *Wi-Fi Protected Access with AES*
 - b. *Wi-Fi Protected Access (WPA & WPA2)*
 - c. *WEP-40 bit or WEP-128bit – only use this for legacy devices that cannot support a stronger encryption type*
3. *Should also support TKIP and AES protocols simultaneously on the same SSID to support mixed and dynamic client environments.*
4. *Shall include PCI and FIPS140-2 audit modes of operation to monitor for compliance.*
5. *Shall monitor, detect, mitigate and report on active or potential wireless threats to your network. These include:*
 - a. *Dedicated threat sensor radio, depending on network design, for complete 24x7 IDS/IPS coverage of the RF environment.*
 - b. *Continuous 24x7 monitoring of the wireless RF environment.*
 - c. *Detection of potential rogue or malicious APs, ad hoc, and stations.*
 - d. *Rogue device classification*
 - e. *Automatic alerts, alarms, and logging of rogue devices.*
 - f. *Key rogue device information such as first seen, last seen, manufacturer, SSID, and channel.*
 - g. *Automatic shielding of rogue devices by Array radios to contain threatening devices when detected, while still scanning for new threats.*
6. *Ensures compliance with wireless security policies and regulations through automated reporting.*

7. *Continuously monitor all 802.11 channels for throughput, signal, noise, errors, and interference levels continually per channel.*
8. *Administrators centrally collect data from their desk and monitor the entire network at one time.*
9. *Monitor all 802.11 channels, not just the ones that are currently being used for data traffic.*
10. *Provides device locating via analysis of Received Signal Strength Indication (RSSI) data collected by radios. This capability is available via the CLI, WMI, and XMS interfaces/applications at different levels of functionality.*
11. *Use integrated directional antennas on each radio, providing angle of orientation information about device location in addition to estimated distance based on RSSI level.*
12. *Both associated and unassociated stations can be located in this fashion.*
13. *Aggregate data from multiple AP's/Arrays to determine device positioning. Multi-AP/Array design provides for even greater accuracy than single AP/Array methods.*
14. *Locating in normal conditions shall provide accuracy within a 5-meter radius or better.*
15. *User access control protocols and features designed to classify, assign, and monitor associated and unassociated clients. These include:*
 - a. *RADIUS 802.1x*
 - b. *Fully support 802.1x authentication servers*
 - c. *MAC Access Control Lists (ACLs) supports 512 ACL entries*
 - d. *Web Page Redirect (Captive Portal) capabilities*
 - e. *Web-based authentication against internal or external RADIUS server*
 - f. *Local host or remotely hosted web page redirect (log-in/splash screen)*
 - g. *Configure splash screen time-out*
16. *Failover capability by allowing the specification of primary and secondary RADIUS servers and timeout values.*
17. *Each SSID can specify a unique RADIUS server set enabling each SSID independent authentication control.*
18. *Each SSID can define limits for users based on time of day, day of week, and traffic volume.*
19. *Identify devices by operating systems, such as iOS®, Microsoft®, BlackBerry®, or Android™*
20. *Identify devices by type, such as tablet, laptop or smartphone.*
21. *The device ID, along with the user ID, can be used together to map the device to a policy to control a user's reach and behavior.*

P. LOCATION SERVICES

1. *Provide Wi-Fi client location services across the entire wireless network using a Management System. Each AP provides a signal reading for each client, and the direction of the antenna provides information about the direction of the client relative to the AP/Array.*
2. *Mapping – Based on RF settings and properties of the environment, the management software shall generate heat maps showing RF coverage patterns across the environment.*

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3. **Asset Tracking – Can have the ability to track assets across a wide variety of devices and use cases. Devices can be tracked to within 3-5 feet accuracy.**

Q. GUEST SERVICES

1. **Web Page Redirect (WPR) allows a guest to be presented with a web browser welcome screen before gaining access to the wireless network.**
2. **Directory Integration – Shall integrate with the same systems used for the wired network.**
3. **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.**

R. VOICE AND MULTI-MEDIA SUPPORT (QoS)

1. **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.**
2. **Enable end-to-end QoS support and tag 802.1P packets.**
3. **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:**
 - a. **Send multicasts unmodified**
 - b. **Convert to unicast and send unicast packets to all stations**
 - c. **Convert to unicast, snoop IGMP, and only send to stations subscribed (send as multicast if no subscription).**
 - d. **Convert to unicast, snoop IGMP, and only send to stations subscribed (don't send packet if no subscription).**
4. **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.**

S. MOBILE DEVICE MANAGEMENT

1. **Provide a high level of flexibility in allocating Wi-Fi users and devices among system resources to optimize overall performance.**
2. **Wi-Fi devices shall be identified by type upon connecting to the network (e.g. laptop, tablet, smartphone, gaming device).**
3. **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.**
4. **Based on device type, specific policies can be applied such as bandwidth restrictions, application types, and time restrictions. Coordinate with Owner.**

5. **Resources can also be allocated based on device performance ensuring the performance of faster device types (e.g. 802.11n) are not negatively impacted by slower device types (e.g. 802.11b). Coordinate with Owner.**
6. **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.**
7. **Allow different user groups to be created with each group being mapped to specific VLANs, access control list, and QoS parameters.**

T. WIRELESS CONTROLLERS AND LOCATION TRACKING

1. Equip each building with a Wireless Controller(s). Provide Location Tracking as an option. This may be a separate appliance or software upgrade to wireless controller(s).
2. These devices shall be directly attached to the associated L-3 Network Core Switch via **10** Gigabit interfaces as required.
3. **Shall adhere to all requirements in the aforementioned sections.**
4. Hosted Control Systems can be utilized as long as all required features are provided as well as a minimum 5 years of licensing.

U. WIRELESS ACCESS POINTS

1. Provide centrally powered IEEE 802.11n Wireless Access Points (APs) for each new and remodeled building.
2. Each Access Point shall support a minimum of 14 VoWLAN Phones and dynamically throttle back non-VoIP traffic.
3. Place and dimension the number of Access Points based on required throughput, load balancing and location tracking.
4. **Shall adhere to all requirements in the aforementioned sections.**

1.6 INSTALLATION

- A. Contractor shall provide and install Wireless System and associated cabling, POE devices, Central Controllers and Console.
- B. The Building Floor Plans and Site Plans shall be entered into the Central Wireless Control Console.
- C. The Central Wireless Control Console floor and site plans shall be calibrated after the installation has been performed.
- D. Access Point cables and associated connectors shall be terminated in accordance with industry standards.
- E. Balance Wireless Access Points to insure complete coverage with minimal service degradation.
- F. Setup Wireless Access Security and provide for CIPA Compliance.

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- G. Determine the optimum location of all devices in the wireless LAN coverage areas and consider the access point density and location.
- H. Locate all internal Access Points above the ceiling tile grid wherever possible.
- I. Provide Antennas mounted external to the building for coverage of areas surrounding the building such as: playgrounds, parking lots, athletic fields, etc.
- J. Connect the external antennas to APs mounted inside of the building.

1.7 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.

1.8 TESTING

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

1.9 TRAINING

- A. Provide a minimum of eight (8) 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. Trainer must be certified by the manufacturer.
- C. Provide a copy of a sign off sheet (signed by District staff) for the completed training with the **construction** close-out documents.
- D. **Provide a minimum of four (4) hours of follow-up training to the District during the 11 month walk-through period.**
- E. Provide **a digital video** copy of the training sessions.

END OF SECTION

SECTION 273113

IP-ENABLED PABX SYSTEM

GENERAL GUIDELINES

1.1 GENERAL

- A. This Section defines the general design requirements for a uniform IP-Enabled PABX System that shall be followed for all OSFC Technology construction projects.
- B. Refer to Section 8500, Technology Systems for additional information.
- C. An IP-Enabled PBX shall only be specified for projects that are expanding or extending existing systems.

1.2 SECTION INCLUDES

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

1.3 QUALITY ASSURANCE

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

1.4 SYSTEM WARRANTY

- A. The telephone components, software, parts etc. shall carry a **two (2)** year full warranty, including labor and material.

1.5 GENERAL REQUIREMENTS

- A. Each Building's telephone system must provide the following minimum requirements:

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- 1) Support for E-911.
 - 2) Support for the following carrier and Inter-switch interfaces:
 - 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 endpoints (phones/devices):
 - a) Digital (TDM)
 - b) IP (must support non proprietary H.323 and SIP compliant devices).
 - c) Analog (phones/faxes etc.)
 - d) Endpoints that provide "full duplex speakerphone" capability must be provided in specific rooms.
 - e) Provide system with capacity for all endpoints required plus 10% spare.
 - 5) Provide support for a minimum of two (2) fax stations per building.
 - 6) Provide UPS.
- 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 inter-operability. In the event that the District already has an established Telephone System that meets OSFC 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 OSFC 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-ENABLED PABX
- A. The Central Switching Exchange shall be a fully-digital, IP-Enabled (minimum) PBX Telephone Switch. Key Systems and hybrid intercom/telephone systems will NOT be acceptable.
- B. The IP-ENABLED PABX must be modular in design.
- C. The IP-ENABLED PABX shall be sized according to student population and traffic requirements and shall be equipped with carrier circuit interfaces for incoming/outgoing call lines. The minimum circuits shall be as follows:
 - 1) One PRI or equivalent SIP trunk for up to 100 stations.
 - 2) Two PRIs or equivalent SIP trunks for greater than 100 stations.
 - 3) Additional PRIs or equivalent SIP trunks based on traffic requirements.
 - 4) The use of 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-ENABLED PABX shall be equipped with full Name and Number Caller ID functions for incoming and outgoing calls.
- E. The IP-ENABLED PABX must be equipped with a minimum of three (3) analog lines to the local Service Provider for E-911 services and PRI backup.
- 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 telephone system must have the following minimum features:
- 1) Access Codes.
 - 2) Attendant's Console.
 - 3) Automatic Location Identifier (ALI).
 - 4) Automatic Number Identification Support (ANI).
 - 5) Call Accounting Software and Hardware.
 - 6) Call Conferencing.
 - 7) Call Forwarding on Busy.
 - 8) Call Forwarding External Calls
 - 9) Call Forwarding Internal Calls.
 - 10) Call Hold.
 - 11) Call Pickup.
 - 12) Call Screening.
 - 13) Dialed Number Identification Service (DNIS).
 - 14) Direct Inward Dialing (DID).
 - 15) Distinctive ring tones.
 - 16) Do Not Disturb
 - 17) E-911 and latest NENA support.
 - 18) E-911 Call Recording and Bridging to E-911 Central Console.
 - 19) FCC Registration.
 - 20) Full Caller ID – Incoming/Outgoing.
 - 21) Full duplex, Digital Display, Speaker Phones.
 - 22) Hands Free Intercom – Phone-to-Phone.
 - 23) IEEE 802.3af compliant VoIP Power
 - 24) Least Cost Routing.
 - 25) Maintenance and Administration Terminal.
 - 26) Malicious Call Trace/Hold.
 - 27) Message Waiting Lamp.
 - 28) Paging Interface (minimum 6 zones).
 - 29) Minimum of eight (8) Pre-program buttons.
 - 30) PRI/T-1 Trunking.
 - 31) Remote diagnostics.
 - 32) SIP Signaling Protocol
 - 33) Standards Based, VoIP Phone Support.
 - 34) Support wireless 802.11 VoWLAN phones
 - 35) System Speed Dial.
 - 36) Unified Messaging.
 - 37) VoIP Trunking – H.323 and SIP.
- H. Inter-Building Trunks (Links) between Systems shall be designed using T-1 Lines, PRI Lines or VoIP Trunking. A minimum capacity of 23 inter-building links shall be provided. Dimension all Trunks based on a minimum of P=0.01 Grade of Service.

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- I. When a high-speed WAN connection exists, use a VoIP connection between buildings.
- J. Design the District-Wide system to provide for Least-Cost Routing and Toll-Bypass when applicable. Supply additional PRI circuits as required.
- K. Provide IEEE 802.3af compliant Power Injectors/switches for all VoIP Phone instruments.
- L. Each District Building's IP-ENABLED 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.
- M. 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.
- N. When more than one building per District is involved, all incoming and outgoing calls may be routed over carrier circuits connected to a Central IP-Enabled PABX. The Central IP-ENABLED PABX capacity shall be dimensioned to handle all current and planned District buildings.
- O. IP-ENABLED PABX units shall employ a hardened Operating System that is not susceptible to Internet Computer Viruses.
- P. IP-ENABLED PABX units shall be provided with a minimum of 10% spare line/station capacity at initial installation.
- Q. The PABX shall be an IP-Enabled PABX or an IP Based PABX. 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. See Section 273123 for additional details.
- R. 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.
- S. All IP Instruments and power sources shall be IEEE 802.3af compliant.
- T. 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.
- U. 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.

1.8 ATTENDANT CONSOLE TERMINAL

- A. Minimum of 32 Character LCD Display.
- B. Display day, date and time.
- C. Display call durations.
- D. Display caller name and extension/telephone number and incoming caller-ID information.
- E. Hands free, Full-Duplex, Speakerphone.
- F. Shall have a system display panel capable of showing all system extension numbers and their status and capable of extending calls via single touch operation.
- G. Provide a minimum of two (2) consoles per building for load sharing and redundancy.

1.9 ADMINISTRATIVE DISPLAY DIGITAL VOICE TERMINAL

- A. Provide one administrative phone for all administrative areas, conference rooms, small group rooms, nurse/health office, and special needs rooms.
- B. At least sixteen characters display window.
- C. At least sixteen programmable keys.
- D. Hands free, Full-Duplex Speakerphone.
- E. Display caller name and extension/telephone number.
- F. Message Waiting Lamp.
- G. Pre-programmed E-911 button that automatically puts the phone into a hands-free mode, and initiates a 3-way conference call with the central console, as well as the local 911 center.

1.10 STANDARD DISPLAY DIGITAL VOICE TERMINAL

- A. Provide one standard 8 button phone for all classrooms, labs, general offices, and other areas not covered above in section 1.9.
- B. At least sixteen characters display window.
- C. At least eight (8) programmable keys.
- D. Hands free, Speakerphone. Full Duplex required if One Way Paging Variance is utilized.

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- E. Display caller name and extension/telephone number.
 - F. Message Waiting Lamp.
 - G. Pre-programmed E-911 button that automatically puts the phone into a hands-free mode, and initiates a 3-way conference call with the central console, as well as the local 911 center.
- 1.11 CONFERENCE PHONE
- A. As a minimum, provide Multi-User, Full-Duplex conference Speakerphone for Conference Rooms and/or Principal's Office.
- 1.12 VoWLAN PHONES
- A. Provide a minimum of two Wireless VoIP (VoWLAN) Phone instruments, with carrying case and charger units.
 - B. Provide integral VoWLAN 802.11e QoS capability or SVP server for VoWLAN QoS.
- 1.13 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 mail box per station plus 20% minimum spares.
 - C. System shall have an automated attendant.
 - D. System shall be fully integrated with IP-Enabled PABX.
 - E. System shall activate telephone station "message waiting" light.
 - F. System shall have Integrated Messaging capability. Supply based on District's requirements. Verify E-Mail Server compatibility (Exchange, Notes, Groupwise, etc.)
- 1.14 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.
- 1.15 UNINTERRUPTIBLE POWER SUPPLIES (UPS)
- A. Provide Dual Conversion UPS units for Main Telephone Switch, 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.
- 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.

1.16 INSTALLATION

- A. Coordinate complete system installation, and Technology Head End 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 and 803.11e support.
- E. Interconnect with existing systems via VoIP trunking.
- F. Integrate system with District's Numbering Plan.

1.17 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 or two (2) years after system acceptance.

1.18 TRAINING

- A. Contractor shall provide a minimum of four (4) 2-hour, user system training classes, sixteen hours (16) of attendant Console Training and forty hours (40) of system programming and administration training to the District. Training shall be provided to all staff and shall be scheduled in advance with the District.
 - 1) Contractor shall provide **a digital video** copy of all training.
- B. **Provide a minimum of four (4) hours of follow-up training to the District during the 11 month walk-through period.**

END OF SECTION

SECTION 273123

IP ONLY PABX SYSTEM

GENERAL GUIDELINES

1.1 GENERAL

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

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 telephone components, software, parts etc. shall carry a **two (2)** years full warranty, including labor, software and material.

1.5 GENERAL REQUIREMENTS

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

- 2) Support for the following carrier and Inter-switch interfaces:
 - 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 endpoints (phones/devices):
 - a) Digital (TDM)
 - b) IP (must support non-proprietary H.323 and SIP-compliant devices)
 - c) Analog (phones/faxes etc.)
 - d) Endpoints that provide "full duplex speakerphone" capability must be provided in specific rooms.
 - e) Provide system with capacity for all endpoints required plus 10% spare.
 - 5) Provide support for a minimum of two (2) fax stations per building.
 - 6) Provide UPS.
- 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 inter-operability. In the event that the District already has an established Telephone System that meets OSFC 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 OSFC 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. The minimum circuits shall be as follows:
 - 1) One PRI or equivalent SIP trunk for up to 100 stations.
 - 2) Two PRIs or equivalent SIP trunks for greater than 100 stations.
 - 3) Additional PRIs or equivalent SIP trunks based on traffic requirements.
 - 4) 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.

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- D. The IP PABX shall be equipped with full Name and Number Caller ID functions for incoming and outgoing calls.
- E. With few exceptions, the IP Only PABX system shall provide the same basic features and functionality as an IP-Enabled PABX.
- F. 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.
- G. 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.
- H. The common control units for the IP PABX shall be fully duplicated.
- I. 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.
- J. For single building configurations, the duplicate Common Control Units, media gateways and other common devices shall all be located in the Main Equipment Room.
- K. For multiple building configurations, consideration shall be given to distributing the common control units and media gateways between two buildings.
- L. 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.
- M. Design the District-Wide system to provide for Least-Cost Routing and Toll-Bypass when applicable. Supply additional PRI circuits as required.
- N. 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.
- O. When the Wide Area Network permits, remote buildings shall be configured in such a fashions as to “dual-home” on the two, distributed Central Processing units.
- P. With few exceptions, all IP station devices shall be served by a dedicated Work Area Cable and Voice traffic shall be segregated from standard data traffic by providing dedicated 802.3af Power Over Ethernet (POE) Switches for the Voice Network.
- Q. The POE switches shall follow the same design rules as the Data Network Switches, namely, one (1) dedicated GBE link to the Data Network Layer-3 Core switch per 24 10/100 ports.
- R. The designer shall adjust the quantity of L-3 Core switch ports and associated fiber and UPS units to accommodate the additional POE switches.

- S. All IP Phone instruments shall be 802.3af powered from POE Ethernet switches.
- T. 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.
- U. 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.).
- V. Connections between the Data Network and the voice network shall be made via a vendor supplied firewall device.
- W. 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.
- X. The IP PABX telephone system must have the following minimum features:
- 1) Access Codes.
 - 2) Attendant's Console.
 - 3) Automatic Location Identifier (ALI).
 - 4) Automatic Number Identification Support (ANI).
 - 5) Call Accounting Software and Hardware.
 - 6) Call Conferencing.
 - 7) Call Forwarding on Busy.
 - 8) Call Forwarding External Calls
 - 9) Call Forwarding Internal Calls.
 - 10) Call Hold.
 - 11) Call Pickup.
 - 12) Call Screening.
 - 13) Dialed Number Identification Service (DNIS).
 - 14) Direct Inward Dialing (DID).
 - 15) Distinctive ring tones.
 - 16) Do Not Disturb
 - 17) E-911 and latest NENA support.
 - 18) E-911 Call Recording and Bridging to E-911 Central Console.
 - 19) FCC Registration.
 - 20) Full Caller ID – Incoming/Outgoing.
 - 21) Full duplex, Digital Display, Speaker Phones.
 - 22) Hands Free Intercom – Phone-to-Phone.
 - 23) IEEE 802.3af compliant VoIP Power
 - 24) Least Cost Routing.
 - 25) Maintenance and Administration Terminal.
 - 26) Malicious Call Trace/Hold.
 - 27) Message Waiting Lamp.
 - 28) Paging Interface (minimum 6 zones).
 - 29) Minimum of eight (8) Pre-program buttons.
 - 30) PRI/T-1 Trunking.
 - 31) Remote diagnostics.
 - 32) SIP Signaling Protocol
 - 33) Standards Based, VoIP Phone Support.
 - 34) Support wireless 802.11 VoWLAN phones

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- 35) System Speed Dial.
 - 36) Unified Messaging.
 - 37) VoIP Trunking – H.323 and SIP.
- Y. The IP PABX shall be dimensioned to support a minimum ABH traffic capacity of 7.0 ccs per line.
- Z. Inter-Building Trunks (Links) between Systems shall be designed using T-1 Lines, PRI Lines or VoIP Trunking. A minimum capacity of 23 inter-building links shall be provided. Dimension all Trunks based on a minimum of P=0.01 Grade of Service.
- AA. When a high-speed WAN connection exists, use a VoIP connection between buildings.
- BB. Provide IEEE 802.3af compliant Power Injectors/switches for all VoIP Phone instruments.
- CC. 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,
- DD. 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.
- EE. 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.
- FF. IP PABX units shall employ a hardened Operating System that is not susceptible to Internet Computer Viruses.
- GG. IP PABX units shall be provided with a minimum of 10% spare line/station capacity at initial installation.
- HH. 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.
- II. 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.
- JJ. All IP Instruments and power sources shall be IEEE 802.3af compliant.
- KK. 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 ATTENDANT CONSOLE TERMINAL

- A. Minimum of 32 Character LCD Display.
- B. Display day, date and time.
- C. Display call durations.
- D. Display caller name and extension/telephone number and incoming caller-ID information
- E. Hands free, Full-Duplex, Speakerphone.
- F. Shall have a system display panel capable of showing all system extension numbers and their status and capable of extending calls via single touch operation.
- G. Provide a minimum of two (2) consoles per building for load sharing and redundancy.
- H. Optional soft consoles should be considered by the designer for the attendant.

1.9 ADMINISTRATIVE DISPLAY IP VOICE TERMINAL

- A. Provide one administrative phone for all administrative areas, conference rooms, small group rooms, nurse/health office, and special needs rooms.
- B. At least sixteen characters display window.
- C. At least sixteen programmable keys.
- D. Hands free, Full-Duplex Speakerphone.
- E. Display caller name and extension/telephone number.
- F. Message Waiting Lamp.
- G. Pre-programmed E-911 button that automatically puts the phone into a hands-free mode, and initiates a 3-way conference call with the central console, as well as the local 911 center.
- H. IEEE 802.3af powered.

1.10 STANDARD DISPLAY DIGITAL VOICE TERMINAL

- A. Provide one standard 8-button phone for all classrooms, labs, general offices, and other areas not covered in section 1.9 above.
- B. At least sixteen characters display window.
- C. At least eight (8) programmable keys.
- D. Hands free, Speakerphone. Full Duplex required if One Way Paging Variance is utilized.

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- E. Display caller name and extension/telephone number.
 - F. Message Waiting Lamp.
 - G. Pre-programmed E-911 button that automatically puts the phone into a hands-free mode, and initiates a 3-way conference call with the central console, as well as the local 911 center.
 - H. IEEE 802.3af powered.
- 1.11 CONFERENCE PHONE
- A. At a minimum, provide Multi-User, Full-Duplex conference Speakerphone for Conference Rooms and/or Principal's Office.
- 1.12 VoWLAN PHONES
- A. Provide a minimum of two Wireless VoIP (VoWLAN) Phone instruments, with carrying case and charger units.
 - B. Provide integral VoWLAN 802.11e QoS capability or SVP server for VoWLAN QoS.
- 1.13 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 station plus 20% minimum spares.
 - C. System shall have an automated attendant.
 - D. System shall be fully integrated with the IP PABX.
 - E. System shall activate telephone station "message waiting" light.
 - F. System shall have Integrated Messaging capability. Supply based on District's requirements. Verify E-Mail Server compatibility (Exchange, Notes, Groupwise, etc.)
- 1.14 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.
- 1.15 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.

1.16 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.

1.17 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 two (2) years after system acceptance.

1.18 TRAINING

- A. Contractor shall provide a minimum of four (4) 2-hour, user system training classes, sixteen hours (16) of attendant Console Training and forty hours (40) of system programming and administration training to the District. Training shall be provided to all staff and shall be scheduled in advance with the District.
 - 1) Contractor shall provide a **digital video** copy of all training.
- B. **Provide a minimum of four (4) hours of follow-up training to the District during the 11 month walk-through period.**

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SECTION 274119

VIDEO DISPLAY EQUIPMENT

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 OSFC Technology construction projects.
- B. Refer to Section 8500, Technology Systems, and Section 8600, Electrical Systems, for additional information.

1.2 SECTION INCLUDES

- A. VIDEO DISPLAY EQUIPMENT
 - 1. Flat Panel **Monitor** Mounts
 - 2. Flat Panel Monitors
 - 3. Projector **Mounts**
 - 4. **Ultra-Short Throw Interactive Projector**
 - 5. **Large Venue Projector**
- B. **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.

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1.4 SYSTEM WARRANTY

- A. The Video Display Equipment Systems and associated software shall be warranted by the contractor for a period of **two (2) years** from date of substantial completion.

1.5 FLAT PANEL **MONITORS** AND PROJECTOR MOUNTS

- A. Provide wall type flat panel mounts with appropriate forward tilt, or fully articulating arm, as required.
- B. Provide Ceiling or Wall Mounts for projectors with appropriate provisions for electrical outlet and A/V cables.
- C. Utilize security/theft-deterrent mounting hardware on all projectors, displays and mounts as required.

1.6 INTERACTIVE PROJECTORS

- 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. Provide high resolution video/data projectors for each classroom, laboratory, and media center.
- C. Conference Rooms may be equipped with either a small venue projector or a flat-panel **TV/Monitor**.
- D. **Ultra-short throw interactive** projectors are required in classrooms. They shall be capable of being interfaced with **any** interactive technology **in the classrooms**.
 - 1. **Verify ADA requirements are met for mounting locations.**
- E. The aspect ratio of projectors shall be 16:9 or 16:10. Aspect ratios of 4:3 should be used only to accommodate legacy equipment.
- F. 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.
- G. Small Venue (Classroom/Labs/Small Rooms) **Interactive** Projectors
 - 1. The projector shall produce a minimum of 3000 ANSI Lumens for standard projectors or 2500 ANSI Lumens for ultra-short throw projectors.
 - 2. It shall have a minimum native resolution of 1280 x 800 and be capable of displaying resolutions up to 1080p (720p).
 - 3. **Inputs/Outputs – Shall consist of the following:**
 - a. **HDMI**
 - b. **Computer / component video: D-sub 15 pin**
 - c. **Composite video: RCA**
 - d. **Audio in x 3: RCA (L and R), Mini stereo**
 - e. **Variable audio out: Mini stereo**

- f. **LAN networking: RJ-45**
 - g. **Serial: RS-232c**
 - h. **Monitor out: D-sub 15 pin**
 - i. **USB Type B (USB display, mouse, interactivity)**
 - j. **USB Type A (USB memory/document camera)**
 - k. **Wireless port 802.11 b/g/n optional**
 - l. **Microphone port**
 - m. **EDID capable and HDCP compliant**
- 4. **Shall be connected to classroom sound reinforcement system for sound**
 - 5. **Shall be able to use any interactive software (open architecture)**

H. LARGE VENUE (STUDENT DINING) PROJECTORS

- 1. The projector shall produce a minimum of 6000 ANSI Lumens.
- 2. It shall have a minimum native resolution of 1920 x 1200 and be capable of displaying resolutions up to 1080p.
- 3. **Inputs/Outputs – Shall consist of the following:**
 - a. **HDMI**
 - b. **Computer / component video: D-sub 15 pin**
 - c. **Composite video: RCA**
 - d. **Audio in x 3: RCA (L and R), Mini stereo**
 - e. **Variable audio out: Mini stereo**
 - f. **LAN networking: RJ-45**
 - g. **Serial: RS-232c**
 - h. **Monitor out: D-sub 15 pin**
 - i. **USB Type B (USB display, mouse, interactivity)**
 - j. **USB Type A (USB memory/document camera)**
 - k. **Wireless port 802.11 b/g/n optional**
 - l. **Microphone port**
 - m. **EDID capable and HDCP compliant.**
- 4. Provide a lift system in lieu of a mount, allowing multiple height positions for storage, projection and service. As required.
- 5. Provide either front or rear screen projection based on District/Architect preferences and/or good projection system design.
- 6. Coordinate screen (size and type) specifications to provide an integrated design based on best practices and project-specific factors.

1.7 FLAT PANEL TV/MONITOR

- A. The Flat Panel TVs/Monitors shall be equipped with a QAM 181-channel tuner and shall have minimum native resolution of 1080p without the use of scan-converters.
- B. The minimum Flat Panel TV/Monitor shall be 32 inches.
- C. Provide Flat Panel TV/Monitor for Public viewing in Entrances, Corridors and/or Reception areas, small conference/meeting rooms, and Small Self-Contained Classrooms.
- D. Provide Flat Panel TV/Monitor Units with Ethernet control connection and central management software.

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- E. Provide an Ethernet or wireless connection to Digital Media Management System.**

1.8 OPTIONAL EQUIPMENT AND SYSTEMS (not baseline)

A. INTERACTIVE TABLETS

1. **Considerations and guidelines:**
 - a) **Tablets should be specified based on each school's curriculum needs.**
 - b) **Assessment should be done about licensing and number of users**
 - c) **Charging stations/policies should be considered**
 - d) **Considerations regarding the Apple iPad**
 - 1) **iPads have lower transmit power (10dBm)**
 - 2) **iPads use a single spatial stream with 802.11n. They are unable to do channel bonding, limiting the link rate to a maximum of 65Mbps**
 - 3) **iPads have dual band support. They can operate on both 2.4GHz and 5GHz frequencies. They default to the 5GHz band.**
2. **Recommended screen size is 7" – 12"**
3. **Touch screen**
4. **Wi-Fi optional**
5. **Wireless connectivity to all other classroom A/V equipment (interactive projector, etc.)**
6. **Minimum resolution 1280 x 600**
7. **Minimum processor 1GHz**
8. **Minimum storage 16GB**
9. **Minimum battery life 9 hours**

B. STUDENT RESPONSE SYSTEM

1. **Should have a full keyboard with direction pad and hot keys**
2. **Wireless range minimum of 328ft (100m)**
3. **Operates on batteries or charge by USB connectivity**
4. **Communication through wireless connection to computer with host software**
5. **All licenses should be included in specification**

C. DOCUMENT CAMERA

1. **Minimum 2.0 megapixels**
2. **Full autofocus lens**
3. **3x digital zoom**
4. **Up to 30 fps live video capture**
5. **USB 2.0 minimum interface**
6. **Windows and Mac compatible**
7. **Open architecture to use multiple application software**
8. **Capture both digital and printed material**

D. 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***

E. *A/V CONTROL SYSTEM*

1. ***Full user control of program source device(s), projector, and lights through either web-based application or touch 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.
- 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 eight (8) hours of training to the District's personnel. Training session(s) shall cover the following topics at a minimum:***
 1. ***System equipment connectivity***
 2. ***Equipment configurations***
 3. ***Operation and maintenance***
- B. ***Trainer must be certified by the manufacturer.***
- C. ***Provide a copy of a sign off sheet (signed by District staff) for the completed training with the construction close-out documents.***
- D. ***Provide a minimum of four (4) hours of follow-up training to the District during the 11 month walk-through period.***
- E. ***Provide a digital video copy of all training.***

END OF SECTION

SECTION 274125

DIGITAL *MEDIA MANAGEMENT* SYSTEMGENERAL GUIDELINES

1.1 GENERAL

- A. This Section defines the general design requirements for a uniform Digital *Media Management* System that shall be followed for all OSFC Technology construction projects.
- B. Figure 1 describes Typical *Digital Media Management* System.
- C. Refer to Section 8500, Technology Systems, and Section 8600, Electrical Systems, for additional information.

1.2 SECTION INCLUDES

- A. DIGITAL *MEDIA MANAGEMENT* SYSTEM
 - 1. Digital Video On-Demand System.
 - 2. Digital Video Control and Scheduling System.
 - 3. Video Bulletin Board System.
 - 4. Video Camera System.
 - 5. Digital Video Source 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).
- 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 warranted by the contractor for a period of **two (2) years** from date of substantial completion. Provide advanced replacement for all *Digital Media Management Equipment* for the **two (2)** year-period.

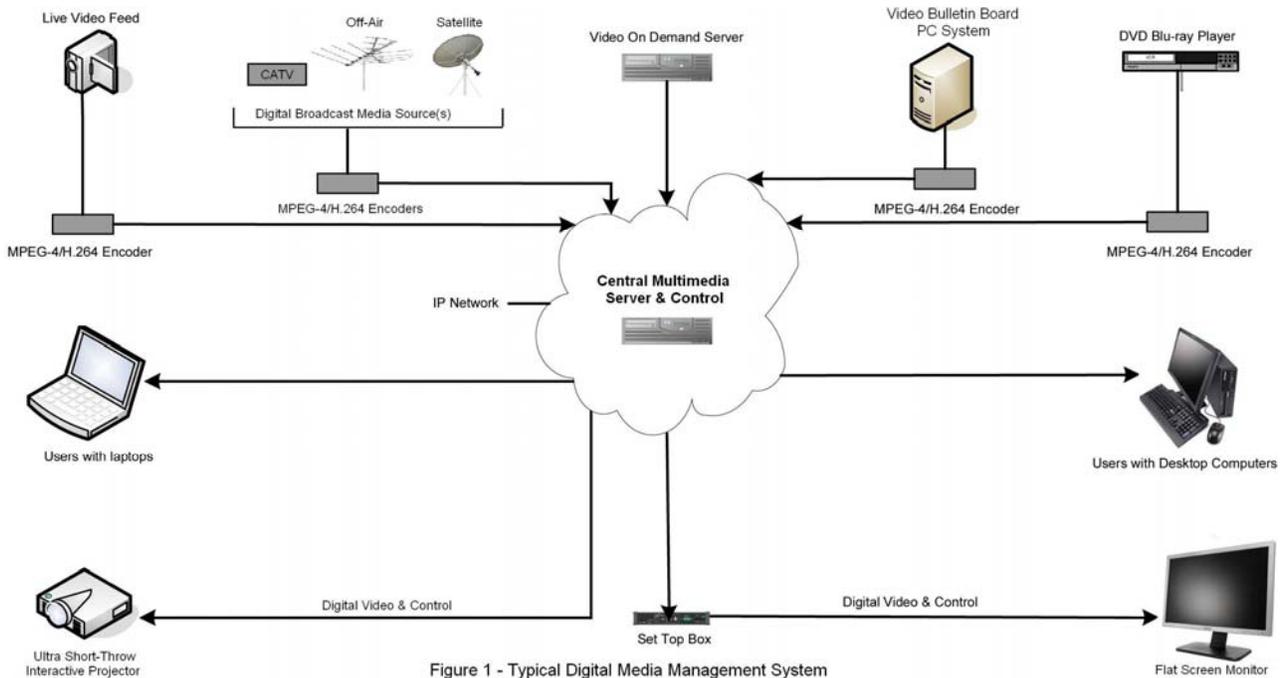


Figure 1 - Typical Digital Media Management System

Figure 1 – Typical Digital **Media Management** System

1.5 DIGITAL VIDEO ON DEMAND SERVER

A. GENERAL

1. The system shall include a centrally based media retrieval system consisting of a video server-based, on-demand, MPEG-4, H.264 streaming video delivery system.
2. System shall include a video billboard message and information system delivered over the **network** or via Digital Decoders.
3. Control of the Central Media System components shall be via a WEB Browser interface from a PC or from a Digital Set-Top-Box.
4. The Digital **Media Management** System shall provide remote access to centrally stored digital video sources. The system shall transmit the video as a streaming data file format (H.264 or MPEG-4) over the Ethernet IP Network.
5. The system shall also be capable of direct access to the Internet (MPEG-4 /H.264). Program the required VLANs and provide sufficient 10/100 Ethernet Ports for connection of all associated devices.
6. 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 and Audio System.
7. Provide Central Control System for Projectors for turning units on/off, selecting inputs and streaming scheduled program sources. Unit should turn all Projectors off at end of day.
8. Playback of the Videos at classroom and Lab PCs shall be through a standard WEB Browser interface using a standard Media Player such as Windows Media Player, Real Player or Apple Quick-Time.

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- B. DIGITAL VIDEO SERVER - VOD
1. Supply a centrally located MPEG-4 and H.264 Video Server Unit consisting of a PC based, Digital Video on Demand Server connected to the Network Electronics on a separate Video VLAN.
 2. Consider supplying one large VOD Server per District when WAN bandwidth permits.
 3. The Digital Video Server shall support True Video-on-Demand (VOD), Near-Video-on-Demand (NVOD), and Subscription-Video-on-Demand (SVOD).
 4. The Digital Video Server shall have a scalable output from a minimum of 25 to 200 – 3 Mbps digital video streams.
 5. The Digital Video Server shall have fault-tolerant, RAID storage with minimum capacity of 200 hours with hot-swappable drives.
 6. The Digital Video Server shall be connected to the local area network through a minimum of one (1) Gigabit Ethernet connection.
 7. Size the VOD Server based on District Video Storage requirements.
 8. ***Hosted service can be utilized as long as all required features are provided.***

1.6 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 VIDEO BULLETIN BOARD SYSTEM

- A. Provide a PC based Bulletin Board system consisting of a Pentium-4 PC, minimum 2.0 GHz, equipped with minimum of 1 Gb of RAM, minimum of a 80 Gb, 7200 RPM Hard Drive, 15 inch Color Monitor/Panel, Multi-output Digital Video Card, Microsoft Windows XP-Pro or later, and Microsoft Office 2010 or later (BBS Software will consist of Power Point Presentations), and PC Anywhere Remote Control Software.
- B. Connect Digital Video and Audio output of Bulletin Board PC to A/V MPEG-4/H.264 Encoder input for streaming of Bulletin Board Broadcasts to PCs and Set Top Boxes.
- C. Connect the Bulletin Board PC to Network Electronics via a **1 Gb** Ethernet Connection.
- D. ***Digital messaging can be part of the Digital Media Management System.***

1.8 VIDEO CAMERA SYSTEM

- A. Provide **1** digital Video Camera with a wheeled tripod for remote origination of video broadcasts, and announcements. Equip each camera with a dual MPEG 4/H.264 Encoder Unit for broadcasting low and high bit rate digital streams.
- 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 VIDEO BLU-RAY SYSTEM

- A. Provide **1 Blu-Ray** player located in the Media Center for live streaming and recording. Equip each unit with a dual MPEG 4/H.264 Encoder Unit for broadcasting low and high bit rate digital streams.

1.10 DIGITAL BROADCAST MEDIA SOURCE SYSTEM

- A. **Provide 6-12 channels of digital broadcast 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.**

1.11 INSTALLATION

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

1.12 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.

1.13 TESTING

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

1.14 TRAINING

- A. Provide minimum of sixteen (16) hours training for District personnel on the operation and maintenance of each of the AV Media systems.
- B. **Provide four (4) hours of follow-up training during the 11 month walk-through period.**
- C. Provide **a digital video copy** of all training.
- D. MPEG-4 encode and place a copy of training video on VOD server.

END OF SECTION

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SECTION 275121

STUDENT DINING / AUDITERIA SOUND REINFORCEMENT SYSTEM – HIGH SCHOOL

GENERAL GUIDELINES

1.1 GENERAL

- A. Refer to Section 8500, Technology Systems, for additional information.

1.2 SECTION INCLUDES

- A. Sound Reinforcement System
- B. Stage/Production Intercom System
- C. Assistive Listening System
- D. Monitor/Effects Foldback System
- E. Backstage Monitor/Cue System

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).
- E. Americans with Disabilities Act (ADA).
- F. Federal Communications Commission Part 15.
- G. Sound System Engineering (Davis & Patronis) – 3rd Edition 2006.
- H. Audio Systems Design and Installation (Giddings) 1990.

1.4 SYSTEM WARRANTY

- A. The Student Dining/Auditeria Sound Reinforcement System shall be warranted by the Contractor for a period of **two (2)** years from date of substantial completion.

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. Stationary Main Equipment Cabinet with the following rack mounted equipment:
1. Mixer/Preamplifier
 2. Power Amplifier(s)
 3. Digital Signal Processor(s)
 - a. RS-232 Interface for Configuration and Tuning
 - b. Equalization Filters – graphic and/or parametric
 - c. Compressor/Limiter
 - d. Digital Delay for cluster alignment (if applicable)
 - e. High and Low Pass and Shelving Filters
 - f. Feedback Suppression (may be incorporated in DSP or a stand-alone unit)
 - g. Crossover (if bi-amplified speaker system is utilized)
 - h. Selectable scene presets
 4. AM/FM radio tuner
 5. Assistive Listening Transmitter (provide with ADA-compliant quantity of receivers)
 6. Monitor/Effects Foldback System amplification and signal processing, including feedback eliminators and equalization
 7. Sequencing AC Power Control System
 8. Passive or Active thermal control
 9. Microphone termination/splitting panel in Main Equipment Cabinet
- B. Program Source Cabinet
1. i-Pod Docking Station
 2. Wireless microphone receivers (minimum qty. 4) and antenna distribution system. Provide with handheld and/or lavalier microphones.
 3. CD/CD-R/CD-RW/MP3 Player
 4. Digital audio recording device.
 5. Production Intercom Wireless Base Station – Provide with a minimum of four (4) wireless belt packs and headsets
 6. Input/output jack panel
 7. AC power distribution panel
- C. House Speaker Options:
1. Point source speaker or speaker cluster suspended from structure.
 2. Speaker cluster with delayed satellite speakers.
 3. Distributed full range speakers.
 4. Sub Woofer(s) – (optional)
- D. Monitor Speakers – floor wedge or stand-mounted – minimum qty. 2. Provide with rubber-jacketed speaker cables.
- E. Distributed Jackplates:
1. Microphone jackplates (XLR-F connectors).
 2. Monitor/Effects speaker jackplates (Speakon style).
 3. Multi-pin send/return connectors at mixing locations in Control Room and at rear of audience seating area.
- F. Multi-pair “snake cable” with individually shielded pairs, connectorized at both ends.

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- G. Direct box(es) for insertion of line level and laptop sound card signals into microphone jacks.
- H. Mixing Console – Minimum requirements: 24-microphone input channels; 2-stereo line level input channels; stereo and mono output busses; 4-aux output busses
- I. Hanging microphones – for use over stage (minimum qty. 2).
 - 1. Microphones, microphone stands, cords, and connectors.
- J. Handheld, lavalier or boundary microphones. (minimum qty. 2) Include floor or desk stands and cords.

1.7 INSTALLATION

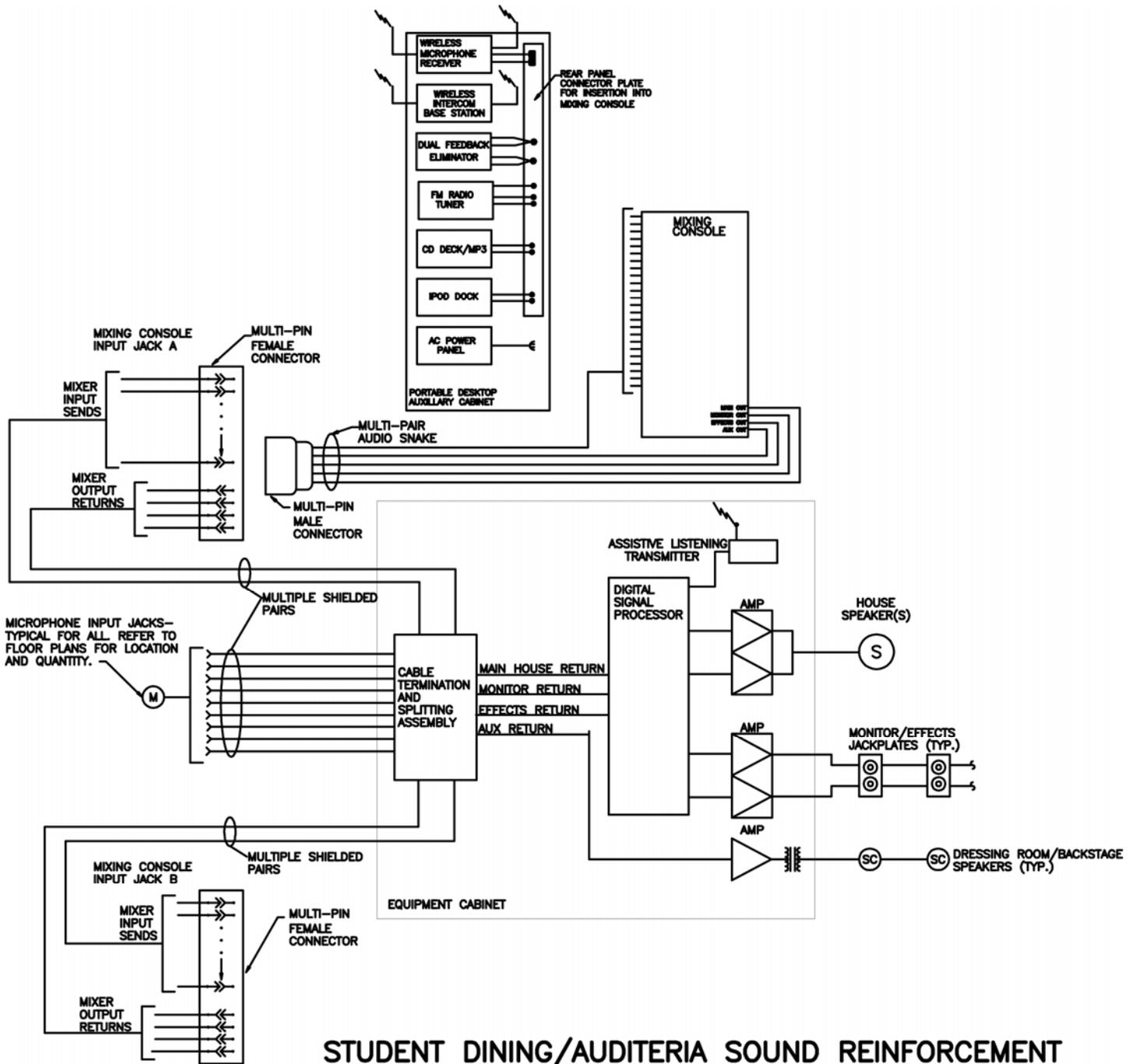
- A. Install and balance system. Adjust all sound levels for desired operation levels and evenness of coverage.
- B. Adjust all wireless equipment and verify coverage areas.
- C. Check polarity of all input jacks, signal chains, and speakers.
- D. Check gain structure.
- E. Connect FM Tuner to external, building mounted FM Antenna Distribution System. Ground antenna in accordance with NEC and TIA/EIA-607.
–OR–
Receive radio reception from Distributed Broadband RF system.
- F. Ground equipment cabinet and associated equipment to cabinet-mounted telecommunications grounding buss bar in accordance with NEC and TIA/EIA-607.
- G. Install in accordance with manufacturer’s installation instructions.

1.8 PERFORMANCE TESTING

- A. Frequency response: 80Hz – 14kHz +/- 3 dB.
- B. Loudness: At least 96dB-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.

1.9 TRAINING

- A. Provide eight (8) hours training for District’s personnel on the operation and maintenance of the system.
- B. Provide **a digital video** copy of all training.



STUDENT DINING/AUDITERIA SOUND REINFORCEMENT SYSTEM DIAGRAM – HIGH SCHOOL

SCALE: NONE (RE: 27 51 21)

NOTE: THIS DIAGRAM IS SCHEMATIC IN NATURE ONLY. IT IS INTENDED TO SHOW GENERAL CONFIGURATION OF THE SYSTEM. MODIFY TO ACCOMMODATE DESIGN PREFERENCES, OWNER NEEDS AND PROJECT CONDITIONS.

END OF SECTION

SECTION 275122**STUDENT DINING / CAFETERIA SOUND REINFORCEMENT SYSTEM****GENERAL GUIDELINES****1.1 GENERAL**

- A. Refer to Section 8500, Technology Systems, for additional information.

1.2 SECTION INCLUDES

- A. Sound Reinforcement System
- B. Assistive Listening System

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).
- E. Americans with Disabilities Act (ADA).
- F. Federal Communications Commission Part 15.
- G. Sound System Engineering (Davis & Patronis) – 3rd Edition 2006.
- H. Audio Systems Design and Installation (Giddings) 1990.

1.4 SYSTEM WARRANTY

- A. The Student Dining/Cafeteria Sound Reinforcement System shall be warranted by the contractor for a period of **two (2)** years from date of substantial completion.

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. Stationary Main Equipment Cabinet with the following rack mounted equipment:
1. Mixer/Preamplifier (minimum of 8 channels)
 2. Power Amplifier(s)
 3. Digital Signal Processor(s)
 4. RS-232 Interface for Configuration and Tuning
 5. Equalization Filters – graphic and/or parametric
 6. Compressor/Limiter
 7. Digital Delay for cluster alignment (if applicable)
 8. High and Low Pass and Shelving Filters
 9. Feedback Suppression (may be incorporated in DSP or a stand-alone unit).
 10. Crossover (if bi-amplified speaker system is utilized)
 11. Selectable scene presets
 12. AM/FM radio tuner
 13. i-Pod Docking Station
 14. CD/CD-R/CD-RW/MP3 Player
 15. Digital audio recording device
 16. Wireless microphone receivers (Minimum Qty. 1) and antenna distribution
 17. Assistive Listening Transmitter (provide with ADA-compliant quantity of receivers)
 18. Sequencing AC Power Control System
 19. Passive or Active thermal control
- B. Speaker Options:
1. Point source speaker or speaker cluster suspended from structure.
 2. Speaker cluster with delayed satellite speakers.
 3. Distributed full-range speakers.
- C. Distributed Jackplates
1. Microphone input jackplates (XLR-F connectors).
 2. Balanced, auxiliary-input, jack plate assemblies.
- D. Microphones, microphone stands, cords, and connectors (minimum qty. 4).

1.7 INSTALLATION

- A. Install and balance system. Adjust all sound levels for desired operation levels and evenness of coverage.
- B. Adjust all wireless equipment and verify coverage areas.
- C. Check polarity of all speakers and adjust all microphone and source input levels.
- D. Connect FM Tuner to external, building mounted FM Antenna and Distribution System. Ground Antenna in accordance with NEC and TIA/EIA-607.
–OR–
Receive radio reception from Distributed Broadband RF system as specified in another spec section.
- E. Ground equipment cabinet and associated equipment to cabinet-mounted telecommunications grounding busbar in accordance with NEC and TIA/EIA-607

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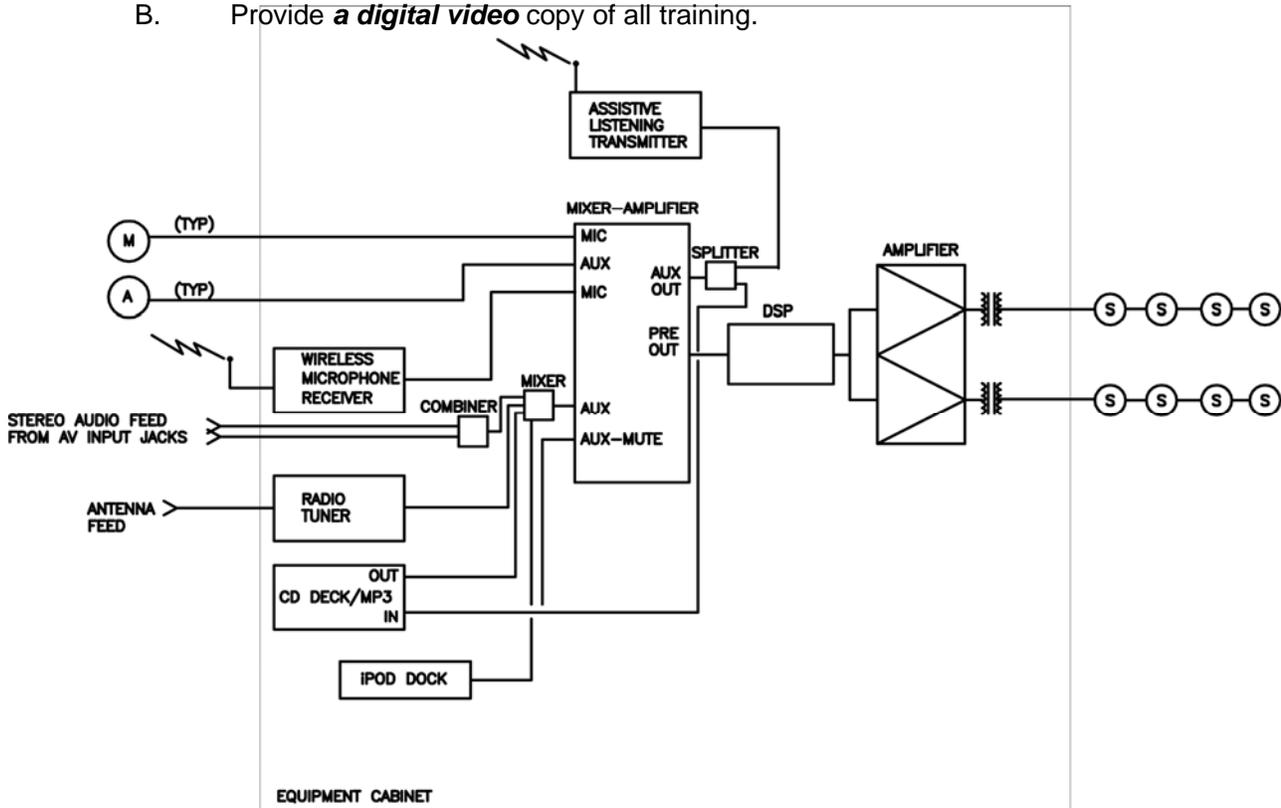
- F. Install in accordance with manufacturer's installation instructions and recommendations.

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.

1.9 TRAINING

- A. Provide eight (8) hours training for District's personnel on the operation and maintenance of the system.
- B. Provide **a digital video** copy of all training.



STUDENT DINING/CAFETERIA SOUND REINFORCEMENT SYSTEM DIAGRAM

SCALE: NONE (RE: 27 51 22)

NOTE: THIS DIAGRAM IS SCHEMATIC IN NATURE ONLY. IT IS INTENDED TO SHOW GENERAL CONFIGURATION OF THE SYSTEM. MODIFY TO ACCOMMODATE DESIGN PREFERENCES, OWNER NEEDS AND PROJECT CONDITIONS.

END OF SECTION

SECTION 275123

CENTRAL SOUND AND PAGING SYSTEM

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 OSFC Technology construction projects.
- B. 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. An optional one-way zoned paging system, interfaced and operated by the telephone system (specified elsewhere) shall require an OSFC variance.
- D. Refer to 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

- 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)
- E. Americans with Disabilities Act (ADA)
- F. Federal Communications Commission Part 15
- G. Sound Systems Engineering (Davis & Patronis) – 3rd Edition 2006
- H. Audio Systems Design and Installation (Giddings) 1990

1.4 SYSTEM WARRANTY

- A. The Central Sound and Paging System shall be warranted by the Contractor for a period of **two (2)** years from date of substantial completion.

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1.5 RELATED SECTIONS

- A. Specification section 275313 – Clock Systems
- B. Specification section 273113 – IP-Enabled PABX System
OR Specification section 273123 – IP-Only PABX System

1.6 MICROPROCESSOR-BASED TWO-WAY INTERCOM / PAGING / PROGRAM DISTRIBUTION SYSTEM (Base Design)

- A. PABX System Interface
- B. Administrative communications console – located in main office or at equipment headend
- C. Microprocessor-based with RS-232 Interface for setup and/or control
- D. Minimum eight (8) paging and time tone distribution zones
- E. Internal time-tone schedule programming and software
- F. Synchronization with clock system
- G. Input signal prioritization
- H. Dedicated home-run speaker circuits from each classroom or special function room (gymnasiums, dining rooms, multi-purpose rooms, exterior spaces, etc.). Call button cabling is included in baseline system whether the call button is installed or not. Extend to speaker location if call button is not installed.
- I. Base Line - Call origination switches or handsets in each classroom with annunciator display in central school reception office. Variance required if District elects not to include. Technology Designer to review system with District, determine need for conduit/box rough-ins for future if District elects not to include in project via variance.

1.7 ONE-WAY ZONED PAGING SYSTEM (Optional System Requires Variance)

- A. PABX System Interface
- B. Microprocessor-based, zoned paging/program distribution system
- C. Minimum of six (6) paging zones
- D. Distribution of class-change time tones as scheduled by Clock System
- E. Input signal prioritization

- F. One-Way Zoned Paging System Options:
1. High impedance, constant voltage system with centrally located power amplifiers and passive speakers with 25-volt transformers. Each classroom speaker circuit to be individually wired and extended to headend equipment. Corridor and common area speakers to be grouped according to zones.
 2. Low-voltage, amplified speakers with central power supplies and star-wired CAT3 cabling system terminated on 110-style cross-connect blocks, located on the backboard in main Equipment Room (ER). Each speaker wired with dedicated, individual home-run cable. Use pair 1 for paging signal and pairs 2-4 for power.
- 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 - Locate a wall-mounted or desktop cabinet in the central school reception office area and place within the cabinet:
1. i-Pod Docking Station (optional)
 2. Weather radio and associated antenna (optional)
 3. CD player or changer
 4. AM/FM radio connected to the building antenna/RF distribution system
 5. Monitor speaker panel for program cueing and preview
 6. 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
- 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.
 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.

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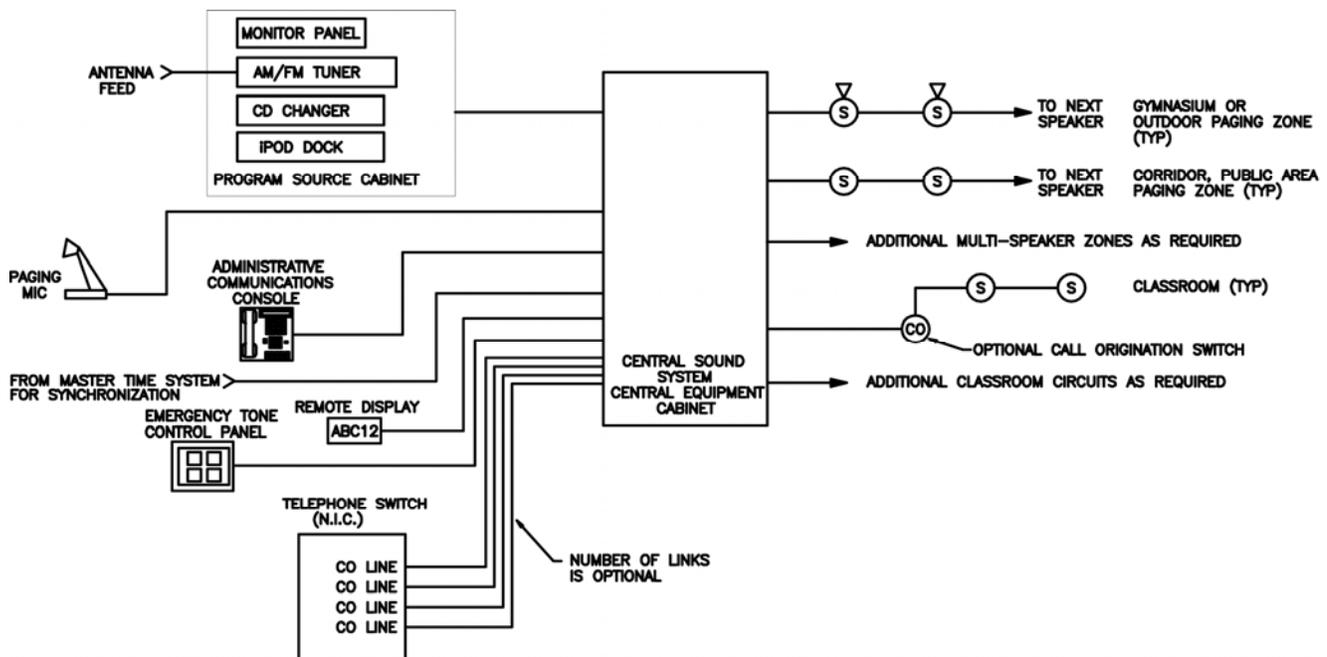
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1.9 INSTALLATION

- 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

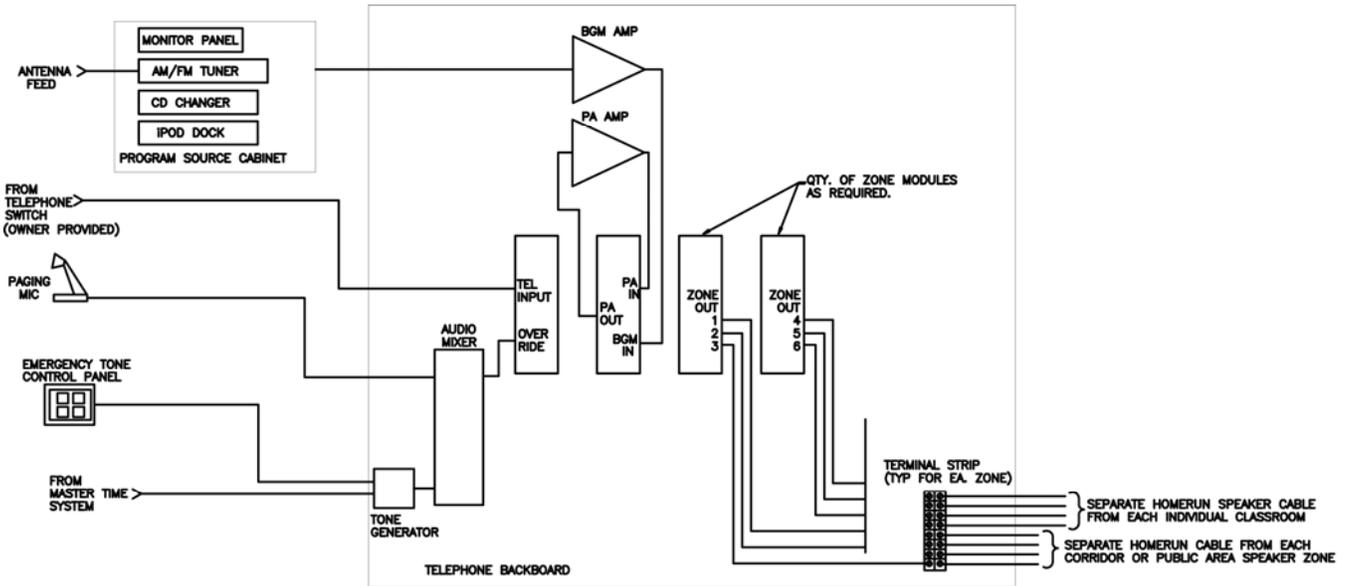
- A. Provide eight (8) hours training for school and district personnel on the operation, programming, and maintenance of the system.
- B. Provide **a digital** video copy of all training.



CENTRAL SOUND/INTERCOM SYSTEM DIAGRAM (BASELINE SYSTEM)

SCALE: NONE (RE: 27 51 23A)

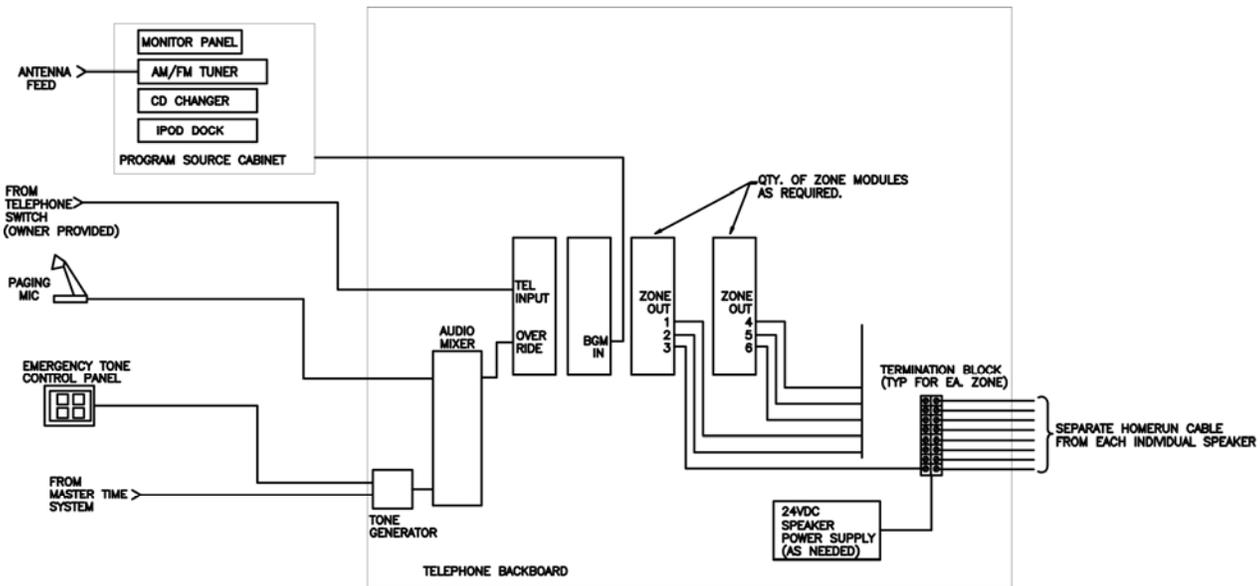
NOTE: THIS DIAGRAM IS SCHEMATIC IN NATURE ONLY. IT IS INTENDED TO SHOW GENERAL CONFIGURATION OF THE SYSTEM. MODIFY TO ACCOMMODATE DESIGN PREFERENCES, OWNER NEEDS AND PROJECT CONDITIONS.



CENTRAL SOUND PAGING/PROGRAM DISTRIBUTION SYSTEM DIAGRAM – PASSIVE SPEAKERS

SCALE: NONE (RE: 27 51 23B) (OPTIONAL – REQUIRES VARIANCE)

NOTE: THIS DIAGRAM IS SCHEMATIC IN NATURE ONLY. IT IS INTENDED TO SHOW GENERAL CONFIGURATION OF THE SYSTEM. MODIFY TO ACCOMMODATE DESIGN PREFERENCES, OWNER NEEDS AND PROJECT CONDITIONS.



CENTRAL SOUND PAGING/PROGRAM DISTRIBUTION SYSTEM DIAGRAM – POWERED SPEAKERS

SCALE: NONE (RE: 27 51 23C) (OPTIONAL – REQUIRES VARIANCE)

NOTE: THIS DIAGRAM IS SCHEMATIC IN NATURE ONLY. IT IS INTENDED TO SHOW GENERAL CONFIGURATION OF THE SYSTEM. MODIFY TO ACCOMMODATE DESIGN PREFERENCES, OWNER NEEDS AND PROJECT CONDITIONS.

END OF SECTION

SECTION 275124

GYMNASIUM SOUND REINFORCEMENT SYSTEM

GENERAL GUIDELINES

1.1 GENERAL

- A. This section defines the general design requirements for a uniform Gymnasium Sound Reinforcement System that shall be followed for all OSFC Technology construction projects – High School, Middle School, and Elementary School facilities.
- B. The variations as related to school type 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. Gymnasium Sound Reinforcement System and all related 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).
- E. Americans with Disabilities Act (ADA).
- F. Federal Communications Commission Part 15.
- G. Sound System Engineering (Davis & Patronis) – 3rd Edition 2006.
- H. Audio Systems Design and Installation (Giddings) 1990.

1.4 SYSTEM WARRANTY

- A. The Gymnasium Sound Reinforcement System shall be warranted by the contractor for a period of **two (2)** years from date of substantial completion.

1.5 MATERIALS

- A. Stationary Main Equipment Cabinet with the following rack mounted equipment:
1. Mixer/Preamplifier
 2. Power Amplifier(s)
 3. Digital Signal Processor(s)
 - a) RS-232 Interface for Configuration and Tuning
 - b) Equalization Filters – graphic and/or parametric
 - c) Compressor/Limiter
 - d) Digital Delay for cluster alignment
 - e) High and Low Pass and Shelving Filters
 - f) Feedback Suppression (may be incorporated in DSP or a stand-alone unit)
 - g) Crossover (if bi-amplified speaker system is utilized)
 - h) Selectable scene presets
 4. AM/FM radio tuner
 5. Digital audio recording device.
 6. Assistive Listening Transmitter (provide with ADA-compliant quantity of receivers)
 7. Sequencing AC Power Control System
 8. Passive or Active thermal control
- B. Mobile Equipment Cabinet shall contain the following equipment for mic level signal insertion into a wall or floor mounted microphone jack:
1. Rack-mounted mixer with mic level output
 2. Wireless microphone receiver with handheld and/or lavalier microphone
 3. CD/CD-R/CD-RW/MP3 Player
 4. i-Pod Docking Station
 5. Input/output jack panel
 6. AC power distribution panel
 7. Note: In Middle and Elementary School Gymnasium systems, the mobile equipment cabinet may be eliminated with the associated components being located in the Stationary Equipment Cabinet.
- C. Speaker cluster or distributed speakers suspended from structure.
1. Middle School and Elementary School Gymnasium speaker systems shall provide even coverage of both the entire floor area and seating areas.
 2. High School Gymnasium speaker systems shall provide switchable speaker zones as follows: Home Bleachers, Visitors Bleachers, Floor, and Mezzanine (where applicable). The zone selection shall be performed via selector switches in the Stationary Equipment Cabinet.
- D. Microphone input jack at scorer's table.
- E. Distributed mic/aux level input jacks on end walls –OR- mic level input jacks only (provide with aux/line level-to-microphones level direct box(es)).

1.6 INSTALLATION

- A. Install and balance system. Adjust all sound levels for desired operation levels and evenness of coverage.

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- B. Adjust all wireless equipment and verify coverage areas.
- C. Check polarity of all speakers and adjust all microphone and source input levels.
- D. Connect FM Tuner to external, building mounted FM Antenna and Distribution System. Ground Antenna in accordance with NEC and TIA/EIA-607. –OR- Receive radio reception from Distributed Broadband RF system as specified in another spec section.
- E. Ground equipment cabinet and associated equipment to cabinet-mounted telecommunications grounding buss bar in accordance with NEC and TIA/EIA-607.
- F. Install in accordance with manufacturer's installation instructions and recommendations.

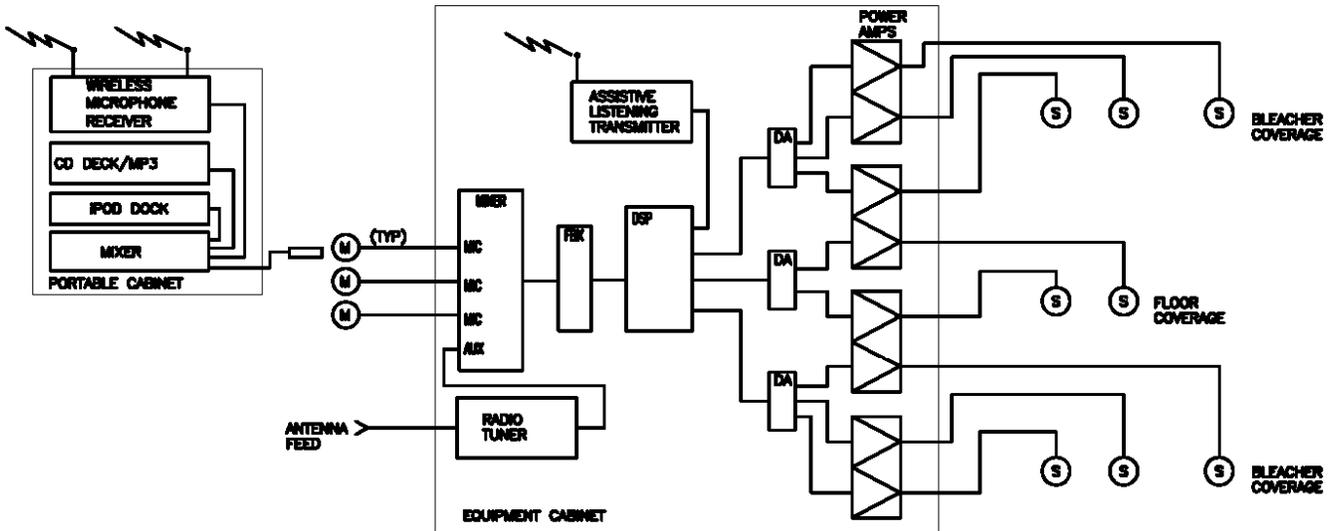
1.7 PERFORMANCE TESTING

- A. Frequency response: 100Hz – 14kHz +/- 3 dB
- B. 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 90dB-SPL program level with an additional 6 dB Crest factor
- C. Evenness of coverage: Variation of less than +/- 3 dB (400Hz to 4000Hz) at all seats.

1.8 TRAINING

- A. Provide minimum eight (8) hours training for District's personnel on the operation and maintenance of the system.
- B. Provide **a digital video** copy of all training.

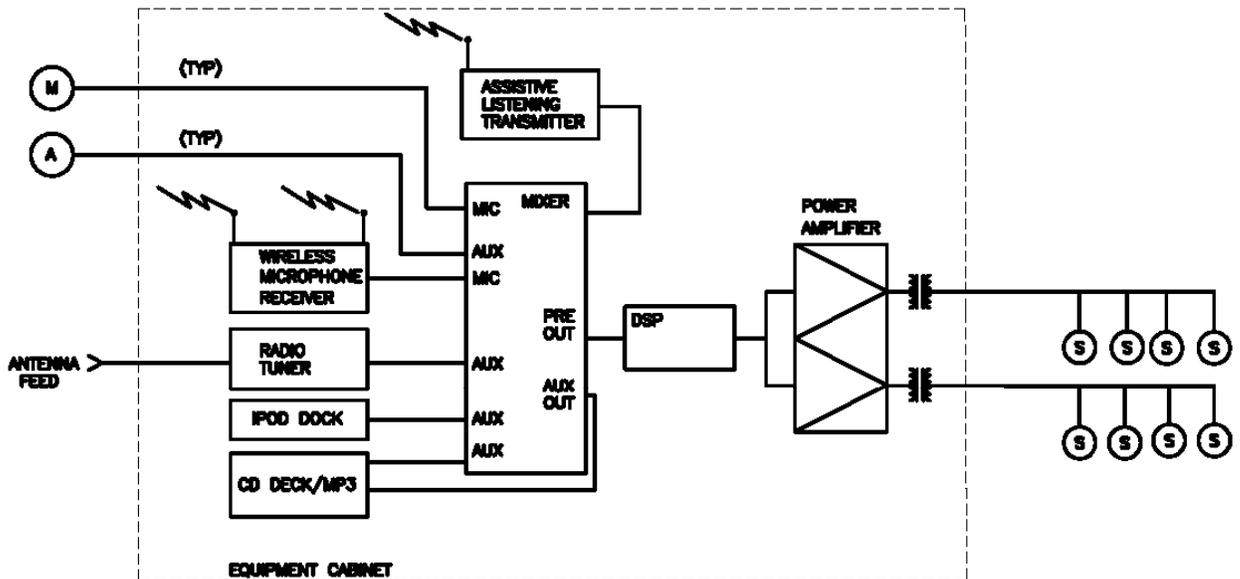
(See diagrams on next page)



HS GYMNASIUM SOUND SYSTEM DIAGRAM

SCALE: NONE (RE: 27 51 24A)

NOTE: THIS DIAGRAM IS SCHEMATIC IN NATURE ONLY. IT IS INTENDED TO SHOW GENERAL CONFIGURATION OF THE SYSTEM. MODIFY TO ACCOMMODATE DESIGN PREFERENCES, OWNER NEEDS AND PROJECT CONDITIONS.



MS/AUX GYMNASIUM SOUND SYSTEM DIAGRAM

SCALE: NONE (RE: 27 51 24B)

NOTE: THIS DIAGRAM IS SCHEMATIC IN NATURE ONLY. IT IS INTENDED TO SHOW GENERAL CONFIGURATION OF THE SYSTEM. MODIFY TO ACCOMMODATE DESIGN PREFERENCES, OWNER NEEDS AND PROJECT CONDITIONS.

END OF SECTION

SECTION 275125

MUSIC ROOM AUDIO PROGRAM PLAYBACK SYSTEM - MIDDLE SCHOOL

GENERAL GUIDELINES

1.1 GENERAL

- A. Refer to 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

- 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).
- E. American with Disabilities Act.
- F. Federal Communications Commission Part 15.
- G. Sound System Engineering (Davis & Patronis) – 3rd Edition 2006.
- H. Audio Systems Design and Installation (Giddings) 1990.

1.4 SYSTEM WARRANTY

- A. The Sound System shall be warranted by the contractor for a period of **two (2)** years from date of substantial completion.

1.5 MATERIALS

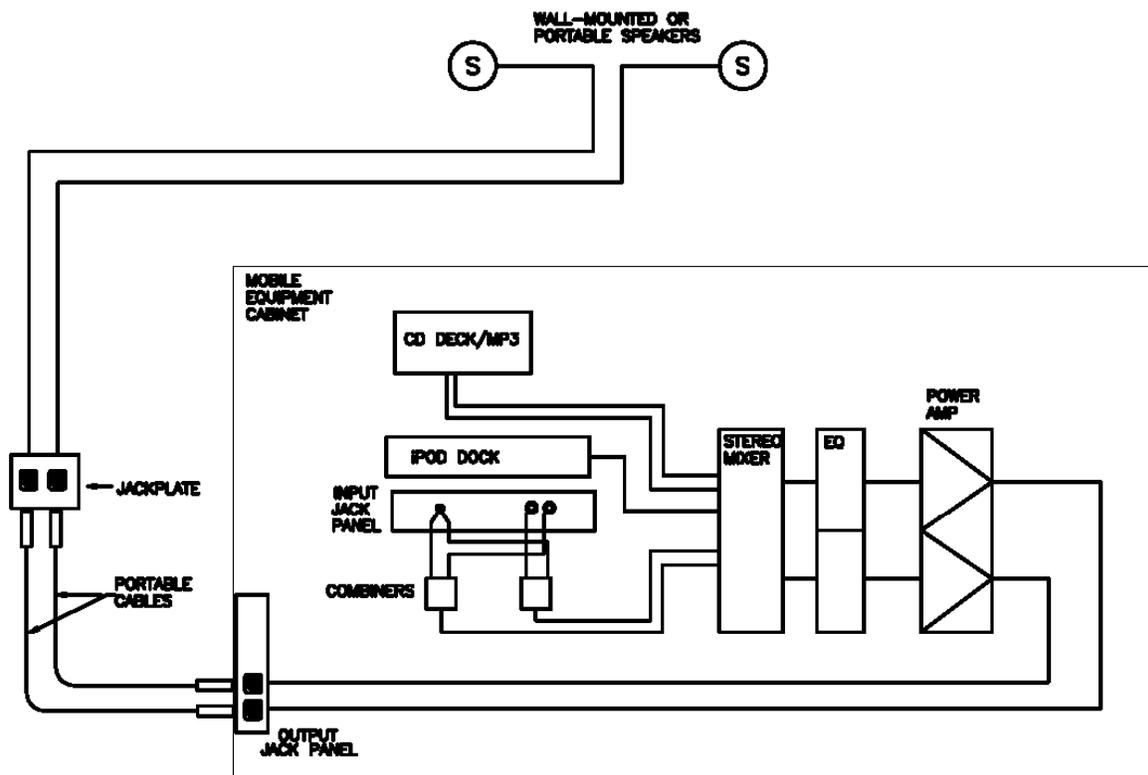
- A. Mobile or permanently mounted main equipment rack.
 - 1. Stereo Mixer or Source Selection Device – rack-mounted.
 - 2. Dual channel Amplifier.
 - 3. Dual channel octave band equalizer.
 - 4. CD/CD-R/CD-RW/MP3 Player.
 - 5. i-Pod Docking Station.
 - 6. Input Jack panel for insertion of external sources.
- B. Wall mounted or tripod mounted speakers – stereo pair.
- C. Wall-mounted speaker jack plate – for connection of amplifier in mobile rack to permanently-mounted speakers.

1.6 INSTALLATION

- A. Install and balance system volume levels.
- B. Check polarity of all speakers.
- C. Install in accordance with manufacturer's installation instructions and recommendations.

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.



NOTE: SINGLE MOBILE EQUIPMENT CABINET SHARED BETWEEN VOCAL & INSTRUMENTAL ROOMS.

NOTE: THIS DIAGRAM IS SCHEMATIC IN NATURE ONLY. IT IS INTENDED TO SHOW GENERAL CONFIGURATION OF THE SYSTEM. MODIFY TO ACCOMMODATE DESIGN PREFERENCES, OWNER NEEDS AND PROJECT CONDITIONS.

MS MUSIC ROOM PLAYBACK SYSTEM DIAGRAM

2012.08.08 (REV. 27 51 25)

END OF SECTION

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SECTION 275126

MUSIC ROOM AUDIO RECORDING/PLAYBACK SYSTEM - HIGH SCHOOL

GENERAL GUIDELINES

1.1 GENERAL

- A. Refer to 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

- 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).
- E. American with Disabilities Act.
- F. Federal Communications Commission Part 15.
- G. Sound System Engineering (Davis & Patronis) – 3rd Edition 2006.
- H. Audio Systems Design and Installation (Giddings) 1990.

1.4 SYSTEM WARRANTY

- A. The Sound System shall be warranted by the contractor for a period of **two (2)** years from date of substantial completion.

1.5 MATERIALS

- A. Mobile or permanently mounted main equipment rack.
 1. Stereo microphone mixer/pre-amplifier – rack-mounted.
 2. Recording Input patch panel for insertion of external microphones or mixing consoles.
 3. Stereo program playback mixer or source selection device – rack-mounted.
 4. Program source, playback patch panel for insertion of external playback devices.
 5. Dual channel amplifier.
 6. Dual channel, octave band equalizer.
 7. CD/CD-R/CD-RW/MP3 Player

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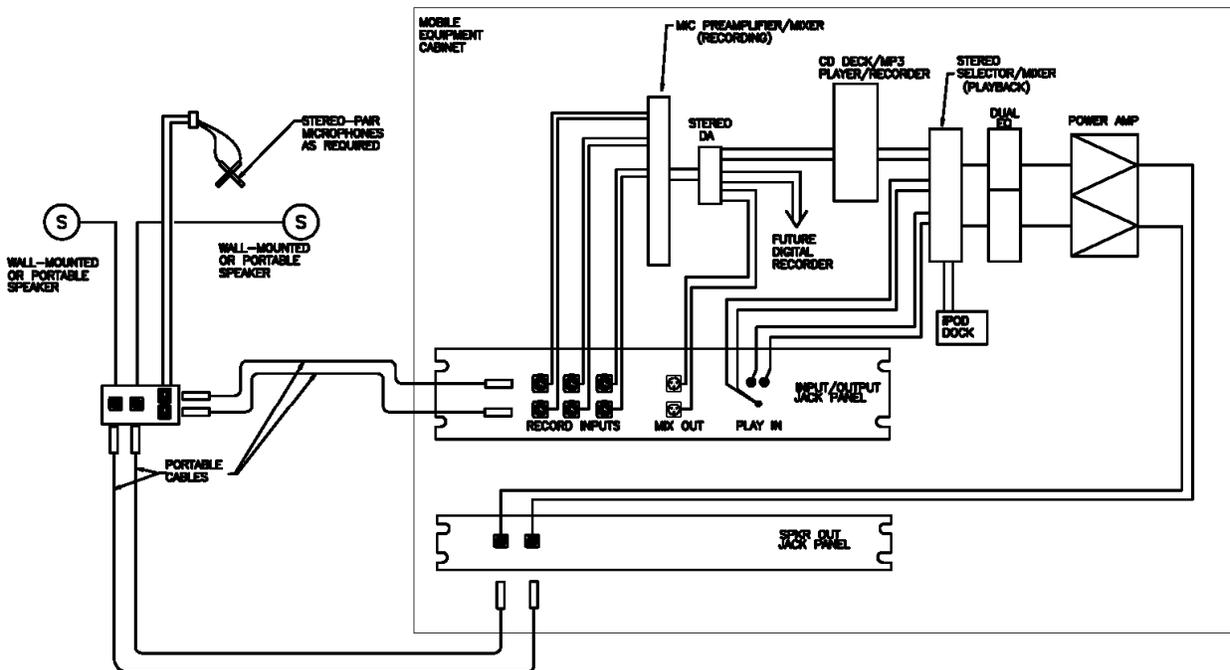
8. i-Pod Docking Station.
 9. Digital audio recording device
 10. Stereo hanging and/or floor stand microphones as required.
- B. Wall mounted or tripod mounted speakers – stereo pair.
- C. Wall mounted speaker jack plate – for connection of amplifier in mobile rack to permanently mounted speakers.

1.6 INSTALLATION

- A. Install and balance system volume levels.
- B. Check polarity of all speakers and microphones.
- C. Install in accordance with manufacturer's installation instructions and recommendations.

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.



HS MUSIC ROOM RECORD/PLAYBACK SYSTEM DIAGRAM

SCALE NONE (RE: 27 51 28)

NOTE: THIS DIAGRAM IS SCHEMATIC IN NATURE ONLY. IT IS INTENDED TO SHOW GENERAL CONFIGURATION OF THE SYSTEM. MODIFY TO ACCOMMODATE DESIGN PREFERENCES, OWNER NEEDS AND PROJECT CONDITIONS.

END OF SECTION

SECTION 275127

CLASSROOM SOUND REINFORCEMENT SYSTEM

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 OSFC 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 **two (2)** 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 50-20 KHz 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. Minimum of one (1) ceiling-mounted, Infrared sensor or RF antenna with plenum rated cabling.

11. One (1) Lavalier or collar microphone, with NiMH rechargeable batteries and charger.
12. One (1) Handheld microphone, with NiMH rechargeable batteries and charger.
13. Minimum of four (4) acoustical ceiling mounted, 360-degree dome speakers with all metal acoustical back enclosure and ceiling tile bridge, minimum 15-Watt capacity and minimum of 65-20KHz frequency response.
14. Receiver/Amplifier must be capable of being placed in Instructor's casework or cabinet mounted with no loss of infrared signal strength.
15. Unit must provide uniform pickup from the Instructor's microphone throughout the classroom.
16. Provide means for the central paging 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.

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. Route speaker wires through associated faceplate Space speakers in classroom to provide uniform coverage.
- D. For rooms using Overhead Mounted Projectors:
 1. Provide a wall bracket/shelf for mounting Infrared Receiver/Amplifier or mounted in cabinet or casework.
 2. Provide Line Level cabling from Instructor's PC, DVD/Blu-Ray Unit and MPEG Set-Top-Box Line Outputs to Auxiliary Line Inputs on Infrared Receiver/Amplifier.
 3. Balance and adjust all volume levels.
 4. Check uniform polarity of speakers.
- E. Add additional speakers and infrared sensors in large classrooms, as required, to maintain complete coverage.
- F. Classroom Sound Reinforcement system shall be installed in all classrooms/labs for K-12.
- G. 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

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 OSFC 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 **two (2)** 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.
 2. Metal hour, minute, and second hands with impact resistant molded plastic case.

3. Corridors: Double-faced, securely mounted perpendicular to wall or ceiling mounted.
 4. 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 with metal case.
 2. Corridors: Double-faced with perpendicular wall or ceiling mount.
 3. Gymnasiums: 4" height minimum, 4-digit, 7-segment LED display with metal case. Provide wire guards in gymnasiums, auxiliary gymnasiums, and locker rooms.
 4. Optional Text Messaging capability.
- 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.

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- E. Located schedule selection and manual bell activation functions in main school office.

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