

MINNESOTA MULTI-PURPOSE STADIUM  
MINNEAPOLIS, MINNESOTA

SECTION 274225

INTERNET PROTOCOL TELEVISION SYSTEMS (IPTV) TECHNICAL SPECIFICATIONS

PART 1 - GENERAL

1.1 PROJECT DESCRIPTION

- A. The project is a new multi-purpose stadium for the Minnesota Vikings. The stadium will seat approximately 65,000± spectators and will be designed to host both football and baseball events.
- B. Refer to the architectural plans for a detailed description of the facility.

1.2 BASIC SYSTEM REQUIREMENTS

- A. Provide a complete and fully functional distributed television system using Internet Protocol. The IPTV system shall be networked and allow for development and implementation of customized content. The systems shall be interfaced to the facility LAN using Ethernet and Internet Protocol (IP) based technology for transporting TV signals, remote monitoring, and control of the system. The system shall support various video distribution applications including television, digital menu boards, digital signage, ad-panels, etc.
- B. The IPTV System shall operate on a converged data network that utilizes a single data network backbone for connectivity to all building systems, applications, tenants, and users. This includes, but is not limited to:
  - 1. Administrative Data (Computers, Printers, and Scanners)
  - 2. Advertising Panels
  - 3. Building Management Systems
  - 4. Building Systems Controllers (HVAC and Lighting)
  - 5. Point of Sale
  - 6. Security Management System
  - 7. IP Telephone
  - 8. IPTV
  - 9. IP Surveillance Cameras
  - 10. IP Security Controllers
  - 11. Ticketing System
  - 12. Wireless Ticket Scanners (Wi-Fi)
  - 13. Wireless POS (Wi-Fi)
  - 14. Wireless LAN (Wi-Fi)
  - 15. Wireless Public Internet (Wi-Fi)
  - 16. Other data communications to be determined (Wi-Fi)
- C. System components shall be provided as necessary and include the following major components:
  - 1. Video acquisition (or video head-end)
  - 2. Video delivery (and signage playback)
  - 3. Centralized management and operations
- D. The following room locations and/or areas will have IPTV devices:

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1. Bars
2. Clubs
3. Concessions
4. Concourses
5. Media and Press
6. Offices
7. Retail and Team Stores
8. Restaurants
9. Suites
10. Ticketing

- E. The IPTV System shall include a total quantity of ~~4200~~ 820 television locations. Exact locations are to be coordinated with Owner and Architect. Refer to the IPTV Drawing set for approximate device placement.
- F. The IPTV Systems shall operate with a maximum of 1 millisecond of latency. Encoding shall provide broadcast level quality.

1.3 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions, Supplementary Conditions, and Division 1 - Specification Sections, apply to the provisions of this section.
- B. Architectural, Electrical and Technology Drawings and Specifications. Other systems may apply.
- C. Division 26 including Basic Materials and Methods sections apply to work in this section.
- D. Division 27 in its entirety.
- E. Rough Carpentry is specified in a Division 6 specification.
- F. Internet Protocol Television (IPTV) System Contractor shall coordinate with Electrical Contractor (EC) on conduit/junction box locations for the IPTV systems equipment and routing of audio, video, control, and power cables/conduits from terminals, poke-thru /floor and pull and back boxes, wall plates, stub-ups etc. to system equipment racks.

1.4 SUMMARY

- A. The term "provide" used throughout this specification and drawings shall mean "furnish, install, test, and certify."
- B. Coordinate project schedule, installation schedule, phasing and any other requirements deemed necessary with Construction Manager and/or General Contractor and all necessary trades to ensure successful completion of work.
- C. Phasing, temporary distribution/equipment, cut-over and implementation shall be coordinated with Owner, Construction Manager and/or General Contractor, Architect, and the IPTV Systems Engineer.
- D. This section is valid only when considered in total with complete Construction Document package. References are for the convenience of the reader. Their inclusion or omission from any section in no way limits the scope or intent of any Contract Documents.

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- E. The extent of IPTV infrastructure work is indicated by Division 27 specifications and Technology drawings and schedules and is hereby defined to include, but not by way of limitation, the provisions of:
1. Provide IPTV system including head-end, IP/HDMI media players, content managers, cable/software, etc. for a complete and operable system.
  2. Raceway systems including but not limited to conduits, cable trays, sleeves, surface raceways, telecommunication services entrance, manholes, pull-boxes, junction boxes, back-boxes, etc. as required and specified in Division 27 sections and select Division 26 sections. The Construction Manager and/or General Contractor shall coordinate this with the Sub-Contractors performing work and determine how scope of work is assigned. The purpose of this specification is to establish design intent and general system scope.
  3. All IPTV system's infrastructure shall be provided as part of the Base Building Project including but not limited to raceway, conduit, floor and back-boxes, poke-through, structural support elements, and mounting frames.
  4. Patch cords, jumper cables, and cross-connect cables to interconnect wiring terminals as well as electronic equipment.
  5. IPTV rack/cabinet fit-out including cabinets, racks, backboard, and raceways for terminating cable and installation of electronic equipment.
  6. Power distribution within equipment racks and cabinets including power sequencers, power supplies and power strips.
  7. Grounding and bonding of all metallic hardware components to the nearest telecommunications grounding bus (TGB) bar including but not limited to equipment racks, cabinets, cable trays, ladder rack, metallic cable sheaths, wall mounted wiring terminals, conduits, sleeves, metallic ductwork, and frames when IPTV equipment is co-located in a Telecom Room or Communication system equipment closet.
  8. All physical cable management hardware including, but not limited to: "J-hooks" in accessible ceiling areas, "D-rings" on backboards, vertical and horizontal managers on racks and cabinets, etc.
  9. Fire stopping as required. Contractor shall provide fire stopping for all low-voltage openings (including empty low voltage raceway) once cable installation is complete. Confirm specific fire stopping scope requirements with General Contractor and/or Construction Manager. Fire stop shall be UL Classified and match the rating of the penetrated element.
  10. Seismic bracing of all equipment cabinets, equipment racks and ladder-type or wire basket cable tray, ceiling mounted loudspeakers etc. as required by code and by local governing jurisdiction.
  11. Testing of all IPTV cable infrastructure and grounding systems as noted by specification, drawings, and applicable industry standards.
  12. Labeling of all IPTV infrastructure components, hardware, cable, and terminations with mechanically printed labels.
  13. Preparation and submission of product data, shop drawings, testing reports, as-built drawings, Operations and Maintenance manuals, quick operation guides and cabling documentation as required in this specification.
  14. Software, including executable files for all electronic devices requiring custom programming as part of a turn-key solution.
  15. Construction and Installation warranties.
  16. Installation and testing of all IPTV system and components.
  17. Onsite administrative and user training.

1.5 SUBMITTALS

- A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section in addition to the following information.

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B. Product Data and Compliance Matrix:

1. Compliance Matrix: Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

C. Shop Drawings (Before Assembly and Installation):

1. Drawings of panels, plates, designation strips and samples showing finish and color.
2. Drawings of all equipment modifications that change or void manufacturer's warranties.
3. Schematic drawings of custom circuitry shall include:
  - a. Receptacle pin numbers and component callouts
  - b. Details of custom resistive combining networks, filter, or pads
  - c. Point-to-point wiring drawings for control system modules and interfaces, and for switches or relays
4. Preliminary control panel layouts in software formats supplied by the manufacturer. Provide descriptions of all control functions and all equipment states associated with each function.
5. Drawings of all equipment modifications that change or void manufacturer's warranties.
6. Complete system construction and point to point wiring color schematic drawings, including all component values and showing complete letter and number identification of all wire and cable as well as jacks, terminals and connectors. These drawings shall detail all equipment that is to be installed or included in the project.
7. Equipment names and model numbers. Include other pertinent information such as number of channels, output signal type etc. In addition, label each item of equipment shown on the drawing with the manufacturer's terminal number or input/output designation (i.e. "HDMI 1 Input" or "RS-232 Output 3"). Show unused inputs and outputs as "Future".
8. Equipment rack, wall plate and patch panel assignment drawings. Plate terminations for amplifier power (where applicable) shall show wattage and rated impedance values (in ohms); power number shown shall be 20.0% less than available wattage from amplifier for head-room unless otherwise noted on the Construction Drawings.
9. Run sheets or field wiring drawings:
  - a. Show at each terminal point the type of connector to be used and include a typical wiring detail of each connector
  - b. Note where shields are connected and where they will float to ensure the integrity of the grounding system
  - c. Call out wire types and color-codes where appropriate
  - d. Assign wire numbers and patch-bay locations to every wire and patch point.
  - e. Show unused equipment termination points, i.e. input/output ports as "Future".
10. Manufacturers' names, descriptions, and model numbers of all equipment to be used for the testing and adjustment of the systems.
11. Loudspeaker mounting details including fly-ware and hardware harnesses with specific aiming angles for each device utilized in clusters or line array designs.
12. Wall plate details showing front and back of plate for verification of connector space.
13. Panels, plates, and designation strips, including details relating to terminology, engraving, finish and color.
14. AC Power sequencing connectivity diagrams.
15. Detailed software programming and GUI simulation files shall be submitted to the IPTV Engineer one (1) week prior to on-site system installation begins. No exceptions.
16. Any of the above drawings created in a Computer-Aided Design program shall be issued to the Owner in AutoCAD or Revit (latest version) format depending on which program was selected for use by the Architect as the project standard.
17. Alternate Equipment: The IPTV Systems Contractor (IPTVC) may propose alternate equipment, however all such proposals shall be submitted separately and will be

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identified as "alternates" with equipment costs shown separate and apart from the costs of the equipment "as specified" in a separate document.

18. Proposals for alternate equipment will receive careful and equitable consideration if the differences do not depart from the overall intent of the design and operation of the system, and are in the best interests of the Owner. All such proposals for alternate equipment shall be accompanied by full technical information, "cut-sheets", EASE modeling (where appropriate), and specifications for the equipment so proposed. The contractor shall identify the substantive differences between the alternate and the specified equipment in a written narrative.
19. Products that do not meet or exceed the original design intent shall be rejected; no exceptions. The IPTV Engineer also reserves the right to reject any and all substitution requests without a detailed explanation as design intangibles may be not readily apparent to other parties not directly involved during the design process.

D. At the completion of the installation (As-built and Drawings of Record):

1. The contractor shall provide one (1) full size color hard copy and an electronic copy each of the following:
  - a. "As-built" drawings for every item and sub-assembly for all of the areas covered under Part 3. Provide an electronic file version of the "As-Built" drawings for all systems in the latest version of Revit and or AutoCAD depending on the native drawing format utilized by the IPTV Engineer or specified by the Architect for the Construction Documents.
  - b. Equipment manufacturer's operation and maintenance manuals for each piece of equipment.
  - c. A System Quick Reference and Operation & Maintenance Manual. The contractor shall produce this manual specifically for the systems detailed herein.
    - 1) The Quick Reference section shall describe in non-technical terms for casual users the method of using the facilities. The document shall be a step-by-step operating procedure for each desired feature utilizing photos or screen captures.
    - 2) The Operation section shall describe all typical procedures necessary to activate each system to provide for the functional requirements as listed under the Detailed Specifications. The reader of this manual shall be assumed to be technically competent, but unfamiliar with this particular facility. It is estimated that this manual will require a minimum of ten (10) pages.
    - 3) The Maintenance section shall provide a recommended maintenance schedule with reference to the applicable pages in the manufacturer's maintenance manuals. Where the manufacturer provides inadequate information, the contractor shall provide the information necessary for proper maintenance.
    - 4) Front view of all equipment racks, showing the final commissioned settings for every variable push-button, rotary control, slider control, indicator, or other such indicator.
    - 5) Recommended maintenance schedule with reference to the applicable pages in the manufacturers' maintenance manuals. Where the manufacturer provides inadequate information, provide the necessary information for proper maintenance.
    - 6) List of replacement parts necessary and recommended for normal maintenance.
  - d. One (1) complete set of software documentation for application programs and system software. Software documentation will include all source-code listings for software supplied by the contractor and to the extent that the contractor, having

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- used its best efforts, is able to obtain source-code listings from any third party suppliers. Contractor shall provide a hardcopy of final touch screen layouts.
2. Notify the Owner and Architect when testing and adjustment of the systems are complete, normal settings marked, and systems are available for acceptance tests. Provide completed copy of the testing and adjustment report organized according to the testing requirements in this section. Frequency related test results shall be submitted in both tabular and graphical formats. No exceptions.
  3. System programming files in software formats supplied by the manufacturer including all executable files.
  4. Provide two (2) copies for the Client and one (1) for the IPTV Engineer of the "Overall System Operation and Maintenance Manual", it shall include:
    - a. Description of the procedures necessary to activate each system for the functional requirements listed in the System Description.

1.6 QUALITY ASSURANCE

- A. Codes: Work shall be done according to applicable requirements of governing international, federal, state, county municipal and local codes, rules, and regulations. In addition, the work shall be in accordance with the latest revisions of all applicable standards and specifications of the following, whether statutory or not:
  1. UL - Underwriters Laboratory
  2. EIA – Electronics Industries Association
  3. NEC – National Electrical Code, Latest Edition
  4. Federal, State, County, City and other local codes and requirements
  5. NFPA 70, NEC Latest edition, Article 300-22(c) UL2043
  6. NFPA 72, Latest Edition, as applicable
  7. NFPA 90A, Latest Edition, Section 2-3.10.1(a), Exception 2.
  8. Underwriters Laboratories (UL): UL1480 (UUMW) UL Control #7P97 Air Handling Spaces, ANSI/UL263
- B. Standards: Equipment and materials specified shall conform to the current edition of the following standards where applicable:
  1. EIA Standard SE-101-A: Amplifiers for Sound Equipment
  2. EIA Standard SE-103: Speakers for Sound Equipment
  3. EIA Standard SE-104: Engineering Specifications for Amplifiers for Sound Equipment
  4. TIA/EIA 862 - Building Automation Systems Cabling Standard for Commercial Buildings
  5. OSHA - Standard 29 CFR 1910.268
  6. UL - Underwriters Laboratories
  7. ASTM - American Society for Testing Materials
  8. NEMA - National Electrical manufacturer's Association
  9. ANSI - American National Standards Institute
  10. ETL - Electrical Testing Laboratories
  11. SMPTE - Society of Motion Picture and Television Engineers
  12. EIA - Electronic Industries Association
  13. ISO - International Standards Organization
  14. AES - Audio Engineering Society
  15. InfoComm - Standard Audio Video Systems Installation Practices
  16. NAB - National Association of Broadcasters
  17. Refer to Section 27 05 00 for additional requirements that shall be fulfilled as part of this specification section.
- C. Prequalification Information To Be Submitted Prior To A Bid

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1. This subsection pertains to all IPTV Contracting firms. The Project welcomes all potential IPTV Contractors to enter in the competitive bidding process providing they can meet or exceed the general requirements listed below. The General Contractor and or the Electrical Contractor, or other sub-contractors shall not have the right to determine the eligibility of IPTV Integrators/Contractors which is an act reserved for the Owner and the Engineer but can coordinate and submit their preferences and or reservations with the design team and Engineer. Each contractor firm must comply and submit all of the requested documentation found within this subsection (1.06D) below:
2. Company Profile:
  - a. The contractor shall be a firm with at least five (5) years' experience in the fabrication, assembly, and installation of IPTV systems of similar scope and magnitude. The Contractor shall submit this documentation to the Architect, Owner's Representative and the IPTV Engineer one (1) week prior to the bid return date. No exceptions will be made for late or incomplete documentation as this documentation will be rejected.
  - b. Documentation shall include a breakdown of the total number of employees, clearly indicating area of responsibility and length of time with firm in that capacity. Employee profile will include number and level of certified installers, if any, available for the project installation. The Bidder shall also indicate union status, if any, of shop and field installation personnel.
  - c. Project Team: The contractor shall clearly identify project team members and that statement shall include name, years with firm and a brief resume of the employees past projects and education. Pertinent team members that are to be identified shall be Project Manager, Chief Engineer, Programmer, Senior Field Technician, and Senior Bench Technician.
    - 1) Engineer: Shall be certified as by manufacturer. The staff engineer shall also be certified by that manufacturer at the highest certification level for that product available. Engineer shall be licensed to practice in jurisdiction where Project is located and who is experienced in providing engineering services of similar scope. The Engineer shall review, sign, stamp, and seal the contractors design as appropriate.
    - 2) Project Manager: Shall be certified by manufacturer.
    - 3) Programmer Certification: Due to the complexity of the today's projects, the contractor shall have manufacturer certified programmers on all equipment requiring programming or custom configurations. The contractor shall provide complete evidence of the certifications with their pre-qualification documentation one (1) week prior to the project's bid submittal due date. No exceptions.
  - d. In-House Capabilities: The contractor shall have in-house capabilities and facilities for equipment rack assembly, shop fabrication, software programming and equipment testing. All equipment racks shall be assembled and thoroughly tested at the contractor facility prior to delivery and installation at the project site. The contractor shall provide a signed statement with the other pre-qualification documentation.
3. Similar Projects:
  - a. Documentation must identify, specifically, similar projects of the same or greater magnitude. Of those projects noted, the contractor must provide current owner/user contact names and telephone numbers, as well as a job description and total value of the audio, video and control components, with a clear delineation between labor and equipment costs, as well as duration of project. The submittal supplied must clearly state that the firm submitting the bid response has actively been involved in the projects in a site installation and service capacity.

D. Manufacturer and Product Qualifications

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1. Provide products from manufacturers regularly engaged in the production of IPTV components, including but not limited to, software and hardware.
2. Provide products from manufacturers whose products of similar types, capacities, and characteristics have been in satisfactory use in similar type projects for not less than five years.
3. Materials and equipment supplied by the contractor shall be new and shall meet or exceed the latest published specification of the manufacturer in all respects.
4. The contractor shall provide the latest comparable model, available at the time of bidding, of each piece of equipment.

1.7 EQUIPMENT DELIVERY AND STORAGE

- A. Deliver equipment and components in factory-fabricated containers or wrappings, which properly protect equipment from damage.
- B. Store equipment and components in original packaging. Store inside well-ventilated space protected from weather, moisture, soiling, humidity and extreme temperatures.
- C. Handle equipment and components carefully to prevent damage. Do not install damaged units or components; replace with new.
- D. Refer to Section 27 05 00 for additional requirements that shall be fulfilled as part of this specification section.

1.8 SEQUENCING AND SCHEDULING

- A. All work shall be reviewed and coordinated with the Construction manager and /or General Contractor prior to commencing.
- B. Project Expectations: Within two weeks after award of contract, the Contractor shall arrange a "CA kickoff" meeting and/or conference call with the General Contractor, Construction Manager, Architect, Engineer, and Owner (when applicable) to discuss general project expectations.
- C. Communication systems, infrastructure, raceway and equipment are sensitive to environmental conditions including but not limited to temperature, dirt, dust, and water. The contractor shall ensure the storage and installation of all communication components are sequenced and scheduled accordingly to prevent any damage, loss of performance, and warranty void of such systems. All miss-installed components shall be replaced with new parts and re-installed at the Contractor's expense.
- D. Coordinate installation with Structural, Electrical, HVAC, Plumbing, Fire Protection, and other trades to eliminate disruption and/or conflict with other systems.
- E. Sequence installation of communications systems and infrastructure with other work to minimize possibility of damage and soiling during remainder of construction.

1.9 PROJECT SITE CONDITIONS

- A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

1.10 WARRANTY

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- A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

1.11 SPECIFICATION RESPONSE

- A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

1.12 DEFINITIONS

- A. The terms "IPTVC" and "IPTV Contractor" shall refer to the Contractor who has been awarded the contract for this scope and who has responsibility for the performance of the work specified in this specification.
- B. The term "specified elsewhere" shall refer to material and work which is related to this contract and for which the contractor is not responsible except as otherwise detailed herein. Some or all of these items may be included in the overall electrical contract.
- C. The term "NIC" refers to work or equipment that is not in the contract covered in this specification.
- D. The term "shall" is mandatory; the term "will" is informative; the term "should" is advisory; and the term "provide" means furnish and install.
- E. The term "Complete" shall refer to equipment and systems that shall be provided with all necessary accessories to complete a turn-key solution. Example: "equipment racks" that include doors, locks, side panels, covers, blank and vented panels, motorized fans, cable management, AC power distribution and sequencing etc. Another example would be control systems that must include all accessories such as RF transceivers, RS-422/485 baluns, distribution amplifiers, and external power supplies etc. as required providing the Owner with a fully functional and operational turn-key solution. If the C is unclear about a particular piece of equipment, system accessories, or design intent, then it is the sole responsibility of the contractor to immediately contact the Engineer via the RFI process for clarification prior to the bid submittal.
- F. The term "OFE" shall refer to Owner Furnished Equipment, which will be provided by the owner or user to the contractor. The contractor shall be responsible for installing the equipment at the audio video system site in good functional order as detailed herein.
- G. The term "EC" shall refer to the Electrical Contractor.
- H. The term "GC" shall refer to the General Contractor.
- I. The term "Bidder" shall refer to a firm submitting a bid response to this specification.
- J. Refer to technology drawings symbol legend and abbreviations.
- K. Refer to Section 27 05 00 for additional requirements that shall be fulfilled as part of this specification section.

1.13 SYSTEMS DESCRIPTION

- A. General

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1. The Internet Protocol Television (IPTV) system is a high-definition IPTV solution that provides advanced video / audio content management using IP edge device delivery. It is a centrally-managed, video / audio processing and multimedia distribution solution that enables the integration and automated delivery of customized and dynamic content from multiple sources to specific areas of the stadium in high definition (HD) video.
2. The IPTV System is purpose-built for this venue, which shall have extensive video systems deployed throughout this facility. This system shall enhance the live events experience for the customer while providing in-house area focused advertising ensuring a return on investment for the Owner. In addition, it leverages video systems in restaurants, clubs, and luxury suites to allow fans to view both in-house programming as well as external network channels.
3. The IPTV system shall be fully capable of utilizing content from existing Four Winds Interactive on non-event times.
4. The IPTV Systems shall incorporate at a minimum the following video feeds:
  - a. Full channel line-up provided by Comcast.
  - b. All Direct TV Game Day channels.
  - c. Red Zone Channels.
  - d. Local, ESPN, Fox, Golf Channel, and others as defined by the Owner.
  - e. Up to 15 IPTV Channels provided by Broadcast System.
5. The system shall have the capability to provide unique high definition (HD) multi-media content to discrete video flat panel monitor(s) located in different areas of the venue; groups and zones of video monitors as well as sending the same video to all video flat panel monitor endpoints simultaneously with all programming based on the Owners requirements. Video resolution available at the edge device / end-points shall be 720p / 1080i or 1080p.
6. Redundancy: The IPTV Contractor shall provide all necessary servers, switch gear, processors etc. to guarantee the Owner with a reliable and stable system with a fully redundant head-end.
7. Turnkey Solution: The Contractor shall design, furnish and install all necessary and all required equipment, hardware and software and licensing so as to provide the Owner with a "Turnkey" solution.
  - a. In addition to the designated "Solutions" manufacturer, specific 3<sup>rd</sup> party electronic equipment shall be provided by the Contractor. Typically this equipment shall be located at the head-end as it aids in video signal processing necessary to format the various types of video audio input signals to be used downstream. Redundancy is also required for these components. See system logic drawings for additional information.
8. The Contractor shall provide 1 Digital Media Player to the Bowl Sound System Contractor for installation in the PA Control Room. Coordinate with the Owner and Construction Manager.
9. Global and or local (i.e. Suites) control of video content
  - a. Channel Selection
10. Optional (Add-Alternates):
  - a. Connectivity to point of sale (POS) services

B. Video and Video Advertisement Content

1. General:
  - a. The video distribution system shall have the capabilities to support two(2) types of HD video:
    - 1) MPEG4 AVC10 (H264.1)
    - 2) MPEG2 (existing and legacy installations)
    - 3) NOTE: Standard definition video (480i) is not a recommended format
2. Head-end Video Acquisition:
  - a. System input video:

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- 1) Building Demarcation
  - a) Satellite
  - b) CATV
  - c) Terrestrial via antenna (MPEG2)
- 2) Locally generated HD video
  - a) Cameras (HD-SDI video format)
  - b) Advertisements (graphics)
  - c) Ticker tape and content wrappers application can be used to provide additional information, such as game scoreboards and statistics from other venues etc.
  - d) Digital menu boards
3. Video Processing
  - a. Encryption
    - 1) MPEG4
    - 2) MPEG2
  - b. Decryption
    - 1) Description: When the incoming off site video signals to the Demark are encrypted, all signals must first be decrypted (clear), and then encoded to the correct format (MPEG4) for processing and distribution.
    - 2) Head-end
      - a) Satellite
        - (1) Thompson equipment bundle
      - b) CATV
        - (1) Set Top Box required per channel
        - (2) Encryption
      - c) IP Feed
        - (1) Set Top Box required per channel

C. Video Distribution and Delivery

1. Network requirements: see specification section 27 21 00 for details.
2. Multicast: Distribute content to single video monitors or groups thereof.
  - a. Video templates
  - b. Video Resolution:
    - 1) HD video: 1080p or 720p
    - 2) Standard definition video: 480i (Typically not supported)
  - c. NOTE: Presently this system cannot process or distribute high-bandwidth digital copyright protected (HDCP) media.
3. Edge device / endpoint:
  - a. Digital media player (DMP)
    - 1) Edge device stored content via internal memory
      - a) Video accessed via a "Video Playlist"
    - 2) Endpoints: 5000 maximum
    - 3) Control: LVC used to operate the local video flat panel
      - a) NOTE: Owner may require edge device on/off power switching via lighting circuits for energy conservation
  - b. Input / output signals:
    - 1) HDMI, input HD video and audio
    - 2) STD, video and audio (not supported)
    - 3) RS-232 (low voltage control two way data stream)
    - 4) Infrared, control one-way
  - c. Video flat panel monitor
    - 1) Video resolution:
      - a) 1080p
      - b) 720p

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- 2) Input terminations:
  - a) HDMI video & audio
  - b) RS-232 Low Voltage Control (LVC)
- 3) Audio: Internal speakers
- d. Local control options:
  - 1) General: only one (1) option can be utilized in within a specified section or locally designated area
  - 2) Head-end low voltage control Options
    - a) RS-232 bidirectional serial data stream
      - (1) 3<sup>rd</sup> party touch panel
    - b) Infrared: Hand-held remote control of local DMP (Infrared)
    - c) Application Programming Interface (API): Customer selected device which is integrated into the system, i.e. iPad, tablets etc.
    - d) IP Phone or Tablet, where integrated solution has been deployed within the Suites and other premium areas)
  - 3) Edge device control (via DMP output):
    - a) Video Flat Panel:
      - (1) Input source selection
        - (a) ATSC / NTSC tuner: channel selection if available
      - (2) Audio:
        - (a) Volume up / down
        - (b) Mute
      - (3) Power
        - (a) Power on / off

D. Network Requirements:

- 1. Head-end
  - a. Data transfer rates:
    - 1) Satellite channel tuners / video processors to Demark switches: 100 Mbps
    - 2) Demark switches to Digital Content Manager devices: 1.00 Gbps
    - 3) Digital Content Manager devices to Video Distribution Switches: 1.00 Gbps
    - 4) Video Distribution Switches to Core Switches: 10-Gbps
    - 5) Core Switches to Endpoints: 1-Gbps
  - b. PoE: Required for Testing and troubleshooting of Edge devices (PoE Standard 802.3af)
- 2. Telecom Rooms
  - a. Guidelines for component placement within racks include:
    - 1) Orient head-end components so all exhaust fans are located on the same side of the rack – all back or all front. If the rack room housing the gear implements a “hot rows / cold rows” layout, ensure exhaust fans emit into a “hot” aisle.
    - 2) Locate each DCM centrally between encoders, receivers and transcoders that connect to it to minimize cable overlap.
    - 3) No empty RU spacing between video head-end components is required.
    - 4) The components included in the head-end will vary depending on the type of video feeds to be processed. The rack units required for each of the possible components are as follows:

Device	Rack Units Required
Encoders	1
Transcoder	1

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Receiver	1
Digital Content Manager	2
Stackable Ethernet Switches	1
Chassis Based Ethernet Switch	5
Thomson COM1000	5
System Director Server	2
Digital Media Manager	2

b. Power

- 1) The following table shows the maximum power consumption for each of the individual devices that may be included in the IPTV head-end:

Device	Power Requirements
Digital Content Manager	350 W (max); 110 to 240V AC
Encoder	60 W (max) ; 100 V AC
Receiver	200 W (max); 95 to 135 / 180 to 265 V AC
Transcoder	110 W (max); 110 to 240V AC
QAM Demodulator	8 W; 48V AC
3 <sup>rd</sup> Party Set-top Box	Varies – 15-20 W; 110 to 240V AC
Thomson COM1000	320 W (max with redundant PSU); 110 to 240V AC
Ethernet Switches	Power supplies for switches should be sized accordingly.

3. The following table shows the ingress and egress connection types for each of the devices that may be included in the IPTV head-end:

Ingress		Device	Egress	
Input	Connection		Connection	Output
ASI	Coax ; 75 Ω BNC	Digital Content Manager	Cat 6; SFP MMF/SMF; SFP	GigE IP
HD-SDI (292M)	Coax ; 75 Ω BNC	Encoder	Coax ; 75 Ω BNC	ASI
RF	Coax ; 75 Ω BNC	Receiver	Coax ; 75 Ω BNC	ASI
ASI	Coax ; 75 Ω BNC	Transcoder	Cat 6; RJ-45	GigE IP
RF	Coax ; 75 Ω BNC	QAM Demodulator	Coax ; 75 Ω BNC	ASI
HD component; separate audio	D connector (supplied)	HD/SD A/D Converter	Coax ; 75 Ω BNC	HD-SDI (292M)
RF	Coax ; 75 Ω BNC	Thomson COM1000	Cat 6; RJ-45	GigE IP
FE or GigE	Cat 6; RJ-45 Cat 6; SFP MMF/SMF; SFP	Ethernet Switches	FE, GigE or 10G	Cat 6; RJ-45 Cat 6; SFP MMF/SMF; SFP or X2

4. Network requirements: see specification section 27 21 00 for details.

1.14 IPTV CONTRACTOR'S GENERAL RESPONSIBILITIES

TECHNOLOGY MANAGEMENT CORP/ALANNA CONSULTING GROUP/SECURITY EVOLUTIONS  
IPTV SYSTEMS - CCD 087 – VA Incorporations #4  
2014-06-27

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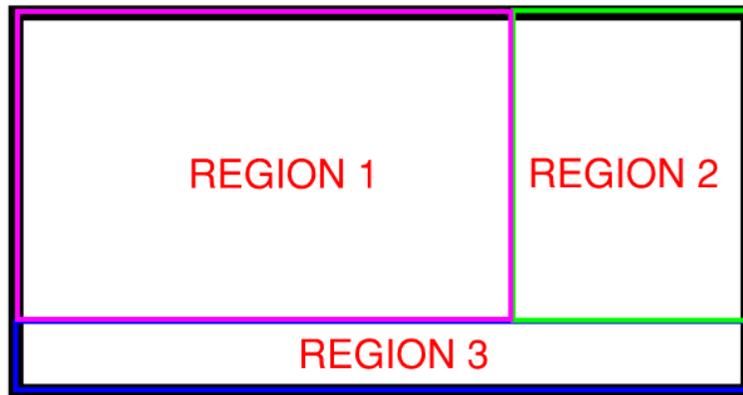
- A. The contractor shall be responsible for delivering a complete and fully functional turnkey system to the Owner. The contractor shall provide equipment and materials, whether specifically mentioned herein or not, to ensure a complete and operating system. The NIC, PBO and OFE equipment and materials are specifically exempted from this requirement.
- B. It is expected that the contractor shall be accountable for a functional system regardless of the packages selected by the Owner and that any deficiencies or added expenses created by the Owners' selections be brought to the IPTV Engineers and Owners attention before acceptance of the contract.
- C. The contractor shall provide software necessary to operate software controlled event operations, proof of purchase, billing, video processors, audio sub-systems i.e. digital signal processors (DSP), low voltage control systems etc. This software shall, in every case, be provided by the manufacturer/programmer of the sub-system, and shall be installed and tested prior to delivery of equipment at site. All preset, configuration and executable (\*.exe) files necessary for a system update (or re-installation) shall become the property of the Owner in perpetuity, no exceptions. These operating system and software files shall be provided to the IPTV Engineer and Owner two (2) weeks prior to Final Acceptance Testing.
- D. Training and Support Training
  - 1. General: It is anticipated that the Owner shall require the manufacturer's training staff to provide a high level of support during the product launch. Both from an application and the hardware point of view. The manufacturer shall provide all necessary training to ensure a successful product deployment including the following:
    - a. Content Manager Application
      - 1) Scheduling and Event planning
      - 2) Template development and deployment
        - a) Video advertisement transcoding / formatting
        - b) Ad insertion
      - 3) Video encoding / decoding
    - b. Hardware
      - 1) Head-end
      - 2) Edge devices
- E. Warranty and Support
  - 1. Warranty
    - a. See specification section 27 05 00 for additional information and requirements.
  - 2. On-site Support
    - a. Event Shadowing
      - 1) Pre-event: Training staff shall be on site one (1) day prior to event.
      - 2) Event: Training staff shall be on site before, during and after the event to assist in any issues that arise.
      - 3) Post-event: Provide end user with constructive feedback on issues relating to systems performance
  - 3. End-user factory training
    - a. Add Alternate: As directed by Owner
  - 4. Long term service
    - a. Add Alternate: Provide pricing for one, two and five year service agreements

PART 2 - PRODUCTS

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2.1 GENERAL

- A. Materials: Supply materials and equipment that shall be new and shall meet or exceed the latest published specifications of the manufacturer
- B. Supply the latest model, available at the time of bidding, of each piece of equipment. The Owner may request, at their option, that the latest model of equipment, or new technology, available at the time of installation be provided. If a later model is requested, adjustments will be made to cover cost changes between the cost at bid submittal and the cost of the latest model at the time of installation.
- C. Digital Content Manager
  - 1. Content Creation:
    - a. The software operating system shall provide a minimum of seven (7) easily utilized basic templates for end user use, as well as the ability to produce custom format panes as required by the Owner. The images are divided into various sized window panes called "Regions". Each region has a specific function in that it displays a specific type of image format. Provided below is a sample template:



- 1) Image Regions:
  - a) "Region 1" shall always display the video content in an 16:9 aspect ratio
  - b) "Region 2" is for still graphics
  - c) "Region 3" is for RSS text feeds
- b. Default Screen templates shall include:
  - 1) "Welcome":
    - a) Content: Full screen message or graphic
    - b) Region layout: 1920 (W) x 1080 (H) pixels
  - 2) "Full Screen":
    - a) Content: Full screen video or full-screen graphics
    - b) Region layout: 1920 (W) x 1080 (H) pixels
  - 3) "Three – Region - Standard", i.e. screen divided into three (3) independent segments:
    - a) Content: Live video, advertisements and ticker tape. Also known as "L-wrapper".
    - b) Region layout:
      - (1) Video: 1500(W) x 844 (H) pixels
      - (2) Advertisements: 420 (W) x 844 (H)
      - (3) Ticker: 1920 (W) x 236 (H)

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- 4) Three – region - single” , i.e. screen divided into three (3) independent segments:
    - a) Content: Live video, advertisements and ticker tape.
    - b) Region layout:
      - (1) Video: 1624 (W) x 914 (H) pixels
      - (2) Advertisements: 296 (W) x 914 (H)
      - (3) Ticker: 1920 (W) x 166 (H)
  - 5) Three – Region - Double” , i.e. screen divided into three (3) independent segments:
    - a) Content: Live video, advertisements and ticker tape.
    - b) Region layout:
      - (a)Video: 1486 (W) x 838 (H) pixels
      - (b)Advertisements: 434 (W) x 838 (H)
      - (c)Ticker: 1920 (W) x 242 (H)
  - 6) “Exit”:
    - a) Content: Full screen exit message
    - b) Region layout: 1920 (W) x 1080 (H) pixels
  - 7) “Emergency”:
    - a) Content: Full screen internal building message
    - b) Region layout: 1920 (W) x 1080 (H) pixels
  - c. Programmable templates:
    - 1) Content: Live video and / or advertisements and / or ticker tape.
    - 2) Region layouts: quantity = five (5) in which total pixels must equal 1920 x 1080.
    - 3) Video region quantity = one (1)
    - 4) Overlays: The ability to utilize non-video graphics with opacity/transparency (PNG files) to overlay a video region.
2. Operations
- a. Event States and Scripts:
    - 1) Description: An event script sets where and at which time the ads, video, and graphics will be displayed in the stadium and on the screen. The event script is typically tied to a timeline of moments in the game such as pre game, first quarter, halftime, and game end.
    - 2) Event scripts shall allow users to display content based upon time as well as physical location, allowing ad sponsors to target different advertising for different demographics and locations in the stadium.
    - 3) Supported Event States shall include:
      - a) Sequential Event States
      - b) Ad Hoc Event States
      - c) Non Event State
      - d) Ad Hoc Sponsored Content
  - b. Video Template
    - 1) A template defines the video and non-video regions and layout of a DMP display.
    - 2) Templates are used to create various layouts for the presentation of different types of content. Templates are assigned to zones or groups and apply to all locations within them.
    - 3) Software shall provide the capability to create custom templates that allow users to specify the size and arrangement of the regions on the screen.
    - 4) Video templates shall include live XML & RSS feeds.
  - c. Playlists
    - 1) Description: a collection of content (images, flash) set to play for a fixed duration in sequence in a given “region” that can then be repeated. Each playlist is independent of others and can include tickers and full screen messages. Typically used to cycle advertisements.

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- 2) Limitations:
  - a) Items per list = 1200
  - b) Items per script = 2200
  - c) Event states per event = 100
  - d) Maximum number of playlists in entire content management data base = 1000
- d. Field Operations / Remote Control
  - 1) IPTV System shall enable centralized content and scheduling control and administration across the entire venue.
  - 2) IPTV System shall contain definitions for each installed DMP, IP Phone, and any other control device to allow users to create local control areas.
  - 3) Customized per area channel guides for use in local control areas are required.
- e. Billing
  - 1) In addition to controlling the power, volume, and channel selection for each of the TVs in a luxury suite, the local control device must be able to provide access to commerce services that allow users to place orders with the venue's catering and merchandise store.
  - 2) Commerce services shall require integration with a third party point of sale application such as Micros or Crestron.

D. Hardware

1. Video and Video Advertisement Content
  - a. The video distribution system shall have the capabilities to support two (2) types of HD video:
    - 1) MPEG4 AVC10 (264.1)
    - 2) MPEG2 (existing and legacy installations)
    - 3) NOTE: Standard definition video (480i) is not a recommended format
2. Encoders / Decoders (CODEC) Standard Definition (D9094 / D9093)
  - a. Description: This unit shall have the capability to encode or decode various types of video / audio signals for use upstream. The requirement for very low latency is one of the most important criteria in the functionality of this product line.
  - b. Video inputs:
    - 1) HD-SDI or SD-SDI x HDMI; Quantity = 1
      - a) HD Resolution : 1920 / 1440 / 960 x 1080i (59.94 / 50.0 Hz), & 60.0 Hz
      - b) HD Resolution : 1280 / 960 / 640 x 720p (59.94 / 50.0 Hz), & 60.0 Hz
      - c) SD Resolution : 720 x 480i (59.94 / 50.0 Hz), 720 x 576i (50.0 Hz)
    - 2) Genlock: NTSC / PAL Black Burst or HD Tri-level Synchronization
  - c. Video outputs
    - 1) HD-SDI or SD-SDI; Quantity = 1
    - 2) HDMI; Quantity = 1
    - 3) NTSC / PAL; Quantity = 1
    - 4) Resolution:
      - a) HD Resolution : 1920 / 1440 / 960 x 1080i (59.94 / 50.0 Hz), & 60.0 Hz
      - b) HD Resolution : 1280 / 960 / 640 x 720p (59.94 / 50.0 Hz), & 60.0 Hz
      - c) SD Resolution : 720 x 480i (59.94 / 50.0 Hz), 720 x 576i (50.0 Hz)
    - 5) Video Coding (Chrominance Subsampling):
      - a) High Definition (HD):
        - (1) 4:2:2CSC – 12.0 to 33 Mbps
        - (2) 4:2:0 – H.264 MP & HP @ L4: 3.00 to 27.0 Mbps

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- b) Standard definition (SD):
  - (1) 4:2:2CSC – 6.00 to 14.0 Mbps
  - (2) 4:2:0 – H.264 MP & HP @ L3: 1.30 to 10.0 Mbps
- c) Latency / Delay

<b>GOP Mode HD @ 12.0 Mbps</b>	<b>Field</b>	<b>1080i (59.94 Hz)</b>	<b>720p (59.94 Hz)</b>
Ultra-Low	IP @ 4:2:0	.43s	.41s
Standard	IP @ 4:2:2CSC	.46s	.43s
Ultra-Low	DVB-ASI @ 4:2:0	.28s	.26s
Standard	DVB-ASI @ 4:2:2 CSC	.31s	.28s
Ultra-Low	IP @ 4:2:0	1.19s	1.03s
Standard	IP @ 4:2:2CSC	1.23s	1.08s
Ultra-Low	DVB-ASI @ 4:2:0	1.04s	.88s
Standard	DVB-ASI @ 4:2:2 CSC	1.08s	.93s

<b>GOP Mode SD @ 6.00 Mbps</b>	<b>Field</b>	<b>480i (59.94 Hz)</b>
Ultra-Low	IP @ 4:2:0	.41s
Standard	IP @ 4:2:2CSC	.44s
Ultra-Low	DVB-ASI @ 4:2:0	.26s
Standard	DVB-ASI @ 4:2:2 CSC	.29s
Ultra-Low	IP @ 4:2:0	1.05s
Standard	IP @ 4:2:2CSC	1.12s
Ultra-Low	DVB-ASI @ 4:2:0	.90s
Standard	DVB-ASI @ 4:2:2 CSC	.97s

- 3. Encoders / Decoders (CODEC) High Definition (D9894)
  - a. Description: This unit shall have the capability to encode or decode various types of video / audio signals for use upstream. The requirement for very low latency is one of the most important criteria in the functionality of this device.
- 4. Encoders / Decoders (CODEC) Satellite (D9094SE)
  - a. Description: This unit shall have the capability to encode or decode various types of video / audio signals for use upstream. The requirement for very low latency is one of the most important criteria in the functionality of this device.
- 5. Server
  - a. Processors
    - 1) Configuration: One (1) or two (2) units
    - 2) Type: Intel Xeon series 5500
  - b. Graphics / Controller
    - 1) ServerEngines Pilot-2 Baseboard Management Controller
      - a) Embedded Matrox G200 core
      - b) IPM1 2.0 Compliant for management control
      - c) One(1) 10/100Base-T out-of-band management interface
      - d) CLI & Web GUI management tool for automated lights out
  - c. Memory
    - 1) Type: Card Cage
    - 2) Capacity: twelve (12) DIMM slots (96.0 GB)
      - a) Card type: 8.00 GB DIMM
    - 3) DDR3 registered DIMM supported
    - 4) Advanced ECC
    - 5) Mirroring option
  - d. Drives
    - 1) Configuration: Up to four(4) front accessible, hot swappable
    - 2) Hard disk: 146-GB SAS, 15.0k RPM or 300-GB SAS 15.0k RPM
    - 3) Optical drive: 24 x CD-R/RW DVD±R/RW
  - e. Operating Temperature: 50.0°F to 95.0° F
  - f. Dimensions: 1.70" (H) x 16.9" (W) x 27.8" (D), 1RU

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- g. Peripheral Connectivity
  - 1) Two (2) PCIe Generation 2 slots
    - a) 1 x 16 full height, half length
    - b) 1 x 8 low profile, half length
  - 2) Mezzanine card:
    - a) Four (4) slots
    - b) LSI 1064 Controller based (RAID 0,1 or 1E)
  - 3) USB: two (2) ports
  - 4) Serial RS 232C: One (1) DB-9 pin
  - 5) RGBHV (VESA): One (1) DB-15 pin
- 6. Head-end Video Acquisition
  - a. System input video
    - 1) Building Demarcation
      - a) Satellite
      - b) CATV
      - c) Terrestrial via antenna (MPEG2)
    - 2) Locally generated HD video
      - a) Cameras (HD-SDI video format) provided by others(PBO)
        - (1) Feeds from Broadcast Control Room
        - (2) Feeds from Remote Trucks
      - b) Advertisements (graphics)
      - c) Ticker tape application can be used to provide additional information, such as game scoreboards and statistics from other venues etc.
- 7. Video Processing
  - a. CODEC
    - 1) MPEG 4 part 10 Baseline / Main profiles
    - 2) MPEG 2 Main profile at high level
    - 3) MPEG 1
    - 4) Windows Media 9 and SMPTE 421.M (VC-1)
    - 5) Data rates:
    - 6) ≤ 28.0 Mbps
    - 7) Frame rates:
    - 8) MPEG: 29.9 fps
    - 9) Windows: 23.9 fps
  - b. Encryption
    - 1) MPEG4
    - 2) MPEG2
  - c. Decryption
    - 1) Description: When the incoming off site video signals to the Demarc are encrypted, all signals must first be decrypted (clear), and then encoded to the correct format (MPEG4) for processing and distribution.
    - 2) Head-end
      - a) Satellite
        - (1) Thomson equipment bundle
      - b) CATV
        - (1) Set Top Box required per channel
        - (2) Encryption
      - c) IP Feed
        - (1) Set Top Box required per channel
- 8. Digital Content Manager
  - a. Description: Device has the ability to perform high density trans-rating and transcoding video a MPEG 2 and MPEG 4 – AVC broadcast quality multimedia. Unit can also process multiple feed receptions of DVB-S/S2, multi-decryption of MPEG 2 services, re-multiplexing, grooming and scrambling of DVB and ATSC

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services. Additionally the DMP is a reliable transport of SDI, AES/EBU audio and ASI transport stream signals.

- b. User Interface
  - 1) Graphical User Interface (GUI)
  - 2) Network Control
    - a) PID
  - 3) Input / output Status
  - 4) Alarms
  - 5) Integrated Network Monitoring & Control
    - a) ROSA
    - b) NMC
- c. Decoding of DVB Satellite Broadcasts
- d. MPEG Signal Processing
  - 1) Closed captioning
- e. Video Streams
  - 1) Control of 85 HD Streams
  - 2) Control of 350 SD Streams
- f. Video Processing
  - 1) Transcoding MPEG2 to H.264(MPEG4)
  - 2) Scaling (up/down)
  - 3) Digital Overlays
- g. Audio Processing
  - 1) Compression
  - 2) AC-3 (Dolby Digital)
  - 3) MPEG -1 Layer II
  - 4) HE-AAC
  - 5) Zone amplification (when required)
- h. RF Off-air 8-VSB reception
  - 1) ATSC
- i. Satellite DVB-s & DVB S2
- j. Transcoding
- k. Transmission
  - 1) IP Networks
    - a) MPEG COP3-2 / SMPTE 2022FEC
- l. Power Supplies
  - 1) Redundant
  - 2) Hot-swappable
- m. Dimensions: 3.50" (H) x 19.0" (W) x 21.8" (D); 2RU
- n. Weight: 46.3 lbs.
- 9. Distribution CODECS
  - a. Cisco D9094
    - 1) HD & SD Video Support
    - 2) Coding
      - a) H.264 (MPEG4)
      - b) DVB? (IS THIS REQUIRED? DO WE NEED TO CALL OUT THE OPTIONAL MODULATOR?)
- 10. Edge Device / End Points (DMP)
  - a. Remote Control
  - b. Signal output types
    - 1) HDMI
      - a) Resolutions:
        - (1) 720p
        - (2) 1080p
    - 2) Composite Video
      - a) Resolution: 480i (not typically supported)

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E. Proof of Play

1. Proof of Play is the ability to generate a report of which advertisements were played during an event. System shall provide Proof of Play reporting.
2. Proof of Play reports shall include the following fields:

Field	Description
Event_Date	Date of event.
State_Start	Timestamp for the start of the event.
Script_Name	Name of the script that generated the PoP report.
MAC	MAC address for the DMP that played the content.
Device_Name	Name of the DMP.
Zone	Zone in which the DMP belongs.
Group	Group in which the DMP belongs.
State_Name	Event script state when the ad played.
Action	Commands to the DMP attached display (reserved).
Content	File name of the content.
Playlist_Name	Name of playlist for the content.
Time_Played	Length of time the ad played out.
Content_Tags_PoP	Content tags assigned to the content.
Airtime	Actual time that the ad played out.
Receive_Time	Interpolated airtime timestamp by using received time (obsolete)
Region	Region info in each record of individual content play-out TemplateName plus RegionName.
Playlist_Number	Item number in the playlist.
Seq_Number	Sequence number beginning at event start increment by ad play.
Cluster_ID	Identifies the cluster of DMPs that are showing the same screen (internal use only).
Spot_ID	For internal use only.

PART 3 - EXECUTION

3.1 INSTALLATION PRACTICES

A. GENERAL

1. Installation shall include the delivery, unloading, setting in place, fastening to walls, floors, ceilings, counters, or other structures where required, interconnecting wiring of the system components, equipment alignment and adjustment, and all other work whether or not expressly required herein which is necessary to result in complete operational systems.
2. Contractor shall construct IPTV equipment racks and sub-assemblies, including all equipment to be installed therein off-site. All wiring work, labeling of wiring, cable dressing, hardware supports, and connection panels, cable wiring documentation, socket

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installation, ventilation and power supply regulation and filtering component installation shall be performed in IPTV Contractor's own premises.

3. The contractor shall not deliver equipment in original packaging to the site for installation. All such equipment will be unpacked and checked thoroughly in IPTV Contractor's premises. Contractor shall test such equipment as it is received to ensure that it conforms to the manufacturer's specifications. On no account shall the Owner be liable for any delays of completion of the installed system due to defective equipment being received by contractor.
4. For the purposes of coordination with Architects specified furniture, the contractor will insure that such equipment or mounting hardware is compatible with and suitable for installation in that furniture. It shall be the IPTV Contractor's responsibility to ensure they coordinate with the furniture and our millwork contractor and that parties shall exchange and follow their Shop Drawings to ensure that dimensions and structural supports are adequate for the IPTV equipment installation. It is the IPTV Contractor's responsibility that the request and delivery of such critical coordination information is satisfactorily executed and in as much as the contractor has control over the delivery of such information, the contractor shall deliver it as requested by the Architect.
5. All installation practices shall be in accordance with, but not limited to, the general design and construction requirements of the Architect, and these specifications and drawings. Installation shall be performed in accordance with the applicable standards, requirements, and recommendations of local authorities having jurisdiction (AHJ). Before commencing work, the contractor shall familiarize all project team members with all of these requirements.
6. If, in the opinion of the contractor, an installation practice is desired or required, which is contrary to these specifications or drawings, a written request for modification shall be made to the IPTV Engineer and/or Architect. Modifications shall not commence without written approval.
7. During the installation, and up to the date of issuance of the Final Acceptance Memorandum, the contractor shall be under obligation to protect his finished and unfinished work against damage and loss. In the event of such damage or loss, he shall replace or repair such work at no cost to the Owner.

3.2 CLEAN UP AND REPAIR

- A. During the installation the contractor shall be expected to maintain a clean and safe working environment.
- B. Upon completion of the work the contractor shall remove all his refuse and rubbish from and about the premises, and shall leave the relevant areas and equipment clean and in an operational state. The contractor shall be responsible for repairing any damage caused to the premises by the IPTV Contractor's installation activities, at no cost to the Owner.

3.3 SECURITY

- A. Provide a project security program to:
  1. Protect Work, stored products, and construction equipment from theft and vandalism
  2. Protect Owner's operations at site from theft, vandalism or damage from contractor's work or employees
  3. Maintain security program throughout construction period, until Owner occupancy or Owner acceptance precludes the need for contractor security.

3.4 PHYSICAL INSTALLATION

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- A. All equipment shall be firmly secured in place unless the equipment has been documented to be portable in nature, either within this specification or as shown in the Construction Documents.
- B. All fastenings and supports shall be adequate to support their loads with a safety factor of five (5) times the load weight or as required by Code, whichever is greater.
- C. All boxes, equipment, wall plates, cabling etc. shall be secured plumb and square.
- D. In the installation of equipment and cable, consideration shall be given not only to operational efficiency, but also to overall aesthetic factors. When an issue regarding a visual aesthetic that the contractor is aware of, they shall inform the IPTV Contractor and Architect immediately so that all parties can coordinate and provide an adequate solution in a timely manner.
- E. Trim and Escutcheon Components:
  - 1. To insure a proper finished appearance, the contractor shall furnish and install trim/escutcheon components at all conditions where IPTV components pass through the finished walls, floors, and ceilings. This would include but not be limited to video projector supports, video flat panel monitors, control panels etc. supports which are not specifically supplied with integral flanges/trim components.
  - 2. The visible component of any trim shall be as small as possible preferably no wider than .50". All trim components at the ceiling plane shall be finished to match the approved ACT ceiling grid system components. The contractor shall obtain a sample from the General Contractor, including any custom color information, or standard color numbers. All trim components shall be submitted to the Architect for review and approval prior to fabrication.

3.5 CABLE INSTALLATION

- A. All cables for this project must conform to the latest version of the NEC as well as local code requirements.
- B. All cables, regardless of length, shall be marked with permanent wrap-around number letter cable markers at both ends. There shall be no unmarked cables at any place in the system; labels must be computer-generated for legibility. Wire labels done by hand in the field must be replaced with computer generated labels. Marking codes used on cables shall correspond to codes shown on drawings and on run sheets. See section 27 05 00 for specific directions and requirements.
- C. Internal and Inter-rack cabling shall be neatly strapped, dressed, labeled, and adequately supported without pinching cable bundle
- D. Terminal blocks, boards, strips, or connectors, shall be furnished for all cables that interface with racks, cabinets, consoles, or equipment modules. The use of "wire nuts" to terminate or connect cabling is strictly prohibited.
- E. All cables shall be grouped according to the signals being carried. In order to reduce signal intermodulation distortion, separate groups shall be formed for the following cables:
  - 1. Power cables
  - 2. Low voltage system cables
  - 3. Video cables
  - 4. Audio cables carrying signal levels less than -20.0 dBm.
  - 5. Audio cables carrying signal levels between -20.0 and +20.0 dBm.

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6. Audio cables carrying signal levels above +20.0 dBm.
- F. As a general practice, all power cables, low voltage control cables and high level cables shall be run on the right side of an equipment rack as viewed from the rear. All other cables shall be run on the left side of an equipment rack, as viewed from the rear.
- G. When dressing the equipment rack, cables ties shall be placed at appropriate intervals of approximately six (6) inches for vertical bundles, four (4) inches for horizontal bundles. No cable ties shall cause the cable to exceed the manufacturer's recommended bend radius or deform the cable.
- H. All vertical cable bundles internal to IPTV system equipment racks shall be attached to the rack frame utilizing a cable management system.
- I. All cables shall be continuous lengths without splices. All system wire, after being cut and stripped, shall have the wire strands twisted back to their original lay and be terminated by approved soldered or mechanical means. No bare wire terminations shall be allowed, unless specified specifically on the drawings. No exceptions. Heat-shrink tubing shall be used to insulate the ground or drain wire.
- J. All solder connections shall be made with rosin-core solder using temperature-controlled solder stations. No cold or cracked solder joints are acceptable. Any connections, which do not appear to be clean and shiny, or which show signs of cracking, shall be re-soldered by the contractor before Final Acceptance testing of the system.
- K. Mechanical connections using insulated, crimp-type connectors shall be bonded to the connector by soldering the wire to the metal part of the connector
- L. Connections made with screw actuated pressure type terminal strips shall be made by stripping approximately .25" of insulation from the stranded conductor. Then the un-tinned wire shall be inserted into the terminal and tightened.
- M. All wire bundles are to be neat and combed free of cable crossovers.
- N. No cable shall be installed with a bend radius less than that recommended by the cable manufacturer.
- O. All wire markers shall face a common direction.
- P. All cables shall have proper connector housing.
- Q. All equipment racks shall be fully dressed out and cables shall not protrude from the back of the rack.
- R. All cable entry shall be through the tops of racks or through entrance holes in the base of the rack. No cable shall enter racks through front, rear or side panel openings.
- S. Millwork installed or pivoting racks shall be provided with a sufficient amount of dressed cabling or harness to allow free and untethered travel of the rack from the permanent locking position to the extended "service" position.
- T. Unless otherwise called for in these specifications and drawings, the following cables (those that apply), or their approved equals:

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1.	RF Antenna Distribution, 50.0 Ω (RG58U)..... Plenum.....	Belden 7806A Liberty WBC - 195 Belden 82240 Liberty RG58-CMP-WHT
2.	RF Distribution, 75.0 Ω (RG59)..... Plenum.....	Belden 1505A Liberty 20 – CMR VIDEO Belden 1506A Liberty 20 – CMP - VID
3.	RF Distribution, 75.0 Ω (RG6)..... Plenum.....	Belden 1694A Liberty 18 – CMR - SD Belden 1695A Liberty 18 – CMP – VID
4.	Control (4 conductor shielded)..... Plenum.....	Belden 1502R Liberty LLINX - U Belden 1502P Liberty LLINX - U - P
5.	RF CATV Distribution 75.0 Ω (RG6)..... Plenum.....	Belden 5339G5 Liberty RG6 - CM Belden 1829P Liberty RG6 – P - CATV
6.	RF CATV Distribution 75 Ω (RG11)..... Plenum.....	Belden 1523A Liberty RG11-CATV Belden 1523AP Liberty RG11 - P – CATV
7.	RF DBS Distribution 75 Ω (RG6)..... Plenum.....	Belden 7916A Liberty QUADFLEX – BC Belden 7916AP
8.	RGBHV High Resolution (18.0 AWG).....	Belden 7712A Liberty RGB5C
9.	Mini High Resolution..... Plenum.....	Belden 1279R Liberty RGB5C - 25 – CM Belden 1279P Liberty RGB5C - 25 – CMP
10.	HDMI: Field Terminated (distances <35.0').....	BTX HDMI128500BK
11.	HDMI Pre-terminated: .....	Extron HDMI Pro/xx
12.	DisplayPort Pre-terminated: .....	Extron DisplayPort M-M/xx
13.	DVI-D: .....	Extron DVID SL Ultra/xx
14.	USB Pre-terminated: .....	BTX (a-a)assembly (m-m)
15.	Triax (RG11): .....	Belden 8233 Liberty RG11 - CM –TRIAX
16.	3G HD-SDI (RG11): .....	Belden 7732 Liberty RG11 – EX – PLN
17.	SMPTE 311 (2-fiber, 2-16.0 & 2-24 AWG conductors):	Belden 7804C
18.	CAT6A, Shielded F/UTP (or ST/UTP)	Belden 10GX
19.	Data Cabling: See sections Communications 271500.	

Note: Any specific cable AWG gauge found in drawing package supersedes this document. These cable types are cited to illustrate the type and quality of cable required. Plenum cable must be utilized as required. Unless otherwise noted, cables from other reputable manufacturers will be considered acceptable only if data sheets are submitted and approved by the IPTV Engineer prior to installation. Contractor must verify cable lengths and confirm the suitability of the cables listed above. Where signal loss is beyond

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anticipated norms, the IPTV Contractor shall select a cable that will meet or exceed the requirements. No exceptions.

- U. Unless otherwise noted, all video and computer video cables are to be terminated using seventy-five ohm (75.0  $\Omega$ ) connector.
- V. Cables running in plenum areas without conduit shall be plenum rated cable; match the specified cable above. It is the responsibility of the bidder to inspect the electrical drawings and verify in what spaces plenum cable shall be used. No claims for additional monies, based on the use of plenum cable, will be allowed.
- W. All cables (except video and pulse cables which must be cut to an electrical length) shall be cut to the length dictated by the run. No splices shall be permitted in any pull boxes without prior permission of the IPTV Engineer. For equipment mounted in drawers or on slides, the interconnecting cables shall be provided with a service loop of appropriate length based on the bend radius of the cable etc.

### 3.6 CONNECTION PLATE RECEPTACLES

- A. Unless otherwise detailed herein, the following types of panel receptacles shall be used on all connection boxes, panels, plates, and wire ways:
  - 1. Data, Serial (RS-232, 422, 485): DB-9 or as noted on the drawings
  - 2. Data: LAN RJ-45 (Shielded where typical or necessary)
  - 3. Line Level Audio: RCA, .25" Tip Ring Sleeve (TRS)
  - 4. Composite and 3G-SDI Video: BNC
  - 5. CATV: "F" connector
  - 6. VGA: HD15, (IS THIS REQUIRED?)
  - 7. RGBHV: BNC
  - 8. DVI-D: DVI-D or DVI-I
  - 9. HDMI: HDMI
  - 10. DisplayPort: DisplayPort, dual-mode
  - 11. Fiber Optics: as shown in the drawings or required by active components, patch-bays, and switch gear etc.

### 3.7 PATCH PANEL ASSIGNMENTS

- A. All patch panels shall be wired so that signal "sources" (outputs from) appear on the upper row of a row pair; and all "loads" (inputs to) appear on the lower row of a row pair
- B. All audio and video patch panel designation strips shall utilize alphanumeric identifications and descriptive information. The jack position in each horizontal row shall be numbered sequentially from left to right. The horizontal jack rows shall be lettered sequentially from top to bottom. The alphanumeric identification of each jack shall be included on the functional block drawings, as well as on reproductions of these drawings, which shall be mounted in an appropriate location near the patch bays

### 3.8 GROUNDING

- A. In order to minimize problems resulting from improper grounding, and to achieve the maximum signal-to-noise ratio, the following grounding procedures shall be adhered to:
  - 1. System Grounds:
    - a. A single primary "system ground" shall be established for the systems in each particular area. All grounding conductors in that area shall connect to this primary

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system ground. The system ground shall be provided in the audio equipment rack for the area and shall consist of a copper bar of sufficient size to accommodate all secondary ground conductors.

- b. Under no conditions shall the AC neutral conductor, either in the power panel or in a receptacle outlet, be used for a system ground.
- c. Refer to section 27 05 26 for requirements.
2. Audio Cable Shields:
  - a. All audio cable shields shall be grounded at both ends. If a ground loop cannot be eliminated then an isolating transformer shall be utilized. For inter and intra-rack wiring this requires that the shield be connected at both ends. Chassis to rack ground shall be utilized if a ground loop can be detected either audibly or with an oscilloscope.
3. General:
  - a. Because of the great number of possible variations in grounding systems, it shall be the responsibility of the contractor to follow good engineering practice, as outlined above, and to deviate from these practices only when necessary to minimize crosstalk and to maximize signal-to-noise ratios in the audio, video, and control systems.
  - b. All connectors/terminations shall be isolated from wall plates, rack plates etc.

### 3.9 PERFORMANCE STANDARDS

A. Unless restricted by the published specifications of a particular piece of equipment or unless otherwise required under the Detailed Specifications, the following performance standards shall be documented and met by each system:

#### B. Performance Test Signal Paths

1. The signal paths for the above Performance Standards shall be as follows:
  - a. Video:
    - 1) From all sources (i.e. computers, camera, Blu-ray, DVD players, recorders etc.) through all format convertor, distribution electronics, keying switchers to the projector and video monitors (and RF distribution system if applicable).
    - 2) A matrix shall be constructed to show the appropriate levels and frequency response of the signals as they pass through each piece of equipment.
    - 3) Frequency Response: DC to 450 MHz,  $\pm 3.00$  dB fully loaded
    - 4) Signal to Noise Ratio: DC to 4.20 MHz, 55.0 dB minimum (peak to RMS) un-weighted
    - 5) Line and Field Tilt: 2.00% maximum
    - 6) Differential Gain: 3.00% maximum
    - 7) Differential Phase: 2.00° maximum
  - b. Control System User Interface:
    - 1) Control system user interfaces pages shall be designed for this project exclusively. While there are a great number of design approaches to designing the user interface, the following guidelines shall be adhered to:
    - 2) All panels are to have the time and date as icons, in the same position on every page
    - 3) All panels are to have a title, indicating the piece of equipment and/or functionality being controlled.
    - 4) User interface function operations shall start with input "Source" selection and then to all possible outputs, i.e. computer to video projector or video flat panel display.

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- 5) Final programming shall include capability to remotely control all functions of the IPTV system. Individual device controls shall provide full manufacturer's functionality.
- 6) Devices similar in nature shall be programmed to operate with a common format.
- 7) No individual component shall be programmed to function atypically unless otherwise requested by the Owner.
- 8) Whenever the same button appears on more than one page, it will be in the same position on each page.
- 9) Functions used during a general presentation shall be accessible with a minimal amount of button presses/page flips.
- 10) Where feasible, multi-level access to controls shall be implemented (i.e. user access vs. technical access) at the Owners request.
- 11) During performance testing, all equipment shall be operated under standard conditions as recommended by the manufacturer.

3.10 IPTV CONTRACTOR SYSTEM CHECKOUT

- A. Before Acceptance Tests are scheduled, the contractor shall perform a complete system checkout. The contractor shall furnish all required test equipment and shall 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:
1. Network:
    - a. Test the network in accordance to specification section 271500. Provide documentation that all matrix switching cross-points have been tested and verified.
  2. Provide documentation that all matrix switching cross-points have been tested and verified.
  3. Test all audio and video systems for compliance with the Performance Standards, using the following test equipment for each input, circuit, and edge device:
    - a. Video:
      - 1) Sencore MSA 1850 MPEG Service Analyzer (or equivalent), required.
      - 2) Sencore Optical Tri-stimulus Color OTC100 Analyzer or newer, required. (Video display calibration)
      - 3) Video test signal generator, Extron VTG 400 DVI, required.
      - 4) Professional Blu-ray player (HDMI), with associated IPTV Blu-ray test discs
      - 5) Computer w/ DisplayPort output.
    - b. Video cable
      - 1) Set of 75.0  $\Omega$  terminators, 'T' pieces, set of video adapter connectors (such as RCA-BNC, BNC-RCA), etc.
      - 2) Assorted prewired cables including DVI-D, DisplayPort, HDMI, VGA etc.
      - 3) CAT6A used for HDBT distribution: Quantum Data 780 analyzer.
  4. High Resolution Signals:
    - a. Connect the video output of the signal generator to all possible source connection points (i.e. floor-box, poke-thru, wall plates, table cubby, and head-end rack etca) and select the SMPTE, PLUGE, Moiré etc. signals at various video resolutions and scan rates. The example resolutions listed below are typical resolutions. All resolutions that are applicable to the project must be tested to ensure correct operation.
    - b. Verify MPEG signal distribution, transport streams, content, coding, decoding, signal transfer rates, signal latency etc.

The contractor shall provide to the IPTV Engineer one (1) week prior to acceptance testing, a copy of the following test results in electronic format in order

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to verify the IPTV video equipment has been installed and configured correctly:

- 1) The number of HDCP KSVs Keys supported by each source.
- 2) The video timing, HDCP use and audio format of each source when operating.
- 3) The video timings and supported audio formats for each connected sink.
- 4) The video timings and supported audio formats presented in the EDID to each source – the preferred video timing shall be indicated.
- 5) The length of cable used on all shielded twisted pair cable used for IPTV distribution.
- 6) The data rate supported by each shielded twisted pair cable used for IPTV distribution per table below.

Video Format Data Rate (in Gbps)

1080p Deep Color	6.75
1600 x 1200	4.86
1920 x 1200	4.62
1080p	4.44
1360 x 768	2.54
720p / 1080i	2.22
1024 x 768	1.91

- c. Check that the image is correctly displayed on the video monitors.
  - d. Test each input using Crosshatch signal, checkerboard signal, Moiré and “H” pattern signals at the scan rates indicated in items above.
5. Blu-ray, DVD and Universal Disc Players / Recorders
    - a. Insert the pre-recorded disc into the deck and check operation of the control panel’s transport controls as well as picture image quality. Also check that the audio signal is heard from the left and right speakers.
    - b. Check that the transport controls are logically presented on the touch screen GUI.
    - c. Re-select the SMPTE & PLUGE signal output of the video signal generator.
    - d. Check that the audio and video signals are recorded and can be played back on the local video monitor(s) with audio.
  6. Audio check:
    - a. Class 1 spectrum analyzer, B & K Type 2250 (or equivalent) must be capable of site calibration. No exceptions.
    - b. Audio Precision P1PLUS Audio Analyzer or equivalent.
    - c. Compact Discs, one technical (containing frequency sweeps, white noise, pink noise, etc.) and one music/program material.
  7. Audio cable assortment
    - a. Set of terminations, adapters etc.
    - b. Adjust all systems (starting at source equipment and terminating at the power amplifiers) for maximum gain and minimum distortion.
    - c. Connect the output of the audio signal generator to a floor-box/table cubby/rack ‘Left’ and ‘Right’ connectors, or the 3.50 mm stereo mini connector and select the 1.00 kHz tone. Check that the signal is emitted from the left and right program speakers in the correct orientation.
    - d. Repeat items for other audio connection locations.
- B. At the conclusion of the tests, return all equipment settings to previously calibrated positions.
1. Submit documented records of all test results in spreadsheet form.
  2. Check all control functions, from all controlling devices to all controlled devices, for proper operations.

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3. 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 record these settings in the "System Operation and Maintenance Manual".
  4. Check all optical projection images for average light level, light fall-off, and image alignment and size to comply with the Performance Standards and specifications drawings. Check to determine that all projectors, projector bases, carts, tables, and mirrors are rigid and vibration-less in operation.
  5. Maintain documentation of all performance tests for reference by the IPTV Engineer during the System Acceptance Tests.
  6. The contractor shall forward to the Architect and the IPTV Engineer a complete list of test equipment available to the IPTV Contractor for the Testing and Commissioning indicating the equipment type (i.e. 1/6<sup>th</sup> octave real time analyzer, 1/12<sup>th</sup> octave fast Fourier transform (FFT) analyzer, video test signal generator, etc.) including manufacturer's name, model number, and relevant calibration information. If such test equipment is capable of multiple comprehensive automated tests, the contractor shall detail the complete range of tests that the equipment can perform.
  7. The contractor shall forward to the Architect and to the IPTV Engineer a complete description of the Testing and Commissioning procedure, which the contractor will use. This must include a complete description of the equipment connections, locations of measuring equipment, locations of transducers (loudspeakers, microphones, optical measuring tools, and etc.), locations of signal generators and methodology for establishing the testing procedure.
- C. The following list of Test Equipment is not exhaustive, but it known that a successful A/V installation of the type specified here cannot be properly commissioned without the contractor using the following list of Test Equipment/functions:
1. True RMS Voltmeter with measurements in decibels, linear to 100 kHz, required (i.e. Fluke 8060A or equivalent).
  2. 250 MHz dual trace oscilloscope, with external video trigger capabilities, required.
  3. 1/6<sup>th</sup> Octave Real Time Acoustical Analyzer, with a minimum of six (6) curve integration averaging or 1/6<sup>th</sup> Octave filter set for Integrating Type 1 sound level meter, both with microphone calibrator, required.
  4. Pink and white noise, sine wave (variable frequency) and sweep generator, with variable output: -60.0 dB-V to +4.00 dBm, required.
  5. Loudspeaker line impedance meter, with readouts at ISO octave band frequencies, required.
  6. Loudspeaker phase meter- clicker, required.
  7. Audio signal test measurement set, for measurement of Signal to Noise ratio (S/N), Total Harmonic Distortion (THD), inter modulation distortion, frequency response (both electrical and acoustical), phase response, wow and flutter and impedance versus frequency (i.e. Audio Precision One, Neutrik A2-D units are recommended).
  8. Acoustical test set, for measurement of RT60, early to late reflections ratio, loudspeaker polar and frequency response, loudspeaker time alignment/delay, STI-PA, (i.e. MLSSA, CLIO, B&K class 1 type units).
  9. Data cable sweep generator: Perform and document certification testing all IPTV related CAT5e, CAT6a etc. TP cables used for the distribution of IPTV and control signals. (See Division 27 Communications specification sections for requirements)
- D. Test all audio for compliance with the Performance Standards.
- E. Provide the IPTV Engineer "Before" and "After" spreadsheet and graphical frequency response test results for a representative quantity of each speaker type or zone, a minimum of one (1) week prior to the final acceptance site testing.