

## SECTION 27 40 00

INTEGRATED AUDIOVISUAL SYSTEMS & EQUIPMENT  
05/18

## PART 1 GENERAL

## 1.1 STANDARDS &amp; REFERENCES

The design and specification of the following audiovisual systems adhere to industry best practices as outlined by the International Communications Industries Associations, Inc. (ICIA). In addition, all designs are performed by Avixa (formerly InfoComm International) Certified Technology Specialists -Designer (CTS-D), an American National Standards Institute (ANSI) accredited designation under International Standard ISO/IEC 17024.

All system designs must meet the minimum requirements outlined in the Federal Standards for Accessible Design (ADA). Applicable code requirements established by the Authority Having Jurisdiction (AHJ) shall be followed. The design shall comply with applicable provisions in the following:

BICSI/InfoComm, Audiovisual Design Reference Manual.  
InfoComm, AV Installation Handbook.  
InfoComm, Audiovisual Best Practices.  
Maltese, AV 9000: Defining Quality in Engineered Audio Visual Systems, 2006.  
City and State or District Ordinances, as applicable to location.  
IEEE C2, National Electrical Safety Code®.  
NFPA 70, National Electrical Code®.  
NFPA 72, National Fire Alarm Code®.  
NFPA 101, Life Safety Code®.  
NFPA 255, Standard Method of Test of Surface Burning Characteristics  
American National Standards Institute (ANSI).  
Federal Communications Commission (FCC).  
National Electrical Manufacturers Association (NEMA).  
Occupational Safety and Health Administration (OSHA),  
Joint Interoperability Test Command (JITC)  
Defense Information Systems Agency (DISA)  
Defense Information Systems Agency Approved Product List (APL)  
Trade Adjustment Assistance (TAA)

## 1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2017; Errata 1-2 2017; INT 1 2017)  
National Electrical Safety Code

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA  
20-1; TIA 20-2; TIA 20-3; TIA 20-4)  
National Electrical Code

NFPA 72	(2022) National Fire Alarm and Signaling Code
NFPA 101	(2021) Life Safety Code
NFPA 255	(2006; Errata 2006) Standard Method of Test of Surface Burning Characteristics of Building Materials

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-568-C.1	(2009; Add 2 2011; Add 1 2012) Commercial Building Telecommunications Cabling Standard
TIA-568-C.2	(2009; Errata 2010; Add 2 2014; Add 1 2016) Balanced Twisted-Pair Telecommunications Cabling and Components Standards
TIA-568-C.3	(2008; Add 1 2011) Optical Fiber Cabling Components Standard
TIA-606	(2021d) Administration Standard for the Telecommunications Infrastructure

1.3 GENERAL REQUIREMENTS

1.3.1 Audio Visual (A/V) Services

When A/V equipment is required, a Certified Technology Specialist-Design (CTS-D) whose certification is ANSI accredited is required for the design and preparation of A/V package. The CTS-D must provide separate Best Value Determinations (BVDs) for all A/V equipment, if required by NAVFAC. If NAVSUP BPA/GSA vendors do not have access to the required equipment, research to find appropriate specialty equipment vendors may be required.

The A/V package must be prepared by the Contractor's A/V Certified Technology Specialist-Design (CTS-D) as a separate package. The CTS-D must validate the design provided in the construction documents and submit any design modifications as required to provide a system that uses equipment that is readily available at time of installation, is no less than 3 years from the manufacturer's end of life support, and provides the systems needed functionality.

Additionally, A/V floor plans and elevations must be provided by the CTS-D, indicating equipment locations and A/V riser diagrams for all A/V systems, and to coordinate equipment locations and power requirements with power plans and FF&E locations. The A/V package must be fully integrated into the design, construction, and schedule of all building finishes and all building systems (HVAC, Plumbing, Fire Protection, Communications, Electrical, Data, Architecture, etc.) All outlets, switches, thermostats, fire extinguishers, etc. must be fully accessible once all equipment is installed. All sprinkler heads, fire extinguishers, ADA clearances, etc. must be accommodated.

A/V systems must be fully integrated with the building systems and finishes. A/V may also include specialty items for which the customer

activity will be responsible for specifying. All A/V items are subject to the Buy American Act or Trade Agreement Act, unless they are considered COTS (Consumer Off The Shelf) items per the FAR.

#### 1.4 DEFINITIONS

Representative: Refers to the Architect or Engineer having contract directly with Government for professional services.

Government Furnished Equipment (GFE): Equipment procured and provided by the government.

Government Furnished Contractor Installation (GFCI): Equipment procured and provided by the government that is given to the contractor to install.

Government Furnished Government Installed (GFGI): Equipment procured, provided and installed by the government.

Code Requirements: Refers to minimum requirements.

Final Acceptance: Refers to Government's Representative's acceptance of project from Audiovisual Contractor.

Relocate: Refers to disassembly, disconnection, packaging, protecting, and transporting equipment to new locations, followed by installation and testing.

Replace: Refers to removing existing item and providing a new item.

Rough-in: Refers to conduit, pipe, cable tray required for audiovisual system.

Pre-wire: Refers to installation of cabling between spaces.

Fabrication: Refers to loading devices and equipment into secure racking or housing and making necessary device interconnections.

Headend: Refers to centralized AV equipment racks.

Audiovisual (AV): Refers to electronic media processing sound and visual content.

Audiovisual Contractor (AVC): Refers to the contractor designing, installing, programming, configuring, testing, or operating the audiovisual systems and or components.

Video Teleconferencing (VTC): Refers to technology that facilitates the communication and interaction of two or more users through a combination of audio and video over a network.

Audio Teleconferencing (ATC): Refers to conference calling of three or more participants in different locations without video.

Bring Your Own Device (BYOD): Refers to IT related equipment associated with visitors or non-government employees (i.e. laptop, tablet, smartphone).

## 1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Audiovisual Drawings; G

Audiovisual Space Drawings; G

In addition to Section 01 33 00 SUBMITTAL PROCEDURES, provide shop drawings in accordance with paragraph SHOP DRAWINGS.

## SD-03 Product Data

LCD Displays - 100"

Presentation Matrix Switcher

Multi-Input Switcher

Video Teleconferencing System (CODEC)

HD PTZ Cameras

Video Scaler

Digital Signal Processor

Speakers

Power Amplifiers - 2 Channel And 1 Channel

Scaling Presentation Switcher

Ceiling Beamforming Microphone Array

Power Injector

Control System Touch Panel - Innovation & Conference

HDMI Transmitters & Receivers

USB Extender Transmitters & Receivers

Wall Mounted DTP Transmitter

Table Pocket

AC & USP Power Module

Equipment Rack

Submittals shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Include performance and characteristic curves. Submittals shall also

include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified in paragraph REGULATORY REQUIREMENTS and as required in Section 01 33 00 SUBMITTAL PROCEDURES.

#### SD-06 Test Reports

Acceptance Testing; G

#### SD-07 Certificates

Audiovisual Contractor Qualifications; G

Key Personnel Qualifications; G

Manufacturer Qualifications; G

Test Plan; G

#### SD-11 Closeout Submittals

Record Documentation; G

### 1.6 DESCRIPTION OF WORK

This document describes the audiovisual requirements related to the Project which is the construction for the new SOF facility. The facility will have one conference room that will require audiovisual equipment and systems. The audiovisual contractor (hereafter referred to as AVC) shall perform all work specified in association with the Architectural, Engineering, and General Contractor Firms. All work shall be completed to the satisfaction of Client and/or other approved client representative(s). The Client reserves the right to modify and/or change these requirements at any time.

Complete Turn-key Systems - The AVC shall validate the current design, update products and functions as required based on equipment and features available at the time of installation, procure, install, program, test, train, commission, maintain and support a turn-key audiovisual system as detailed in this specification and depicted on the drawings.

Understanding of Functional Requirements - It is the responsibility of the AVC to fully understand the functional requirements of the systems and shall verify the completeness of the equipment specified.

Confirm all dimensions, calculations and equipment model numbers as detailed on the drawings and within this document.

AVC shall provide project management of the audiovisual implementation, including product and labor control, scheduling and coordination.

The audiovisual systems to be installed in the facility will be utilized by both technical and non-technical personnel; therefore, the systems must be easy to setup, operate and support. It is not expected that a technician will be available to operate and/or maintain the systems.

The system will include a programmable touch panel with an intuitive

graphical interface.

This document is meant to identify specific requirements for procurement of the described audiovisual products and services.

AV contractor must supply written documents detailing equipment specifications, installation and pricing in the manner requested.

## 1.7 SYSTEM DESCRIPTIONS

### 1.7.1 Conference Rooms 113

Conference Room 113 will support up to 12 people at the table with another 4-6 in gallery seating on either side of the table. The room will be equipped with a 4K UHD wall mounted display and sound reinforcement speakers. The conference room will require VTC and Audio Teleconferencing along with a dedicated free-standing equipment. The rack will be located on the opposite side of the room from the display wall. The VTC will utilize a POE PTZ wall mounted camera. Audio from the audience will be supported via a ceiling mounted microphone array located above the conference room table. Video inputs will be located at the conference room tables in the form of one (1) table pocket that are configured with connectivity for laptops with HDMI outputs. The system will be controlled via a 10" touch panel that will reside at the conference table. The touch panel will be programmed to control all audio and video sources within the room. Sound will be distributed throughout the rooms via flush mounted ceiling speakers. The AV equipment required to support the audio signal processing and video scaling will be installed in the AV rack.

## 1.8 QUALITY ASSURANCE

### 1.8.1 Shop Drawings

In exception to Section 01 33 00 SUBMITTAL PROCEDURES, submitted plan drawings shall be a minimum of 11 by 17 inches in size using a minimum scale of 1/8 inch per foot. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

#### 1.8.1.1 Audiovisual Drawings

Provide communications technology specialist - designer (CTS-D) approved drawings in accordance with TIA-606. The identifier for each termination and cable shall appear on the drawings. Drawings shall depict final audiovisual installed wiring system infrastructure in accordance with TIA-606. The drawings should provide details required to prove that the distribution system shall properly support connectivity from the audiovisual equipment to the audiovisual device outlets. Provide a plastic laminated schematic of the as-installed audiovisual cable system showing cabling and devices for each room. Mount the laminated schematic in

audiovisual equipment rack in each space as directed by the Contracting Officer. The following drawings shall be provided as a minimum:

- a. TA1 - Layout of complete building per floor - Building Area/Serving Zone Boundaries, Backbone Systems, and Horizontal Pathways. Layout of complete building per floor. The drawing indicates location of building areas, serving zones, vertical backbone diagrams, telecommunications and audiovisual equipment rooms, access points, pathways, grounding system, and other systems that need to be viewed from the complete building perspective.
- b. TA2 - Serving Zones/Building Area Drawings - Drop Locations and Cable Identification (ID'S). Shows a building area or serving zone. These drawings show drop locations, telecommunications and audiovisual equipment rooms, access points, and detail call outs for common equipment rooms and other congested areas.
- c. TA4 - Typical Detail Drawings - Faceplate, Equipment, and Panel Labeling, Firestopping, Americans with Disabilities Act (ADA), Safety, Department of Transportation (DOT). Detailed drawings of symbols and typicals such as faceplate labeling, faceplate types, faceplate population installation procedures, detail racking, and raceways.

#### 1.8.1.2 Audiovisual Space Drawings

Provide TA3 drawings in accordance with TIA-606 that include telecommunications or audiovisual rooms plan views, pathway layout (cable tray, racks, ladder-racks, etc.), mechanical/electrical layout, and , rack and wall elevations. Drawings shall show layout of applicable equipment including incoming cable stub or connector blocks, building protector assembly, outgoing cable connector blocks, patch panels and equipment spaces and cabinet/racks. Drawings shall include a complete list of equipment and material, equipment rack details, proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation. Drawings may also be an enlargement of a congested area of TA1 or TA2 drawings.

#### 1.8.2 Audiovisual Qualifications

Work under this section shall be performed by and the equipment shall be provided by the approved audiovisual contractor and key personnel. Qualifications shall be provided for: the audiovisual system contractor, the audiovisual system installer, and the supervisor (if different from the installer). A minimum of 30 days prior to installation, submit documentation of the experience of the audiovisual contractor and of the key personnel.

##### 1.8.2.1 Audiovisual Contractor Qualifications

The audiovisual contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified audiovisual systems and equipment. The audiovisual contractor shall demonstrate experience in providing successful audiovisual systems within the past 3 years of similar scope and size. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the audiovisual contractor.

#### 1.8.2.2 Qualifications

- a. AVC shall have completed up to three (3) projects of similar size and scope within the last three years.
- b. Technical Certifications - AVC shall have a CTS-D to perform the system design and oversee all system installations for this project.
- c. Project Team Resumes - AVC shall include a project resume of project team members.
- d. Programming Capacity - AVC shall employ in-house (non-subcontractor) full-time programming resources certified by proposed system.
- e. Location - AVC shall be within 120 miles of the project site and provide all necessary functions needed to support the project.
- f. List of Substitutions as detailed in section 2.1

#### 1.8.2.3 Key Personnel Qualifications

Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified audiovisual systems and equipment. There may be one key person or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful audiovisual systems within the past 3 years. Supervisors and installers assigned to the installation of this system or any of its components shall be Avixa/InfoComm or Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current Avixa/InfoComm or BICSI certification for each of the key personnel.

Indicate that all key persons are currently employed by the audiovisual contractor or have a commitment to the audiovisual contractor to work on this project. All key persons shall be employed by the audiovisual contractor at the date of issuance of this solicitation, or if not, have a commitment to the telecommunications contractor to work on this project by the date that the bid was due to the Contracting Officer.

Note that only the key personnel approved by the Contracting Officer in the successful proposal shall do work on this solicitation's audiovisual system. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the audiovisual contractor's key personnel requires approval from the Contracting Officer.

#### 1.8.2.4 Minimum Manufacturer Qualifications

Cabling, equipment, and hardware manufacturers shall have a minimum of 3 years' experience in the manufacturing, assembly, and factory testing of components which comply with TIA-568-C.1, TIA-568-C.2 and TIA-568-C.3.

#### 1.8.3 Test Plan

Provide a complete and detailed test plan for the telecommunications cabling system including a complete list of test equipment for the components and accessories for each cable type specified, 60 days prior to the proposed test date. Include procedures for certification, validation,



and testing.

#### 1.8.4 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

#### 1.8.5 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

##### 1.8.5.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

##### 1.8.5.2 Materials and Equipment Manufacturing Date

Products manufactured more than 1 year prior to date of delivery to site shall not be used, unless specified otherwise.

#### 1.9 DELIVERY AND STORAGE

Provide protection from weather, moisture, extreme heat and cold, dirt, dust, and other contaminants for telecommunications cabling and equipment placed in storage.

#### 1.10 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 0 to 60 degrees C 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, noncondensing.

#### 1.11 WARRANTY & SERVICE

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract. Standard and additional service coverage must include: 2-hour Help Desk phone service response from a Tier 1 qualified AV engineer available 24-hours a day x 5 days a

week, plus 8-hours a day x 5 days a week emergency response. Maintenance repair services are required for all systems purchased under this agreement. All system documentation shall be available in a secure online portal accessible to the client 24-hours a day x 7 days a week including, but not limited to; system as-built drawings, signal flow drawings, control system source code, service manuals, training guides, etc. A total of two (2) Preventative Maintenance visits shall be performed in the first year post substantial completion. This will be performed at the Client's discretion. The minimum warranty provisions specified above should not supersede the terms of individual manufacturer warranties.

## 1.12 MAINTENANCE

### 1.12.1 Operation and Maintenance Manuals

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance of products provided as a part of the audiovisual cabling and pathway system, Data Package 5. Submit operations and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein not later than 2 months prior to the date of beneficial occupancy. In addition to requirements of Data Package 5, include the requirements of paragraphs AUDIOVISUAL DRAWINGS, AUDIOVISUAL SPACE DRAWINGS, and RECORD DOCUMENTATION. Ensure that these drawings and documents depict the as-built configuration.

### 1.12.2 Record Documentation

Provide TA5 drawings including documentation on cables and termination hardware in accordance with TIA-606. TA5 drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts and cover plate assignments, cross-connect information and connecting terminal layout as a minimum. TA5 drawings shall be provided in hard copy format and on electronic media using Windows based computer cable management software. Provide the following TA5 drawing documentation as a minimum:

- a. Cables - A record of installed cable shall be provided in accordance with TIA-606. The cable records shall include the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the av equipment in accordance with TIA-606. Include manufacture date of cable with submittal.
- b. Termination Hardware - A record of installed patch panels, cross-connect points, distribution frames, terminating block arrangements and type, and outlets shall be provided in accordance with TIA-606. Documentation shall include the required data fields as a minimum in accordance with TIA-606.

### 1.12.3 Spare Parts

In addition to the requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA, provide a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking.

### 1.13 TRAINING

AVC shall employ a full-time Training Manager resource to provide a detailed system orientation for the Client including an overview of the system components, operational functions, testing and troubleshooting, proper upkeep and maintenance, and protocol for placing service calls. This Training Manager is required to demonstrate all relevant functionality to the end-users and supplement the training with an orientation manual. A minimum of forty (40) onsite training hours is required. Virtual training sessions are not permitted.

## PART 2 PRODUCTS

### 2.1 GENERAL

All equipment provided for this project shall be new and unused unless provided by the owner. Any and all product substitutions must be submitted in writing to the project team for approval. Final acceptance of all substitutions is subject to owner acceptance. Products specified that have been discontinued shall have newer model provided by the AV contractor. Any increase in cost must be identified in advance to Client Specifics Here. Newer models must retain all required features of the original model. AVC is required to propose equipment that meets the performance requirements of the equipment detailed in the specification and drawings. AVC is required to provide manufacturer, model, and quantities of all equipment proposed including relevant datasheets or engineering specifications. At a minimum equipment must meet or exceed performance and interconnectivity requirements outlined within the specifications and drawings.

### 2.2 CABLES

Refer to Section 271513 - Communications Copper Horizontal Cabling

#### 2.2.1 Twisted Pair Horizontal Cabling

Microphone and Line Level Cables: Provide #22 AWG Shielded Twisted Pair Cable. High-Impedance Loudspeaker Cables: Provide #16 AWG Unshielded Twisted Pair Cable. DC Power Cables: Provide #16 AWG Unshielded Twisted Pair Cable. Low-Impedance Loudspeaker Cables: Provide #12 AWG Unshielded Twisted Pair Cable. RS-232/RS-422/RS-485 Control Cables: Provide Shielded Data Cable. Data/Power Cables: Provide Data/Power Cable. STP Data Cable: Provide Category 6 STP Cable. Provide color coded cable for all in-rack network cabling following the following standard unless an alternative standard is reviewed and approved. Control Red. Graphics : Orange. HDBaseT: Grey.

#### 2.2.2 Shielded Twisted Pair (STP) Video Cable

Must be certified by video routing manufacturer.

#### 2.2.3 Interface Cables

Provide one (1) cable with molded connectors for each auxiliary audio, video, and control interface location provided as specified herein, unless noted otherwise on the Drawings. Where multiple formats are typically utilized together cables shall include all formats within a single jacket, included but not limited to, VGA with mini-TRS. Provide the following length cables, unless noted otherwise on the Drawings:

- a. Rack Mounted Interface: 12 feet.
- b. Wall Mounted Interface: 12 feet.
- c. Lectern Mounted Interface: 6 feet.

## 2.3 CONNECTORS

Audio connectors of XLR, 3.5 mm (1/4 inch), and RCA types shall be solder type and incorporate metal shells and bodies. Acceptable manufacturers: Switchcraft or Neutrik. Video connectors of BNC and RCA shall be:

- a. Dual crimp or compression style nickel plated brass connector utilizing a gold plated center contact.
- b. Connector and pin appropriately selected based on the specified cable as part of a manufacturer's approved assembly.
- c. Crimp or compression tool and die sets utilized shall be approved by the manufacturer for the assembly.
- d. Color coded via strain relief boot, isolation bushing or O-ring to designate video type.
- e. Acceptable manufacturers: ADC, Extron, Tyco, Kings, Bomar, Canare, or Trompeter.

Use only rosin core solder or approved mechanical connectors for joints and connections within the system. Twist-on wire-nuts are not acceptable.

## 2.4 LCD DISPLAYS - 100"

- a. 100"/75" diagonal screen size.
- b. Display resolution ultra HD (3840x2160)
- c. Aspect ratio: 16:9
- d. Max bezel width: 1.1"/.7"
- e. Min. frame rate: 60hz
- f. Min. contrast ratio: 3000:1/5000:1
- g. Connections: (2) HDMI 2.0, (2) HDMI 1.4, 1 Displayport 1.4, USB Audio Out
- h. Built-In 10W x2 speakers

Basis of Design: Planar UltraRes Series.

## 2.5 PRESENTATION MATRIX SWITCHER

- a. 10x8, 4K resolution matrix switcher
- b. Max data rate: 10.2Gbps
- c. 300Mhz pixel clock
- d. 4K/UHD @ 60 Hz with 4:2:0 chroma subsampling
- e. 4K (4096x2160) @ 30Hz
- f. HDMI 1.4, HDCP 1.4 compliant
- g. 6 HDMI digital video inputs (HDCP compliant)
- h. HDbT compliant inputs
- i. 4 HDMI outputs, 4 HDbT compliant outputs (scalable)
- j. 10x8 Stereo switching audio matrix (balanced)
- k. Min. 6 analog audio inputs, 4 mic/line inputs
- l. Min. 4 analog audio outputs
- m. Options for low/high impedance amplifier with 25w (rms) per channel
- n. Integrated control processor for AV system control
- o. Remote powering of system endpoints
- p. Support for HTTP, HTTPS, SSH, SFTP, SMTP, NTP, Discovery Service, DHCP, DNS, ICMP, IPv4
- q. 1 Bidirectional RS-232/422/485 port, 2 bidirectional RS-232 ports,

- 2 Serial/IR, 4 Digital I/O, 4 Relays, bus ports
- r. Network connectivity with AV VLAN support

Basis of Design: Extron DTP CrossPoint 108 4K capable of 10x8 I/O configuration.

## 2.6 MULTI-INPUT SWITCHER

- a. 230 feet transmission of HDMI, analog video, control, audio
- b. 2 HDMI, 1 VGA, 1 3.5mm stereo mini inputs
- c. 1 HDbT compliant output
- d. Supports 1920x1200 including 1080p/60
- e. Auto-switching capable

Basis of Design: Extron DTP T USW 233 three input switch with integrated DTP transmitter and audio embedding.

## 2.7 VIDEO TELECONFERENCING SYSTEM (CODEC)

CODEC - GFCI.

## 2.8 HD PTZ CAMERAS

- a. 30x motorized zoom, F1.6 to F4.7 Lens
- b. Auto and manual focus
- c. .7lx minimum illumination @59.54 Hz (without accumulation)
- d. PoE capability
- e. ±175° panning range, -30° to 90 tilting range
- f. HDMI, HD-SDI, Network H.264/Motion JPEG outputs
- g. LAN, RS-232C, RS-422 control
- h. Resolution up to 1080P/60)

Basis of Design: Panasonic AW-HE40 PTZ Camera - Black.

## 2.9 VIDEO SCALER

- a. 3 HDMI, 1 analog multi-format input
- b. Option for HDMI or HDbT compatible output
- c. Auto-switching capability
- d. Resolutions from 640x480 to 1920x1200
- e. HDCP compliant

Basis of Design: Extron - IN 1604 - Four input HDCP compliant scaler.

## 2.10 DIGITAL SIGNAL PROCESSOR

- a. 12 analog mic/line inputs, 8 analog line outputs
- b. Dante compliant
- c. LAN, RS232C control
- d. 8 channels of acoustic echo cancellation
- e. VoIP support
- f. Built in gigabit switch

Basis of Design: Extron - DMP 128 Plus C AT - 12x8 ProDSP digital matrix processor.

## 2.11 SPEAKERS

- a. 6.5" two-way speaker

- b. Ceiling mounted with 8" composite back can
- c. Frequency range: 65Hz to 22kHz -10 dB
- d. 65W (rms) power capacity continuous pink noise, 130W (rms) continuous program
- e. Plenum rated, UL 2043, UL 1480

Basis of Design: Ceiling - Extron Sound Field XD Speaker SF 26CT - White.

#### 2.12 POWER AMPLIFIERS - 2 CHANNEL AND 1 CHANNEL

- a. 200/60 watts rms output power
- b. 70V high impedance 100w per channel/60w
- c. Energy Star qualified
- d. Fan-less operation

Basis of Design: Extron - XPA 1002 Two Channel Amplifier, 100 watts per channel. MPA 601 - Single channel 60 watt.

#### 2.13 SCALING PRESENTATION SWITCHER

- a. 4 HDMI, 2 analog multi-format, 2 HDbT compatible inputs
- b. 2 HDMI, 1 HDbT compatible outputs
- c. Integrated 3 port AV LAN switch
- d. Integrated 100 watt 70V audio amplifier
- e. Resolutions from 640x480 to 1920x1200
- f. 6 audio inputs, 2 mic/line inputs, 3 audio outputs (1 variable)
- g. RS232/IR injection on HDbT compatible ports
- h. LAN control and interfacing
- i. 3 RS232 ports, 2 IR ports, 4 Relay ports, 4 Digital I/O, proprietary bus port

Basis of Design: Extron - IN1608 xi IPCP MA 70 - Eight Input HDCP compliant scaling presentation switcher with DTP extension and 100 watt amplifier.

#### 2.14 CEILING BEAMFORMING MICROPHONE ARRAY

- a. 8 discrete steerable lobes with custom positioning
- b. Built-in DSP functionality: Automix, echo reduction, 4 band EQ per ch.
- c. Control via software browser, 10 presets
- d. Dante and AES67 networking with PoE (class 0), control
- e. Multi-color LED bar, configurable
- f. Flush mountable in standard ceiling tile, VESA mount compatible
- g. White, black and aluminum finishes

Basis of Design: Shure MXA910 - BWhite.

#### 2.15 POWER INJECTOR

- a. 48VDC, .35A, 16.8 watts power output
- b. Passive cooling
- c. Rack mount, zip tie mount

Basis of Design: Extron - XTP PI 100 - power of twisted pair injector.

#### 2.16 CONTROL SYSTEM TOUCH PANEL - INNOVATION & CONFERENCE

- a. 1280x800 capacitive 10" touch screen, 24bit color depth

- b. Scratch/smudge resistant screen
- c. Compatible with specified control systems
- d. PoE compatible
- e. Built in speaker

Basis of Design: Extron 10" TLP Pro 1025T Tabletop Touch Panel-Black.

#### 2.17 HDMI TRANSMITTERS & RECEIVERS

- a. HDbT extension over twisted pair cabling
- b. 230 feet point to point over shielded CAT6 cable
- c. Resolutions up to 4K
- d. HDCP 2.2 compliant
- e. Bidirectional RS-232 and IR passthrough
- f. Remote power capability
- g. UL-2043 plenum rated

Basis of Design: Exetron - DTP HDMI 4K 230 TX - HDMI Transmitter, DTP HDMI 4K 230 RX - HDMI Receiver.

#### 2.18 USB EXTENDER TRANSMITTERS & RECEIVERS

- a. 330 feet point to point extension over CATx cable
- b. USB 2.0, 1.1 full support
- c. USB 3.0 support at 2.0 data rates
- d. Network switch compatible with separate controller
- e. 4 port USB hub (Receiver unit only)
- f. Option for peripheral emulation (specific models only)

Basis of Design: Extron - USB Extender Plus Series, extend USB over twisted pair, USB Extender Plus T - Transmitter, USB Extender Plus R - Receiver.

#### 2.19 WALL MOUNTED DTP TRANSMITTER

- a. HDbT compliant, 230 feet over CAT cable
- b. Supports resolutions up to 4K
- c. HDMI, Analog 3.5mm audio
- d. HDCP compliant
- e. Wall mountable in single gang wall box

Basis of Design: Extron - DTP T HWP 4 K 231 D Decora style HDMI wall mounted transmitter -white.

#### 2.20 TABLE POCKET

- a. 6.1"L x 6.1"W dimensions
- b. Retractor interfaces for HDMI, VGA, 3.5mm
- c. Interface plates for RJ45 (shielded, unshielded) connectors
- d. Closeable lid with passthroughs

Basis of Design: Extron - Cable Cubby 500 with power.

#### 2.21 AC & USP POWER MODULE

- a. Provides a total of up to 4 A / 20 watts of power
- b. 9.5' power cord

Basis of Design: Extron - AC+USB 200 Series power module for Cable Cubby

500.

## 2.22 EQUIPMENT RACK

- a. 54"H x 24"W x 23.3"D
- b. 19" mounting rails
- c. Doors - lockable front and back, smoke glass on front, solid on back
- d. Rolling lockable casters

Basis of Design: Middle Atlantic - RCS-2724

## PART 3 EXECUTION

### 3.1 CABLE INSTALLATION

AVC will review all architectural, mechanical, electrical and audiovisual design drawings. Notification shall be given to COR of any discrepancies or errors. All cabling provided and installed in the ceiling will be plenum rated. All cabling within the ceiling that is not in conduit must be suspended using black Velcro straps for cable management and should not be visible from below. All cabling provided within this project will be marked with a number which corresponds with any and all logic outlined on the 'As Built' drawings. All cables will be grouped to the signals being carried in order to reduce signal contamination. All cable will be installed in accordance with local and state electrical and fire code requirements. Neatly bundle excess AC power cabling with Velcro style cable wraps. Patch panels shall be wired so that the signal sources appear on the upper row and outputs to devices appear on the lower row.

### 3.2 CABLE PATHS

All cables are to be run whenever possible in cable trays or conduit systems. When the system is not available to the room or area required, the path used should be as direct as possible. If the cables need to be run across ceiling/deck than they must be concealed in 'Wiremold' or equal product.

### 3.3 INSTALLATION

AVC will be responsible for all signal cable routing, termination, connection, and testing associated with the equipment required to provide a fully operational and functioning system. AVC shall perform all tasks and duties at the minimum levels as outlined below. These minimum standards are in addition to any applicable local, state, and federal codes and regulations. AV contractor shall assemble and test all equipment at the AV contractor's facility. AV contractor must apply all necessary interfaces, cables, adapters, back boxes, mounts etc. to make a working system. Unless otherwise noted, all above ceiling hardware shall be painted or ordered in a finish to match the ceiling. Unless otherwise noted, cover plates will be used wherever cables exit the wall or floor and shall be a white finish. AC electrical lines shall not be bundled or come in close contact with line level signals, component or composite level runs. Site shall be left at all times clear from debris and trash. AV contractor will give consideration, not only to operational efficiency, but also to overall aesthetic factors in the installation of equipment and cable. Installation will be coordinated closely with COR to avoid conflict or disruption. A schedule of installation and system completion must be coordinated and approved by the COR. Bi-Weekly project reports



must be provided on a weekly basis outlining the following:

- a. Any open items
- b. Ownership of open items
- c. Expected date open items need to be closed
- d. Closed items

Labor and hardware costs shall be stated separate of equipment and shall be fixed. Any changes must be issued via change order. AVC shall install all audiovisual systems and components in place as indicated on the issued drawings. Final system testing and tuning shall be completed by the AVC. The AV contractor shall correct punch list items in a timely manner.

### 3.4 LABELING

Label the front and rear of devices mounted in equipment racks to coordinate with the nomenclature used on the Drawings. Indicate the location and function that the equipment serves. Use only engraved plastic laminate labels on equipment. Provide unique cable markers on both ends of every cable in the system. This should use a logical numbering scheme and should coordinate with numbering schemes already in use. Markers shall be a clear heat-shrink or self-adhesive type and shall be within 6 inches of each termination. Label the plug end of the power cord of each device, indicating the device to which it attaches. Label ancillary devices such as switches, terminal strips, and receptacles in a logical manner clearly indicating their function in the system. Label relevant inputs and outputs on switchers, matrices, and mixers. Label rack plates. Label the telephone numbers, ISDN numbers and IP addresses of pertinent devices. Label equipment with externally visible labels that indicate the equipment's serial number.

### 3.5 ELECTRICAL POWER AND GROUNDING

For active equipment, float the ground wire at the output side of balanced audio lines other than microphone lines or intercom and where required by manufacturer. Carry audio shields straight through passive devices such as patch panels and terminal strips. Arrange inner-rack power distribution so that no circuit exceeds 80% of full power. Ground control lines in compliance with the manufacturer's specification for the appropriate equipment. Provide current sensing power strips with power sequencing for automated start up and shut down capabilities and power monitoring.

### 3.6 EQUIPMENT RACKS

Perform rack fabrication before delivering the racks to the job site. Only wiring and terminations dependent on external devices shall be done at the job site. Test equipment power and functionality to the fullest extent possible prior to delivering the racks to the job site. Equip the rack with sufficient AC power distribution to support equipment as well as two spare, non-switched, convenience outlets. One convenience outlet is to be readily accessible from the front and one readily accessible from the rear of the rack. Provide service loops within the equipment rack for cables connected to external devices. Locate equipment in racks to comply with ADA guidelines. Install equipment racks level and plumb with the room and with adjacent racks. Organize inner-rack cables in an orthogonal manner and organized into neat harnesses by cable type. The rear of equipment shall be fully visible without an array of cables in the way. Horizontal cable management in rack shall be neatly tied in manageable bundles with

cable lengths cut to minimize excessive cable slack, but allowing for service and testing. Provide horizontal support bars if cable bundles sag. Adhesive backed cable tie anchors shall not be used. Velcro style cable wraps shall be used in vertical wire management. Plastic cable ties shall not be acceptable. Arrange unlike signal types in separate harnesses maintaining adequate separation distances to avoid interference. Package spare parts for each device in a clear plastic pouch and attach it to the rear of that device. The Owner's Representative may request to inspect the racks for approval prior to delivery to the job site.

### 3.7 CONTROL SYSTEM PROGRAMMING

Coordinate control system functionality for systems with COR and adhere to Control System Touch Panel Submittal requirements detailed herein. Unless otherwise indicated on the Drawings, devices should be controlled by the first protocol provided by the device manufacturer from the following list:

- a. Networked IP control.
- b. Bidirectional hardwired serial control.
- c. Unidirectional hardwired serial control.
- d. Contact closure(s) or relay(s).
- e. Hardwired infrared emitter over infrared receiver on device.

Adequately size GUI buttons. Label buttons using consistent verbiage.

### 3.8 SYSTEM SETUP AND PERFORMANCE VERIFICATION

#### 3.8.1 Preparation

Interior finishes and furnishings shall be in place for these tests. HVAC system is to be balanced and in operation. Confirm complete and proper labeling of system components. Attach reduced-size Block Drawings to a rack in each location. Remove boxes and debris from the project site. Deliver portable and spare equipment to the premises, tested and stored as directed. Tests and adjustments shall be performed in the sequence specified herein.

#### 3.8.2 General Setup

Verify that audiovisual related components are free from rough or jagged edges. Verify that rack ventilation is working properly. Test power sensing and sequencing devices. Verify that systems are free from oscillation and stray RF interference. Test and verify continuity and proper termination of every cable in the system. Following final acceptance of system set-up and performance, equipment with front panel controls, not normally adjusted by the operator shall have the controls disabled or be mounted behind blank panels or be furnished with security panels.

#### 3.8.3 Audio Equipment Setup and Testing

##### 3.8.3.1 Signal-to-Noise Ratio

Measure and document the signal-to-noise-ratio of audio cables connected to devices external to the equipment rack. Reject and correct measurements less than 55 dB.

### 3.8.3.2 Impedance

Measure and document the impedance of each loudspeaker circuit at 63 Hz, 250 Hz, and 1 kHz. Measure at the circuit's entry point to the equipment rack. Measurement shall be taken prior to the loudspeaker circuit being connected to the amplifier. Reject and correct measurements that differ significantly from calculated values or fall outside of amplifier specifications.

### 3.8.3.3 Polarity

Visually and electronically verify consistent polarity of audio circuits in the system.

### 3.8.3.4 Ambient Noise

Measure and document the ambient noise level in each loudspeaker zone in the system. Ensure that the minimal loudspeaker level is at least 25 dB above the ambient noise level at the furthest listener. At the direction of the Owner's Representative, make additional level adjustments that the space requires.

### 3.8.3.5 Unity Gain

Bring the system to a unity gain level of plus 4 dBu. Verify proper gain structure throughout system.

### 3.8.3.6 Uniform Coverage

Using pink noise at the nominal operating level as the source and measuring in dBA with a sound pressure level meter at the typical listening height, verify that there is a variance of no more than a plus or minus 1.5 dB within the listening area. Report any deviations to the owner's representative.

### 3.8.3.7 Frequency Response

Using a dual channel FFT with boundary-plane measurement, adjust equalizers to achieve a flat frequency response within a margin of plus or minus 3 dB. Take an average of measurements performed at a variety of locations in the room. Perform this measurement and setup only after furniture and floor, wall, and ceiling treatments have been installed. Smooth out and adjust the room curve to achieve a desirable response for the most typical source material. Avoid equalizer settings that result in a 6 dB or greater change from either adjacent band. Re-take the uniform coverage test and make adjustments as required. Document both the un-equalized and equalized average frequency response curves of the room and include the graphs in the Project Record documentation.

### 3.8.3.8 Adjustments

Properly adjust processing equipment, such as compressors, limiters and feedback eliminators for typical operation.

### 3.8.3.9 Spurious Noises

Verify that the system is free from pops, crackle, hum, and other distortion when active controls are operated. Using an electronic audio oscillator, slowly sweep through the usable frequency band of the sound

system in order to verify that the system and other building elements are free from buzzes or rattles.

#### 3.8.3.10 THD+N

Measure and document the THD+N at 15 dB above nominal operating level for entire audio system signal chain. Test from output of all line level input device and end with amplifier input cable. Reject and correct measurements that exceed 0.5 % between 40 Hz and 20 kHz.

### 3.8.4 Video Equipment Setup and Testing

#### 3.8.4.1 Video Displays

Video display adjustments shall be performed using the native resolution at each utilized input of the display. Color Level and Phase. Properly adjust using a SMPTE color bars test pattern on the display being tested. While viewing the blue information only, adjust the color level until the first and last large bar blends with the small patch underneath. Document the onscreen value for color level. Perform Color Level and Color Phase tests until there is no additional color or tint control interaction and document the final onscreen values for color and tint. Video images shall be free of anomalies, including, but not limited to, banding, bending, ghosting, reflections, video roll, visible jitter and double images. If the conferencing system is connected to multiple network types, such as both IP and ISDN, testing shall be conducted on all connected networks. If the conferencing system includes internal multipoint capabilities, multipoint test conferences shall be conducted connecting the maximum number of sites that the system is capable. For third-party bridging or gateway services, tests shall be conducted to and through the service provider.

#### 3.8.4.2 Cameras and camera equipment

Adjust and set reference black and white levels. Camera images shall be free of visible vibration. Adjust and set pan/tilt limit switches. Set camera presets in accordance with the design intent and COR's requirements.

#### 3.8.4.3 Video Scaling and processing Equipment

Configure and adjust signal processing equipment to produce a properly aligned and centered image at the native resolution of the relative display for each potential source resolution.

#### 3.8.4.4 Digital Video System Calibration

Configure EDID tables between source and display devices. Confirm HDCP handshaking is happening along all relevant paths and test with DRM content. Properly calibrate individual system components. Verify signal continuity and quality throughout the signal path.

### 3.8.5 Control Equipment Setup and Testing

Test all hardwired and wireless network connections connected to the audiovisual system. Verify proper operation of all equipment and devices connected to the audiovisual control system. Verify correct function of all control system operations, including, but not limited to:

- a. Equipment powers on and off correctly and in the proper order.
- b. User is locked out of the system during system start-up and shutdown, timers are provided if this is an excessive period.
- c. When system is "shutdown" all appropriate audio and video has stopped playing.
- d. Gauges and feedback are registering correctly.
- e. Automated functions are sequencing properly.
- f. Interfaces are registering the same feedback.
- g. Devices are being controlled using the most robust control method available

Verify installed GUI complies with approved design. Confirm via network monitoring conducted jointly with owner that all networked devices are utilizing proper bandwidth allocations.

### 3.9 ACCEPTANCE TESTING

Before Acceptance Tests are scheduled, perform a system checkout. Furnish all required test equipment and perform all work necessary to determine and/or modify performance of the system to meet the requirements of this specification. This work shall include the following:

- a. Test all audio, video and related systems for compliance with the System Setup and Performance Verification as specified herein.
- b. Check all control functions, from all controlling devices to all controlled devices, for proper operation.
- c. Adjust, balance, and align all equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for all level controls, and document these settings in the Operation and Maintenance Manual.
- d. Unless otherwise specified, use tamper-proof security covers on all controls affecting overall system level balance and signal-to-noise ratio, such as power amplifier input level control, and input-output level controls for equalizers, mixers, amplifiers, etc. Some controls may require re-adjustment as the result of Acceptance Testing.
- e. Maintain documentation of all performance tests for reference by the Owner's Representative during the System Acceptance Tests.

Upon completion of the tests and necessary adjustments, submit two copies of a written report presenting test results, including numerical values of all measurements, for review by the COR prior to demonstration and System Acceptance testing. With the above report, submit written certification that the installation conforms to specifications, is complete, and is ready for inspection and testing by the COR.

Meet with the COR and make system changes as directed.

Upon completion of the Contractor's system checkout and performance verification, demonstrate the proper operation of all audiovisual systems in the project to the COR. Provide a qualified technician knowledgeable with the system and the installation to assist the COR with the acceptance procedure. The Contractor shall provide all labor, materials, tools, and measurement equipment necessary for these demonstrations, tests and adjustments. System Acceptance Tests will not be performed until the Contractor's system checkout has been completed. The System Acceptance Tests will be supervised by the COR and will consist of the following:

- a. A physical inventory will be taken of all equipment on site.
- b. The operation of all system equipment shall be demonstrated by the

Contractor.

- c. Both subjective and objective tests will be required to determine compliance with the specifications.
- d. Acceptance Tests may include speech intelligibility surveys and subjective evaluations by observers listening at various positions under various operating conditions, using speech, music, and live or recorded effects material. Acceptance tests shall include viewing of monitor images for sharpness, contrast, brightness, and color.
- e. Measurement of frequency response, distortion, noise, wave form, color vector, or other characteristics may be performed (or a demonstration test requested) by the COR on any item, or group of items, deemed necessary to determine conformity with criteria.
- f. All final Record Drawings, run sheets, manuals, and other required documents, as detailed herein, shall be on hand. Two complete sets of these documents shall be delivered to the COR at this time. (One complete set shall have been delivered to the COR prior to the scheduling of Acceptance Tests).
- g. In the event further adjustment is required, or defective equipment must be repaired or replaced, tests may be suspended or continued at the option of the COR.

### 3.10 DEMONSTRATION AND INSTRUCTION

Upon completion of the system installation and acceptance procedure, provide 24 hours of system training and orientation for the COR personnel. An individual intimately familiar with the equipment in the system and qualified to explain it in detail should conduct the training. When an employee capable of providing such training is not available, retain the services of someone qualified to do so at no additional fee. Conduct the training prior to the owner using the system for the first time to ensure proper usage. If necessary, conduct the training at a time outside of normal business hours at no additional fee. Shall include, but not be limited to:

- a. Physical review of installed systems.
- b. Review of systems documentation and test results.
- c. Instructions on standard care and maintenance methods to enable COR personnel to successfully maintain system.

-- End of Section --