MINNESOTA MULTI-PURPOSE STADIUM
MINNEAPOLIS, MINNESOTA

SECTION 272100

IP DATA NETWORKING INFRASTRUCTURE LAN SWITCHING & ROUTING SYSTEM

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PART 1 – GENERAL

1.1   RELATED DOCUMENTS

A.   Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Section apply to work of this section.

B.   Division 26 Basic Electrical Materials and Methods sections apply to work specified in this section.

C.   When included as part of this specification, the following divisions contain related requirements and information that shall be adhered to.

1.   Division 11 AV and Broadcast
2.   Division 23 Heating, Ventilation, and Air-Conditioning
3.   Division 26 Electrical
4.   Division 27 Communications
5.   Division 28 Security
6.   Division 28 Fire Alarm

1.2   SUMMARY

A.   Equipment Installation

1.   The Contractor shall provide all required labor necessary to physically install the equipment and components specified in this specification and associated drawings. This includes connection to power systems, grounding, and tele/data patching of low voltage systems. The Contractor shall coordinate all Union Labor requirements associated with this project with the Owner and Construction Manager. The Contractor shall include all such cost in their scope of work and contract.

B.   System: Extent of the Date Network Routing and Switching System work is indicated by drawings schedules, and specifications and is hereby defined to include, but not by way of limitation, the provisions of:

1.   All references herein to Data Network Switching and Routing System shall hereby be referred to as Data Network from this point forward.
2.   The term "provide" used throughout this specification and drawings shall mean "furnish, install, implement, test, certify and warranty".
3.   In general, the Data Network equipment required by this work will interface with communications cable infrastructure provided by Others as part of the Base Building and/or unless noted otherwise. This includes the backbone topology including Cat.3 telecom and fiber optic backbone cable/terminations from each Intermediate Communications Rooms (IC) to the Main Communications Room (MC) or Data Center. Additionally, horizontal tele/data infrastructure including all from all communication outlets to the nearest intermediate communications distribution room (IC) is provided in the Base Building. Refer to the following specification sections and associated drawings for additional requirements.
   a.   27 11 00 – Common Work for Communications

     b.   27 13 01 – Fiber Optic Backbone Cabling
     c.   27 13 02 – Telecommunications Backbone Cabling
     d.   27 15 01 – Horizontal Cabling
     e.   27 21 00 – IP Data Networking Infrastructure & LAN Switching and Routing System
     f.   27 33 53 - Technology Uninterruptible Power Supply (UPS)
     g.   27 21 00 – Data Wireless Network System

4. 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.

5. The IP data networking infrastructure shall converge the transport of all users, systems, and applications requiring IP data network and communications connectivity. Contractor shall work and coordinate with Owner and all associated users, tenants and trades that will have systems converged to the data network. This shall include determining network traffic and bandwidth requirements. Additionally, the contractor shall set up, configure, and program all Layer 2, Layer 3, routing and switching, traffic shaping, class of service (CoS), quality of (QoS), traffic prioritization, and IEEE 802.1q VLANs, etc.

6. This specification is intended to establish the minimum performance criteria for providing a high-speed, broadband, and converged, IP data networking infrastructure that can support both real-time and non-real-time IP communications and data connectivity. The contractor shall coordinate all system and performance, components and criteria with Owner to ensure project requirements and intent are maintained.

7. This specification is not intended to contain proprietary information or requirements based on any specific manufacturer system. Any proprietary information included in this specification is unintentional.

8. Design, furnish, install, setup, program, and configure a complete, production ready IP data networking infrastructure as described in this technical specification document. The Contractor's Work shall include all necessary components (hardware and software), software configuration, installation, documentation, and acceptance testing as describe in this specification document. Patch cables (copper RJ45 and fiber optic duplex SC/LC) shall be provided and specified in the Cable Plant specifications document.

9. The IP Data Networking Infrastructure and LAN Switching and Routing System shall be complete, fully functioning, physically/electronically secure, and include but not be limited to the following:
     a.   Core or Backbone Switches (Data Center)
     b.   Distribution or Intermediary Switches for Server Farm Access (Data Center)
     c.   Access or Edge Switches (IC Rooms)
     d.   Data Center/Server Farm Switches (Server Farm Switches)
     e.   Internet & DMZ Network Switches (Layered Security Infrastructure)
     f.   Firewall Appliances (Layered Security Infrastructure)
     g.   Operating System Software, Firmware, and Application Software (IOS)
     h.   IP KVM Switches (Multi-Access Switch for Console/System Admin Access)
     i.   Out-of-Band Management System (Analog Phone Lines w/Modem)
     j.   Network Management Software (e.g., Solarwinds, etc.)
     k.   Network Monitoring Equipment (e.g., Solarwinds Performance Monitor, etc.)
     l.   Information and Pricing for Alternate Equipment (as noted in spec)

10. Switch Programming/Configuration
     a.   Physical Interfaces (production-enabled, spare-disabled)
     b.   Physical Interface MAC-layer Address Filtering and/or other Physical Port and Access Security Controls
     c.   IEEE 802.1q, Virtual LAN (VLAN) Determination, Assignment, Configuration, and Implementation
     d.   Class of Service (CoS) Determination, Assignment, Configuration, and Implementation

      e.   IP Traffic Type Shaping & Quality of Service (QoS) Requirements and Implementation

      f.   IP Multicasting Determination, Assignment, Configuration, and Implementation

      g.   Layer 2 Switch Determination, Assignment, Configuration, and Implementation

      h.   Layer 3 Switch Determination, Assignment, Configuration, and Implementation

      i.   L2/L3 Link Aggregation and L2/L3 Resiliency Determination, Assignment, Configuration, and Implementation

      j.   Installation, Configuration, Documentation, Testing of Switch OS Software

      k.   Installation Configuration, Documentation, Testing of Switch Software Feature Sets & Licenses

      l.   Installation, Configuration, Documentation, Testing of Client or Node Device Software & Licenses

      m.   Installation, Configuration, Documentation, Testing of Firewall OS Software

      n.   Installation, Configuration, Documentation, Testing of IDS/IPS OS Software

      o.   Installation, Configuration, Documentation, Testing of Internet & DMZ Layered Security Infrastructure

      p.   Installation, Configuration, Documentation, Testing of an Enterprise, SNMP Network Management System (e.g., SolarWinds, Server/Workstation, etc.)

      q.   Applications Software Licenses; Power Supplies; Media Converters; etc. Interfaces and integration to existing systems and equipment shall be included and coordinated with the Owner.

11.   Provide all necessary coordination and service requirements with the Owner's preferred Telephone, Internet and WAN Telecommunications Service Providers and Carriers as required to interface equipment. (Note: It may be determined at a future date, to obtain managed services from the Telecomm/ISP/Communications Service Provider. Managed services may include management of routers, security devices, and other elements as needed.)

12.   Coordinate all support systems requirements such as architectural, HVAC, electrical, and technology systems.

13.   All phasing, temporary distribution/equipment, cutover and implementation shall be coordinated with Construction Manager and Owner.

14.   Physical installation of all equipment shall be housed within cabinets (Data Center) and/or equipment racks (IC rooms, etc.). Cabinets and racks will be provided for the Contractor.

15.   Equipment placement. Coordination with Owner for final placement of all equipment, including but not limited to cabinet enclosures, rack elevations and mounting details.

16.   All necessary electronic equipment setup, programming, and configurations. Coordinate with the Owner to establish system programming and configuration requirements as specified in this document.

17.   Connection from power supplies to electrical power receptacles located on walls, UPS, PDUs, and/or vertical power strips.

18.   The Contractor shall install all required patch cords. All patch cords to interconnect end devices to wall outlets, patch panels to data network equipment, intra-data network equipment, data network to servers, data network to service provider equipment, or handoff, etc. The Contractor is NOT responsible for providing patch cables (copper or duplex, optical fiber) as part of this project scope.

19.   Bond all equipment and components to the nearest telecommunications grounding bus (TGB) bar per Manufacturer recommendations and building code requirements. Racks in equipment rooms will be grounded to TGB. Contractor must confirm each piece of equipment is grounded as per manufacture requirements.

20.   Seismic bracing of all equipment and components provided under this work as required by code and by local governing jurisdiction.

21.   The IP Data Networking Infrastructure shall be field tested and verified, certified, and guaranteed upon installation with a 30-day burn-in period. Acceptance Testing shall

include powering, configuring, and testing all installed equipment, components, and software features as designed by the Contractor and approved by the Owner. Acceptance Testing shall include a 30-day burn-in period to properly test and certify that all IP traffic types can be supported with optimal performance.

22. Labeling of all system equipment, components, hardware, cable, and terminations with mechanically printed labels.

23. Preparation and submission of formal submittals required by project including but not limited to product data, shop drawings, testing reports, as-built drawings, manufacturer user manuals and cabling documentation as required in this specification.

24. Contractor and Manufacturer installation and equipment warranties.

25. Manufacturer equipment, components, and solutions warranties for all equipment, components, software, and infrastructure.

26. On-site system administration, network administration, and hands-on training for Owner's IT and Networking staff.

27. Manufacturer training of equipment and components (e.g., hardware) and software configuration and features (e.g., software configuration).

28. Preparation of maintenance plan and Standard Operating Procedures manual recommended by system Manufacturer and the Contractor for performing day-to-day, monthly, quarterly, and annual network maintenance and performance reviews.

29. Planning and inventorying a critical component, spare parts list required for immediate on-site parts replacement and maintenance.

C. Standards and Codes

1. The installation of the Data Network shall comply with all local building codes, authority having jurisdiction (AHJ), FCC, BICSI, IEEE, NEC, TIA, UL, and other industry standards, codes and methods.

1.3 CODES AND STANDARDS

A. All work including materials and installation shall conform to all applicable sections of currently adopted editions of the codes and standards listed below or the codes, standards and specifications published by the organizations listed below:

1. Uniform Building Code (UBC).
2. State and local codes.
3. ANSI: American National Standards Institute (ANSI).
4. ANSI/TIA-526: Standard Test Procedures for Fiber Optic Systems.
5. ANSI/TIA-568-C: Commercial Building Telecommunications Cabling Standard.
6. ANSI/TIA-569-AC-2012: Commercial Building Standard for Telecommunications Pathways and Spaces.
7. ANSI/TIA-606AB-2012: Administrative Standard for Commercial Telecommunications Infrastructure.
8. ANSI/TIA-607-B-2013: Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
9. ASTM: American Society for Testing and Materials
10. BICSI TDMM Telecommunications Distribution Methods Manual (current edition).
11. ANSI/TIA 1152-2009: Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling.
12. Federal Specification Compliance: Comply with applicable requirements of FS W-C 586, "Electrical Cast Metal Conduit Outlet Boxes, Bodies, and Entrance Caps."
13. ICEA: Insulated Cable Engineers Association.

14. IEEE: Comply with applicable requirements and recommended installation practices of IEEE Standards 80, 81, 141 and 142 pertaining to grounding and bonding of systems, circuits and equipment.
15. IEEE-802.3: 10Mb/s, 100Mb/s, 1Gb/s, and 10Gb/s Ethernet Standards as applicable based on media types (twisted pair copper, fiber optics, etc.)
16. IEEE-802.3ak: 10Gb/s Ethernet (evolving copper standard).
17. IEEE-802.3af: Power-over-Ethernet (PoE).
18. IEEE-802.3at: Power-over-Ethernet Plus (PoE+)
19. IEEE-1100-1999: Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.
20. IEEE-141: Comply with applicable requirements for installation of cable tray systems.
21. IEEE-241: Recommended Practice for Electric Power Systems in Commercial Buildings.
22. ISO/IEC 11801: International Standard on Information Technology – Generic Cabling of Customer Premises.
23. NEC: Comply with applicable local electrical code requirements of the authority having jurisdiction, and the NEC as applicable to electrical boxes and fittings, cable tray systems, and grounding and bonding, pertaining to systems, circuits and equipment.
24. NESC: National Electrical Safety Code
25. NEMA: Comply with applicable requirements of NEMA Stds/Pub No.'s OS1, OS2 and PUB 250 pertaining to raceways, outlet and device boxes, covers, and box supports.
26. NEMA: Comply with NEMA Stds/Pub No. VE 1 "Cable Tray Systems"
27. NFPA-70/NEC: National Electrical Code.
28. NFPA-70B: "Recommended Practice for Electrical Equipment Maintenance" pertaining to installation of cable tray systems.
29. UL Compliance: Provide components which are UL-listed and labeled.
30. UL Compliance: Comply with applicable requirements of UL 50, UL 514-series, and UL 886 pertaining to electrical boxes and fittings.
31. UL Compliance: Comply with applicable requirements of UL Standards No.'s 467, Electrical Grounding and Bonding Equipment", and 869 "Electrical Service Equipment", pertaining to grounding and bonding of systems, circuits and equipment. In addition, comply with UL Std 486A, "Wire Connectors and soldering Lugs for Use with Copper Conductors." Provide grounding and bonding products which are UL-listed and labeled for their intended usage.

B. Where there is a conflict between the code and the contract documents, the code shall have precedence only when it is more stringent than the contract documents. Items that are allowed by the code but are less stringent than those specified on the contract shall not be substituted.

1.4 SCOPE

A. General

1. The project scope encompasses the design, delivery, installation, configuration, testing, and documentation of a fully functioning, end-to-end, IP data networking infrastructure capable of supporting a converged communications environment. The Contractor's work is to provide a complete IP data networking infrastructure and LAN routing and switching solution capable of supporting real-time, intermediary real-time, and non-real-time IP traffic types. Throughout the remainder of this document, we shall refer to the IP data networking infrastructure and LAN routing and switching solution as the "Data Network".
2. Major system components and performance requirements have been listed in the specification but there are other components that are required and shall be included with this work. The Contractor shall provide all components necessary for a complete and fully functioning system except for copper and duplex, optical fiber patch cables.

3. All hardware, firmware, operating systems, application software, and software licenses shall be included for a fully operational system meeting and/or exceeding the performance criteria herein.

4. Requirements for add alternates are noted in this specification for Owner review and approval. This work shall be included with a detailed project plan once approved by Owner.

B. System

1. The Data Network shall be a high-speed, broadband, L2/L3 IP data networking infrastructure capable of supporting different IP traffic types throughout. Given the mission critical requirements for events, the Data Network must be robust, resilient, and always available. The support for real-time (=< 100mSec), intermediary real-time (=< 250mSec), and non-real-time IP traffic is of the utmost importance given the time sensitivity of certain protocols. The Data Network equipment scope shall encompass the overview provided in Section 1.2.B.9. The Data Network labor scope shall encompass the overview provided in Section 1.2.B.10.

2. The Data Network Technical, Functional, and Performance Requirements are presented in Part 2 – **'Technical, Functional, and Performance Requirements'** of this document.

3. Communications Infrastructure:
   a. The system shall function utilizing the communications infrastructure and topology noted below. The communications infrastructure is provided by others as part of a separate contract as part of the Base Project. The Data Network shall be coordinated with this infrastructure. The Contractor shall obtain all necessary documentation to ensure Data Network design and installation complies with this requirement. The Contractor shall coordinate Data Network requirements with Base Project Contractor providing infrastructure to ensure all requirements are met.
   b. Horizontal Distribution: Category 6A cable is routed from multi-port communication devices to the nearest Intermediate Communications Room. Cables are terminated at each end with equivalently rated RJ45 jacks. Other specification as noted in the 'Summary' section note communications infrastructure requirements. Patch cords of equal or greater capacity shall be provided by the Data Network Contractor to connect with planned cable infrastructure, End-Point Equipment, and Data Network Equipment.
   c. Backbone/Riser Distribution: Each Intermediate Communications Room has single-mode fiber optic cables originating from the Main Communications Room for interfacing uplink connections between Core Switches and Access Switches. Other specification sections note communications infrastructure requirements. Patch cords of equal or greater capacity shall be Contractor by the system Provider to connect with planned cable infrastructure.

4. Electrical Power and Uninterruptable Power Supply (UPS):
   a. Electrical Power and UPS equipment are being provided by another specification.
   b. The Contractor shall coordinate all power and UPS requirements with Contractor providing electrical systems and UPS equipment to ensure all requirements are met.
   c. UPS shall maintain a minimum of 15-minute runtime or necessary to ensure cutover to emergency generator power. Additionally, UPS shall allow for appropriate runtime to shut down the Data Network equipment during catastrophic power loss.
   d. UPS system shall have management software that allows full control and monitoring of all UPS from a single point.
   e. Contractor shall review requirements of the UPS specification for other UPS systems.

1.5   SUBMITTALS

    A.   General Description and Requirements:

        1.   In addition to the requirements noted herein, refer to Division 1 Specification for additional requirements.

        2.   Within 15 days after award of contract or as dictated by the construction schedule (whichever period of time is shorter), the Contractor shall submit pre-deployment submittals consisting of product data, compliance matrix and shop drawings for Owner and Engineer review. Partial submittals will not be accepted without prior written approval from the Architect. Coordinate all submittal dates with Construction Manager.

        3.   Review of the pre-deployment Submittals by the Architect is for purposes of tracking the work and contract administration and such review does not relieve the Contractor of responsibility for any deviation from the Contract Documents, or from providing equipment and/or services required by the Contract Documents that were not documented in the pre-deployment submittal.

        4.   No portion of the project shall commence nor shall any equipment be procured until the Owner and Architect have approved the pre-deployment submittals, in writing. All installations shall be in accordance with the Contract Documents.

        5.   A letter of transmittal identifying the name of the project, Contractor's name, date submitted for review, and a list of items transmitted shall accompany pre-deployment submittals.

        6.   Contractor shall refer to other parts of this section, for details on specific submittal requirements. A submittal shall not be considered complete until all requirements of this section are completed.

        7.   In addition to submitting as required by the Construction Manager and the Architect, the contractor shall provide all submittal documentation electronically for review.

    B.   Bid Documents: Refer to Section 1.13 Bid Information for additional requirements.

    C.   Compliance Matrix: Provide a specification compliance matrix indicating compliance or deviation for each item in the specification. Any deviations shall be fully explained including proposed change. Refer to Section 1.13 Bid Information section later in this specification for additional requirements.

    D.   Bill of Materials:

        1.   Provide a detailed Bill of Materials including all equipment (and serial numbers), cables, components, firmware/software, software licenses, and other options.

        2.   Information shall be listed in specific categories according to equipment type and include a basic description, quantities, retail price, extended price, total price, labor hours, labor costs, etc.

        3.   List all Equipment Alternates separately at end of report. This should include any adds and deduct alternates.

        4.   Contractor shall refer to Warranty and Maintenance sections of the specification below. Contractor shall list all Equipment Maintenance and Support items separately at end of Bill of Materials broken out in the same categories as the rest of the equipment.

        5.   Provide Unit Cost for each piece of equipment, accessories, and labor so that the Owner may select that equipment during the project to meet expanding or declining requirements.

        6.   Refer to Section 1.13 Bid Information section later in this specification for additional requirements.

E.   Product Data: The Data Network system Product Data Submittal shall be submitted prior to starting any work for review and approval by Owner, Architect, and Engineer. Information shall include detailed manufacturer's specifications for each component to be installed. Submittal shall include a list of every component with Manufacturer's part numbers (and serial numbers inventoried) referenced. Manufacturer data sheets with features, options, ratings, and performance shall be submitted. Product numbers and options to be used shall be highlighted with a color marker as part of the submittal.

1.   Component List: Provide complete submittal component list at the beginning of the submittal package. Component list shall identify each component name, manufacturer, and specific product/part number. All part numbers shall clearly indicate special options, color, accessories, etc. Each component on shop drawings, elevations and one-lines shall share the same naming convention. Each item listed in the component shall be listed in a corresponding detailed inventory spreadsheet as part of the As-Built Documentation (provided by the Contractor) that lists the following: Name, Description, Part #, Quantity, Production Use/Spare Part Use, IC Room Installed, Serial #

2.   Cut-Sheets: Submit manufacturer's cut-sheets on all components listed within this specification. All components and parts being used shall be highlighted in color or clearly underlined on cut-sheets to distinguish specific product/part numbers, options, colors, accessories, etc. Cut sheets shall be submitted in the same order of the Component List.

3.   Product Substitutions: This specification is intended to be performance based, thus requirements and products noted are benchmarks. The Contractor may substitute manufacturers and models that may be more cost effective or readily available. All substitutions shall meet or exceed the minimum functional, physical, and technical specifications. Acceptance of such substitutions is at the discretion of the Owner, Architect, and Engineer. Additionally, the requirements of Division 1 Specifications shall apply and may supersede requirements noted herein.

4.   Design Changes: The Contractor shall provide and install the necessary fiber optic 10GigE or 40GigE fiber-optic uplink connections from the Data Center/Main Comm Room to the outer-lying IC Rooms throughout as specified in this document. The Owner desires a lower total cost of ownership solution without any loss of performance, resiliency, and availability. Where appropriate, the Contractor is encouraged to appropriately size and recommend whether or not chassis-based or stackable LAN switches provide a lower total cost of ownership. In addition, the Contractor shall specify whether or not it is a cheaper and a more flexible solution to offer multiple, 10GigE fiber-optic uplinks versus 40GigE fiber-optic uplinks where needed.

5.   Project Plan & Schedule: A detailed project plan and schedule shall be submitted with the prefabrication submittals. The schedule shall include the expected timelines, for ordering, shipping, burn-in, configuration, installation, acceptance, and training. Schedule shall be presented in Gantt chart format. Dependencies on work being completed by Others shall be clearly defined on the schedule. The schedule shall be coordinated with the Construction Manager to include all critical path construction deadlines impacting the deployment of the Data Network. This shall take into account final testing and turn over to take place before the opening of the building.

6.   Warranty Information: Provide all warranty information as described in this specification section for review and approval.

7.   Product Certificates: Signed by manufacturers of systems certifying that products furnished comply with requirements.

8.   Installer and Network Engineer Certificates: Provide copies of the manufacturer's certification certificates signed by manufacturer certifying that the project installers and network engineers have been trained and certified to install and configure all components of the proposed system and that the end-solution will comply with manufacturer's specifications and the requirements as defined in this document.

F.   Coordination Data: A detailed equipment and component schedule with supporting manufacturer cut-sheets shall be developed for all equipment, components and options for architectural, engineering, and construction coordination. These documents shall include electrical requirements (volts, phase, amps, power consumption, receptacle configuration, etc.), UPS requirements, heat dissipation, temperature operating range, target operating temperature, physical equipment sizes (LxWxH), equipment deployment weight, equipment configurations for Owner review, etc.

G.   Shop Drawings: The Data Network Shop Drawings shall be submitted prior to ordering of any equipment and starting of any work. Shop drawings shall be submitted for review by Owner, Architect, and Engineer. Additionally, Shop Drawings shall be used for coordination with Construction Manager and Trades impacted by this installer. Information shall include all drawings necessary to present installation intent including diagrams, plans, enlarged plans, elevations, sections, details, and interface to other work or systems.

1.   Legend Sheet: Provide drawings including descriptions of all abbreviations and symbols.
2.   Network Topology Diagram: Provided drawing of all major components located in main communications room, and each intermediate communications (IC) room. Drawings shall include relevant information such as room numbers, equipment number and references, uplinks, equipment links, bandwidth, panel numbers, and uplink bandwidths.
One-Line Diagrams: Provide drawings that indicate all equipment being installed, their physical location, how equipment is interconnected for all of the following elements provided by the Contractor:
a.   Core or Backbone Switches (Data Center)
b.   Distribution or Intermediary Switches for Server Farm Access (Data Center)
c.   Access or Edge Switches (IC Rooms)
d.   Data Center/Server Farm Switches (Server Farm Switches)
e.   Internet & DMZ Network Switches (Layered Security Infrastructure)
f.   Firewall Appliances (Layered Security Infrastructure)
g.   Operating System Software, Firmware, and Application Software (IOS)
h.   IP KVM Switches (Multi-Access Switch for Console/System Admin Access)
i.   Out-of-Band Management System (Analog Phone Lines w/Modem)
j.   Network Management Software (e.g., Solarwinds, etc.)
k.   Network Monitoring Equipment (e.g., Solarwinds Performance Monitor, etc.)

Drawings shall include relevant information such as IC room numbers, cabinet and/or rack elevations, equipment number and references, panel numbers, and uplink types and bandwidth.
3.   Floor Plans: Provide scaled plan drawings based on architectural background indicating equipment and locations. Drawings shall include all relevant information such as room numbers, equipment numbers and references, patch panel numbers, etc.
4.   Enlarged Plans: Provide enlarged scaled plan drawings for equipment layouts in communications rooms. Equipment shall be clearly labeled including numbers and references.
5.   Elevations: Provide scaled drawings for elevations of all equipment layouts in communications rooms, on walls, in racks, and in cabinets. Equipment shall be clearly labeled including model numbers and labeling references.
6.   Details: Provide detail drawings as required to show any installation or component configurations that require greater detail.
7.   Labeling: Provided documentation of all equipment and component labeling, etc.
8.   Project Plan & Schedule: A detailed project plan and schedule shall be submitted with the shop drawings. The detailed project plan and schedule shall include the expected timelines, for ordering, shipping, burn-in, configuration, installation, acceptance testing, and training. The detailed project plan and schedule shall be coordinated with the

Construction Manager and indicate where Owner critical business decision making is required throughout the project plan and schedule.

H.   As-Built Drawings: The Data Network system As-Built Drawings shall be submitted after completing the work to the Owner and after completion of Acceptance Testing. As-Built Drawings shall indicate the final installation of the Data Network in working and accepted condition. Information shall include all drawings necessary to present final installation state including diagrams, plans, enlarged plans, elevations, sections, details, and any interface to other work or systems.

1.   Legend Sheet: Provide drawings including descriptions of all abbreviations and symbols.
2.   Network Topology Diagram: Provided drawing of all major components located in main communications room, data center, and each intermediate communications room. Drawings shall include relevant information such as room numbers, equipment number and references, uplinks, equipment links, bandwidth, panel numbers, and uplink bandwidths. An accompanying detailed, equipment inventory spreadsheet shall be provided as described in Section 1.5.E.1.
3.   One-Line Diagrams: Provide drawings that indicate all equipment being interconnected, backbone uplinks between access layer switches, core switches, and existing core switches, all equipment and locations. Drawings shall include relevant information such as room numbers, equipment number and references, panel numbers, and uplink type and bandwidth.
4.   Floor Plans: Provide scaled plan drawings based on architectural background indicating equipment and locations. Drawings shall include all relevant information such as room numbers, equipment numbers and references, patch panel numbers, etc.
5.   Enlarged Plans: Provide enlarged scaled plan drawings for equipment layouts in communications rooms. Equipment shall be clearly labeled including numbers and references.
6.   Elevations: Provide scaled drawings for cabinet and rack elevations of all equipment layouts in IC rooms and anything that is installed on walls or ceilings, etc. Equipment shall be clearly labeled including model numbers and labeling references.
7.   Details: Provide detail drawings as required to show any installation or component configurations that require greater detail.
8.   Labeling: Provided documentation of all equipment and component labeling, etc.
9.   Acceptance Test Results: Provide all final acceptance test results in a table or matrix. Information shall be organized by IC room location and then piece of network equipment.
10.   Network Installed Information: Contractor shall provide a full network installed information document for submittal to Owner at the conclusion of the project. Each IC room (including Data Center and any room housing equipment for the Data Network) shall be documented as a separate folder and each document represent a piece of equipment or a set of equipment (in the case of stacked or paired equipment) amended to an overall architecture document. Drawings shall be provided in Visio format and documentation shall include, but not be limited to:
      a.   Equipment Information:
            1)   Name
            2)   Description
            3)   Part Number
            4)   Serial Number
            5)   Warranty Expiration Date
            6)   Maintenance Expiration Date
            7)   Level of Maintenance Coverage (As applicable)
            8)   Software Licenses (As applicable)
      b.   Detailed Software Configuration Information:
            1)   Router/Switch OS and Boot Settings

        2)   VLAN Names and Configuration
        3)   IPv6 Addressing and VLSM/CIDR Configuration
        4)   L2 Networking Software Features (e.g., MPLS, etc.)
        5)   L2 Link Aggregation Configuration
        6)   L2 Resiliency Configurations
        7)   L3 Networking Software Features (e.g., OSPF, etc.)
        8)   L3 Link Aggregation Configuration
        9)   L3 Resiliency Configuration
        10)   IP Multicasting
        11)   Traffic Shaping: QoS, CoS, Traffic Prioritization Configuration
        12)   Etc.

    c.   Back-ups Software Configurations for all production equipment installed
    d.   Back-ups of all Software OS's for all production equipment installed
    e.   Breakdown of Identification/Labeling Scheme (nomenclature)

11.   Data Network Standard Operating Procedures Manual: Contractor shall provide an accompanying Standard Operating Procedures (SoP) Manual. This SoP Manual will include all the As-Built documentation as listed above. In addition, the manufacturer's warranty, software licensing, and on-site maintenance plan details and documentation shall be incorporated into the SoP Manual.

I.   Field Acceptance Test Reports: Indicate and interpret test results for compliance with performance requirements of the entire installed Data Network system.

J.   Component Failure Tests: After system completion but prior to system acceptance; tests shall be performed in front of live IPTV feed on video display connected to an access layer switch interfaced to the core switches. It shall also be acceptable to use a continuous Ping test that traverses the core, as long as the network isn't supporting IPTV distribution. Acceptance Tests for equipment shall include but not be limited to, pending final coordination and approval by Owner:

1.   Power Cord
2.   Power Supply – Primary & Redundant
3.   Supervisor Modules – Primary & Redundant
4.   Core or Backbone Switches (Data Center)
5.   Distribution or Intermediary Switches for Server Farm Access (Data Center)
6.   Access or Edge Switches (IC Rooms)
7.   Data Center/Server Farm Switches (Server Farm Switches)
8.   Internet & DMZ Network Switches (Layered Security Infrastructure)
9.   Firewall Appliances (Layered Security Infrastructure)
10.   Out-of-Band Management System (Analog Phone Lines w/Modem)
11.   Network Management Software (e.g., Solarwinds, etc.)
12.   Network Monitoring Equipment (e.g., Solarwinds Performance Monitor, etc.)
13.   Access Switch Uplink – Primary & Redundant Backbone Connections
14.   Access Switch Interconnectivity – Stackable Only

K.   Maintenance Information: Provide Maintenance Manuals for the Data Network equipment and components as specified in Division 1 within the Standard Operating Procedures Manual as part of the As-Built Documentation requirements. Maintenance information shall include the following:

1.   Detailed operating instructions covering operation under both normal and abnormal conditions.
2.   Routine maintenance requirements and schedule for system components.

3. Lists of spare parts and replacement components recommended being stored at the site for ready access or details of provided maintenance or warranty, including contact information for such contracts and agreements.

NOTE: The Contractor is encouraged to come up with the lowest total cost of ownership solution for the Owner. This may mean procuring an on-site spare-parts strategy to minimize the requirement for on-site, spare parts replacement maintenance costs.

L. Warranty Documentation: Provide warranty information on all equipment, components, firmware, operating systems, application software, and labor. This shall include time period, contact information, and processes.

1.6 QUALITY ASSURANCE

A. Contractor Qualifications: An experienced Contractor who is a certified and authorized representative of the Manufacturer, for design, installation, warranty, support and maintenance of units required for this Project, and has sufficient experience to supervise installation of the system.

1. Contractors shall have at least five (5) years of successful installation experience with projects similar is scope and size to this project and the Data Network.
2. Contractor shall have at least two (2) similar stadium projects similar in size and scope to this project and the Data Network.
3. The Contractor shall have a fully staffed office with technical installations support personnel that can be at the project site within one (1) hour.
4. The Contractor shall have on-staff within its office certified installers and certified network engineers of the Equipment and Components Manufacturer and shall provide a warranty on installation/applications. Refer to Warranty Periods for additional requirements.
5. The Contractor shall be a current certified installer and network engineer for the Data Network solution proposed and shall provide warranty service and support for all equipment and component according to the manufacturer's Warranty Period and any Extended Warranty Period if desired by the Owner.
6. The Contractor shall have a Professional Engineer licensed to practice in jurisdiction where Project is located and who is experienced in providing engineering services of similar scope. The Contractors design shall be reviewed, sign, stamp, and seal the Contractors design as appropriate.

B. Manufacturer and Product Qualifications

1. Provide products from manufacturers regularly engaged in the production of Data Network Switching and Routing System.
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 (5) years.

C. Products and Substitutions: Other manufacturers' products complying with requirements may be considered. All manufacturer solutions, products, and components proposed and/or substitutions shall be submitted at bid time for review and approval by Owner and Engineer. Cost changes including additions, deduction, or no changes shall be submitted for all items.

D. Alternates: All requested, manufacturer, and/or Contractor proposed alternates shall be submitted at bid time for review by Owner and Engineer. Cost changes including additions, deduction, or no changes shall be submitted for all items.

E.   Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, NEC, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. All materials shall be Underwriters Laboratories (UL) Listed unless otherwise noted or required by AHJ.

1.7   PROJECT CONDITIONS

A.   Prior to submitting a proposal, the Contractor shall inspect the Contract Documents, and shall become fully informed as to laws, ordinances, regulations and union jurisdictions affecting the project. The Contractor shall immediately bring to the Owner, Architect, and Engineer's attention, in writing, any existing condition or statute that contradicts, is in conflict with, or negates the Contract Documents. Failure of the Contractor to become fully informed as to all above mentioned items shall in no way relieve the Contractor from any obligations with respect to their proposal.

B.   The Technology and Data Network Drawings depict locations of major equipment and components, etc. in a schematic manner. Field conditions and coordination with related trades may warrant relocations of field devices and equipment. No additional compensation will be allowed due to these revisions.

C.   System components and equipment shall be rated for the environments where installed. Normal temperature range requirements for each area within the project will be identified per the following categories noted below.

   1.   Exterior Areas: -20 to +140°F (-29 to +60°C)
   2.   Interior Areas-Seasonal: +32 to +104°F (0 to +40°C)
   3.   Interior Areas-Temp Controlled: Typ. 72°F (22.2°C) but range up to +50 to +104°F (+10 to +40°C)
   4.   Riser Shafts: -20 to +140°F (-29 to +60°C)
   5.   Communication Rooms: Typ. 69°F (20.5°C) but range +32 to +104°F (+0 to +60°C)

1.8   DELIVERY, STORAGE, AND HANDLING

A.   Contractor shall be responsible for acceptable delivery, storage, and handling of all equipment, components, and options.

B.   Deliver equipment and components in factory-fabricated containers or wrappings, which properly protect equipment from damage.

C.   Handle equipment and components carefully to prevent damage including but not limited to breakage, denting or scoring of surfaces, etc. Do not install damaged units or components; replace with new.

D.   Store equipment and components in original packaging in a dry clean space. Store inside in a well-ventilated space protected from construction traffic, weather, moisture, soiling, humidity, and extreme temperatures. Equipment storage shall comply with Manufacturer specifications for each piece of equipment, component, and option.

E.   All equipment installation shall be coordinated and approved by the Owner and Construction Manager. Electronic communications equipment such as data network switches is highly sensitive to dirty environments. Examples, such as drywall compound sanding; is always a problem and will shorten the life of the equipment and void the warranty due to dust. HVAC systems shall also be fully functioning without interruption to ensure the specified temperature range. Equipment shall be installed only when stable power distribution is available with UPS

equipment installed. Additionally, equipment shall only be installed in rooms that are physically secure to prevent theft and tampering.

F.   Contractor shall provide an offsite facility for initial configuration of equipment. Equipment will then be repackaged and shipped to installation on owner premises. This is to limit exposure of equipment to conditions on a construction site and to ease the delivery of parts to the site. This also allows the Data Network contractor to test all parts.

1.9   SEQUENCING AND HANDLING

A.   All work shall be reviewed and coordinated with the Owner and Construction Manager prior to commencing.

B.   Data Network Equipment and infrastructure 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 system components are sequenced and scheduled accordingly to prevent any damage, loss of performance, and warranty void of such systems. All mis-handling of items including delivery, storage, handling, and installation of equipment and components shall be replaced with new and re-installed at the Contractors' expense.

C.   The contractor shall not deliver, store, handle, and/or install any equipment or component in a manner that will degrade system performance, reduce life span, and/or void Manufacturer's Warranty. All such items shall be brought to the attention of the Owner and Construction Manager.

D.   Coordinate installation with Tele/Data, Structural, Electrical, HVAC, Plumbing, Fire Protection, and other trades to eliminate disruption and/or conflict with other systems.

E.   Sequence installation of Data Network and infrastructure with other work to minimize or eliminate the possibility of damage and soiling during remainder of construction.

F.   Each vendor that is awarded the cabling infrastructure, LAN network, WLAN network, and VoIP communication system must communicate and work with the other vendors during installation, implementation, testing, and final acceptance readiness.

The sequencing of stadium's technology infrastructure implementation will be coordinated with the General Contractor and will include but is not limited to:

1.   Cabling Infrastructure
2.   LAN IP Data Network Infrastructure
3.   WLAN Infrastructure
4.   DAS and Wi-Fi Systems
5.   Building Automation Systems
6.   Security Systems and Control Rooms
7.   VoIP Communications System
8.   Broadcast and AV Infrastructure, Systems and Control Rooms
9.   IP TV System and Monitors

Testing and final acceptance readiness must be coordinated between the Cabling infrastructure vendor and the LAN IP data network provider. Testing and final acceptance readiness for the LAN and WLAN infrastructure and VoIP communication system must be coordinated between the VoIP communication system vendor and both the LAN Data Network provider and WLAN infrastructure provider. Each vendor will work with the other vendors to ensure that a complete,

end-to-end, IP communications infrastructure is enabled in accordance with the requirements and specifications as stated in this document.

1.10   COORDINATION

A.   Coordinate Work of this Specification with the requirements of Owner, Construction Manager, and General Contractor.

B.   Coordinate layout and installation of Data Network equipment with other construction trades that penetrates ceilings, communication equipment/distribution rooms or is supported by them, including but not limited to light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

C.   Coordinate location of equipment in the communications rooms and spaces with the Owner and Architect.

D.   Coordinate and provide a detailed system signoff checklist. This shall be used to track the completion of network and provide documentation for completion of Owners final acceptance letter of the system.

1.11   SPARE COMPONENTS AND EQUIPMENT

A.   Due the strict timelines of this project Contractor shall have available appropriate spare components and equipment, such as power supplies, line cards, GBICs, 10GB Zenpaks, 10GB SFPs, 1GB SFPs, supervisory modules, etc., before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver spare components and equipment to Owner. Optionally the contractor may coordinate parts depot access with the manufacturer. This parts depot must be able to deliver replacement parts within the same business day. Delays as a result of parts failure shall be the responsibility of the contractor.

1.12   WARRANTY

A.   The warranty requirements shall comply with Division 1 and as noted in this Section. Any conflicts shall meet the most stringent required unless approved otherwise by Owner.

B.   Warranty Periods: Provided below are the minimum warranty period requirements for this work.

1.   Contractor Installation and Labor: 1-year.
2.   Manufacturer's Electronic Equipment and Components: 1-year.
3.   Manufacturer's Communications Infrastructure: 25-year.

C.   The Warranty Period shall not start until Owner's written acceptance of system. Acceptance shall not be considered until system is fully operational, fully tested, problems corrected and the Owner has verified the work is in compliance with system requirements and performance requirements.

D.   The Contractor shall provide Installation and Warranty against defects in material and workmanship from time of system Owner acceptance of the installed system. Warranty shall include all parts and labor required to honor the warranty. The warranty shall be a minimum of one-year from date of Owners system acceptance letter.

E.   The Manufacturer shall provide Electronic Equipment and Components Warranty for all hardware, firmware, operating system, and application software proposed or equivalent maintenance coverage.

F.   The Contractor shall provide a warranty on the Work for the terms noted in the Warranty Periods section. If, within the warranty period after the date of final acceptance of the installation or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required by the Contract Documents or provided by a Manufacturer, any of the work or equipment is found to be defective or not in accordance with the Contract Documents, the Contractor shall correct it promptly including all parts and labor after receipt of notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. This obligation shall survive termination of the contract. The Owner shall give such notice promptly after discovery of the condition. Such a notice shall be provided by the Owners representatives to be identified, either verbally or in writing.

G.   The Manufacturer shall provide an Infrastructure Warranty as noted in Warranty Periods section for all communications cable infrastructure components provided as part of this work. This warranty shall cover all components including: cable, terminations, patch panels, and wiring panels, etc. The Manufacturer shall provide any such component, link, or channel and shall be replaced by the Manufacturer at no cost to the Owner during this period. The Contractor and Manufacturer shall submit all information and documentation on Warranty.

H.   Nothing contained in the Contract Documents shall be construed to establish a shorter period of limitation with respect to any other obligation that the Contractor might have under the Contract Documents or any manufacturer's warranty. The establishment of the time period of warranty after the date of final acceptance or such longer period of time as may be prescribed by law or by the terms of any warranty required by the Contract Documents relates only to the specific obligation of the Contractor to correct the work or equipment, and has no relationship to the time within which his obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to his obligations other than specifically to correct the work or equipment.

I.   If system operation is not fully restored during the warranty period within one (1) business days, the Owner reserves the right to require the Contractor to provide on-site Manufacturer's service technicians at no additional cost to the project or Owner.

J.   The Owner reserves the right to expand or add to the system during the warranty period using firm(s) other than the Contractor for such expansion without affecting the Contractor's responsibilities, provided that the expansion is done by a firm which is an authorized dealer or agent for the equipment of system being expanded.

K.   Special warranty specified in this Specification shall not deprive Owner of other rights that the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

   1.   Special Warranty for Equipment and Components: Written warranty, signed by Manufacturer and Contractor agreeing to correct system deficiencies and replace components that fail in materials or workmanship within specified warranty period when installed and used according to manufacturer's written instructions. This warranty shall be in addition to, and not limiting, other rights Owner may have under other provisions of the Contract Documents.

    2.   Contractor shall guarantee operation and functionality and fix any problems at no cost to the Owner. The Owner will not accepts the system at turn-over until the system has been field tested, verified, certified, and guaranteed that requirements have been fulfilled.

1.13   BID INFORMATION

A.   Instructions to Bidders

    1.   The following is a partial list of instructions. Bidders shall provide a complete proposal including all information requested in the Contract Documents, including Specifications and Drawings.

    2.   Any questions or misunderstanding should be submitted in writing with the bid.

    3.   Copies of the bid proposal shall be submitted to the Owner, Architect, and Engineer for review and approval.

    4.   Bidders shall prepare equipment lists showing each item included in the bid. Equipment Lists must include the quantity, model number, manufacturer and price of each item listed under the generic description.

    5.   Bidders shall provide a detailed description of any and all voluntary alternates and include cost changes in the Voluntary Alternate Bid forms. Bidders should submit voluntary alternates that will either provide for a better system or reduce costs without degrading the system. This includes alternate manufacturers and product substitutions.

    6.   If Drawings and Specifications do not directly coincide, or coincide individually, the item of better quality, greater quantity and/or higher cost shall be included in the base bid.

    7.   Network Topology Diagram: Provided drawing of all major components located in main communications room, data center, and typical intermediate communications room. Drawings shall include relevant information such as room numbers, equipment number and references, uplinks, equipment links, bandwidth, panel numbers, and uplink bandwidths.

B.   Unit Pricing and Labor Rates

    1.   Unit prices and labor rates submitted with the bid proposal shall be used for all additions, deductions, and alterations of the original contract and shall further be used for future purchases by the Owner from the Contractor for one (1) year from the date of final acceptance of the system.

C.   Compliance

    1.   Bidders shall submit a Statement of Qualifications with their bid proposal that shall include the following information:

        a.   Company name, address, telephone number and contact person.

        b.   Brief company history.
            1)   Years in business.
            2)   Number of employees.
            3)   Location of Headquarters and branch offices, including international locations.

        c.   Resumes of key personnel.

        d.   Local staffing description (job descriptions and numbers of persons in each position).

        e.   Local service capabilities (hours of operation and parts availability).

        f.   Technician factory or manufacturer certifications.

        g.   Description of local engineering and project management capabilities.

        h.   Line sheet listing major suppliers of network equipment.

        i.   Annual dollar value of sales, installation and service of each product line carried.

        j.   List of all projects and references for all projects completed in the last five years, including a brief project description, location, construction cost, and completion date.

        k.   List of references describing five (5) completed projects of similar size and complexity, including names and telephone numbers of the contact persons.

        l.   List of references describing similar projects completed in the area and in the last year including names and telephone number of the customer's contact person.

        m.   List of similar projects currently under construction in the area including names and telephone numbers of the customer's contact person.

        n.   Licensing information.

2.   Bidders shall provide a specification compliance matrix indicating compliance or deviation for each item in the specification. The matrix shall be comprised of a list of all numbered paragraphs that appear in this Specification. Compliance of the proposed equipment and/or services shall be indicated by the word "Comply" following each paragraph number. Exceptions to the requirement shall be indicated by the word "Exception" following the applicable paragraph number. Should the proposed equipment and/or services not entirely comply with the requirements specified, but ultimately achieve the intent, the Bidder shall explain fully the extent, or lack thereof, of compliance for the applicable equipment and/or services proposed. Instances where there is no indication of compliance or exception shall be considered non-compliant. This matrix is critical for proposal evaluation. Failure to submit the matrix may result in the disqualification of the bid. Contractor shall submit Compliance Matrix with the Bid Proposal AND at the time of Product Data submittal (as indicated previously in this specification) so that a complete submittal review can be performed.

3.   Additionally, and as described in this Specification, bidders shall submit the following information with their bid proposal:

        a.   Manufacturer's literature sheets for all standard manufactured items included in the equipment list and as proposed in the Voluntary Alternate Bid form, if applicable.

        b.   Workload and capability statements. The statements shall detail projects that will be active during the completion of this project, and the manpower that would be available for this project.

        c.   Confidentiality and return statements. The statements shall guarantee that the Contract Documents shall not be copied or distributed physically or verbally. The Contractor shall also assure the Owner that the Contract Documents shall be returned in their entirety upon request. The successful Contractor will be provided with as many copies as requested.

4.   Certain paragraphs of the Specification require the Bidder to provide information (possibly not listed above) in the proposal to demonstrate compliance with a requirement. If the Bidder fails to provide detailed responses to these items, the proposal will be deemed to be non-compliant to the paragraphs stated.

5.   Bidders shall number all pages of the bid submittal.

D.   Specification Response

1.   The Bid Response Documents shall provide an overview and narrative description of the system architecture including but not limited to topology, application point of interfaces, backbone infrastructure, horizontal infrastructure, cables, terminals, amplifiers, repeaters, media converters, taps, splitters, and antennas.

2.   The Bid Documents shall include a full design including Product Data Submittals and Shop Drawings Submittal per the requirements noted below. The Bid Response Documents shall include a complete and comprehensive discussion of the products, processes, techniques, and methods that will be used to accomplish the tasks and functional requirements.

3. The Bid Response Documents shall include unit pricing for all components, cable, software, hardware, licenses, and labor.
4. The Bid Response Documents shall include all Service Agreements, Warranties, and Guarantees.
5. The Bid Response Documents shall include an implementation schedule and project timelines starting from Contract Procurement to System Turn-Over.
6. The Bid Response Documents shall include expected annual maintenance costs, consisting of:
   a. Annual maintenance cost beyond expiration of warranty.
   b. Annual maintenance for any items required outside of warranty.
   c. Annual maintenance for each year up to 5-years following the warranty period.
7. The Bid Response Documents shall include Customer Obligations.
8. The Bid Response Documents shall include a complete bill of materials indicating quantities, length, etc. of all components, cable, software, hardware, licenses, and labor required to complete the project.
9. The Bid Response Documents shall include any alternate or optional items that should be considered by Owner that has not been included in Base Bid. The Owner wants to ensure that they are aware of any items that should be evaluated that may enhance or allow support of future technologies.

PART 2 – SYSTEM REQUIREMENT

2.1   MANUFACTURERS

A.   Manufacturers: Subject to compliance with requirements, provide products and solution by one of the following Data Network Equipment Manufacturers in alphabetical order:

1. Avaya (Nortel)
2. Brocade Communications Systems
3. Cisco Systems
4. Enterasys Networks
5. HP Networking
6. Juniper Networks
7. Other as Specified by Owner

2.2   TECHNICAL SPECIFICATIONS

A.   Architecture

1. General:
   a. The Data Network shall be a converged platform that provides a single but redundant backbone network for all building systems, applications, tenants, and user. This includes but not limited to the following:
      1) Administrative Data (Computers, Printers, and Scanners)
      2) Advertising Panels
      3) Building Management Systems
      4) Building Systems Controllers (HVAC and Lighting)
      5) Digital Signage
      6) IPTV
      7) IP Surveillance Cameras
      8) IP Security Controllers
      9) Multipurpose and Event Communications
      10) Point of Sale (POS)

11) Security Management Systems
12) Sound System
13) VoIP Communications System
14) Wireless POS
15) Wireless LAN
16) Wireless Public Internet
17) Home Team
18) Visiting Team
19) Sports Authority
20) League
21) Food Service
22) Ticketing
23) Press/Media Internet
24) AV Systems
25) Other data communications to be determined and coordinated by Contractor with Owner.

b. The general architecture shall use an industry standard, star-wired, point-to-point, collapsed backbone data network architecture with Core/Backbone Network Switches located at the Main Communications Room and Data Center, Distribution/Intermediate Network Switches located at the Data Center for Server Farm connectivity, and Access/Edge Network Switches located at the approximate 52 outer-lying IC Rooms throughout the stadium facility.

c. The Data Network shall be a multi-layer, scalable, redundant, highly available data network that will support Ethernet based technologies such as Ethernet (10 Mbps), Fast Ethernet (10/100 Mbps), Gigabit Ethernet (10/100/1000 Mbps), and 10-Gigabit Ethernet (10,000 Mbps), and other evolving high-speed interfaces such as 40 and 100 gigabit Ethernet for a variety of networks and network applications.

d. The Data Network shall be modular and support an integrated services architecture.

e. The Data Network shall be fully scalable to add future equipment, components, uplinks, users and interfaces with remote sites to provide seamless operation and continuity without major upgrade of changing current protocols, software, and hardware.

f. The Data Network shall be new and shall also be of the current standard production of the manufacturer at the time of the proposal and shall be expandable in design, and implementation.

g. The Contractor is required to supply the latest 'stable' or manufacture recommended version of software, providing all the features enumerated in this specification, at the time of contract award, or as required by the manufacturer.

h. The Data Network shall be an off-the-shelf type and meet all FCC and UL requirements. The Contractor shall also list the FCC and UL registration/listing numbers and guarantee the equipment is certified/registered.

i. The Contractor and Manufacturer shall propose system components including hardware and devices that meet or exceed the intent of this specification and associate performance.

2. Switches:
a. Core/Backbone Switches:
1) The Data Network shall consist of Core/Backbone Layer Switches with redundant power supplies, supervisor engines, and inter-connectivity between them.
2) The Data Network shall have a fully redundant Core/Backbone Switches with identical equipment specifications and mirrored configuration of the Primary Core Switch.

3) The Core/Backbone Switches shall be modular and support a chassis configuration at the Core/Backbone Layer to support modularity, availability, and scalability.

4) The chassis must have complete redundancy and support N+1 functionality for routing and switching, this includes all systems including, but not limited to: Power Supplies, Processors, Uplinks, etc. The manufacture should go into detail of the core/backbone architecture design with backplane architecture for routing and switching.

5) The Core/Backbone Switches (Primary and Redundant) shall be located in the Main Communications Room and Data Center, or as shown on accompanying drawings.

b. Distribution/Server Farm Switches:

1) These switches shall be chassis-based that can support 24-port or 48-port blades/modules at GigE, 10GigE, full-duplex, port connection speeds.

2) Each server will have dual, NIC cards supported by 2 physically separate network connections to 2 different server-farm switches for full, 100% redundancy.

3) Flexibility for either copper or SC-fiber optic GigE and 10GigE ports is required.

4) The Owner will provide specific quantities desired for the purposes of this Bid Package. For specific details, refer to page 26, the Switch and Node Count Section of this document: Main Comm Room & Data Center (Level - 01)

5) The Distribution/Server Farm Switches shall be installed at the Data Center near or within the enclosed equipment cabinets.

6) The Distribution/Server Farm Switches shall be Layer-2 and Layer-3 Switches with full redundancy: power, supervisory modules, inter-switch connections, etc.

c. Access Switches:

1) These switches shall be chassis-type and/or stackable-type with 48-port or 24-port 10/100/1000 Mbps Ethernet supporting full power over Ethernet (PoE+) on each port. Multiple stack-type switches shall be interconnected with appropriate stacking cables. Stack must provide a system for redundant fault-tolerant stacking.

2) The Access Layer Switches shall be installed at Intermediate Communications Rooms to provide connectivity to multipurpose and event tele/data communications devices.

3) Switching shall be provided using a Layer-3 networking scheme.

4) The Access Layer Switches shall be installed at Intermediate Communications Rooms to provide connectivity to tele/data/video communications devices.

d. Network Uplinks:

1) Uplinks between the Core/Backbone Switches and Access/Edge Switches shall be comprised of single, dual, or multiple 10-Gbps Ethernet (link aggregated as active/active) using Single-Mode Fiber Optic Cable.

2) General rules of thumb for # of uplinks are as follows:

- Single 24-port or 48-port L2/L3 switch (PoE or Non-PoE) with less than 12 connections – only has 1 x 10GigE Uplink (Active – No Redundancy)

- 1 to 3, 24/48-port L2/L3 switches (PoE or Non-PoE) – will have 2 x 10GigE Uplinks (Active/Active for redundancy and aggregated BW)

- 4+, 24/48-port L2/L3 switches (PoE or Non-PoE) – will have up to 3 x 10GigE Uplinks (Active/Active/Active) or will upgrade to 1 x 40GigE Uplinks (Active – No Redundancy). Vendor to assess price points of

multiple x 10GigE Uplinks compared to a 2 x 40GigE Uplinks, etc. Lower total cost of ownership is desired by the Owner. Vendor is to compare the cost of multiple 10GigE Uplinks versus 1 x 40GigE, versus redundant 40GigE Uplinks as needed in conjunction with an on-site, spare-parts strategy.

3. Traffic Type Requirements:
   a. The overall objective of the Data Network is to accommodate the various different types of IP-based systems and applications that currently support operations and internal departments. The Data Network must support both real-time and non-real-time systems and applications. For game and event support, the Data Network must be available and optimally performing.
   b. Because of this mix, the need to support both real-time and non-real-time applications and protocols is paramount. Given the different systems, applications, traffic types, and use of IP-based protocols, it is envisioned that the Data Network will support existing network traffic types as well as future or anticipated network traffic types. These traffic types are derived from the list of systems and applications provided.
   c. The Data Network and their traffic types will be categorized into one of three different network traffic type categories. These traffic type categories consist of the following:

   - Real-time, interactive data communications – High

   This traffic type represents the highest prioritization for IP-based communications given that real-time applications must be supported by real-time protocols (i.e., time sensitive protocols) to support that application. Examples of real-time (High) include, but are not limited to, VoIP, SIP, Unified Communications, CCTV IP surveillance communications, IPTV, etc.

   - Non-real-time, interactive data communications – Medium

   Medium prioritization for IP-based communications given that real-time access to data must be supported by high-speed connectivity (i.e., operations, control systems, etc.) to support applications.

   - Store-and-forward, interactive data communications – Low

   Lowest prioritization for IP-based communications given that non-real-time access to data is categorized as low priority. Examples of non-real-time (Low) include, but are not limited to Owner departmental traffic, e-mail, Internet access, all other systems and applications, and access to non-life threatening data, etc.
   d. The traffic type requirements that are defined in this section must be supported by the proposed solution using whatever technology and techniques the Contractor desires. It is important for the Contractor to carefully design and implement the new network infrastructure (network) such that support for high-prioritized network traffic (real-time traffic), medium prioritized network traffic (real-time access to data), and low prioritized network traffic (non-real-time traffic) can be supported. Use of Quality of Service (QoS) for time-sensitive protocols may be required to support end-to-end communications depending upon the solution designed.
      1) The Data Network must support end-to-end, IP-based real-time applications and real-time IP-based protocols and communications
      2) The Data Network must support VoIP real-time communications throughout the entire network infrastructure

3) The Data Network must support SIP/Unified Communications real-time communications throughout the entire network infrastructure

4) The Data Network must support real-time CCTV IP video surveillance (i.e., H.264 protocol) communications with end point IP-based cameras throughout the entire physical network infrastructure

5) The Core/Backbone network must be resilient with alternate paths, incorporate physical redundancy (i.e., routing engine processors, switching engine processes, and power supplies, etc.), and have no single point of failure in the backbone switches core architecture to support all types of IP traffic

6) The Core/Backbone network must be capable of supporting scalable growth and support fiber-optic trunk connections from 10GigE, 40GigE, 40GigE+, and 100GigE connections

7) The Core/Backbone network should be capable of supporting "link aggregated" or "trunked" 40Gig Ethernet trunks to provide 80Gig of throughput and backbone trunking if required

8) The Core/Backbone network should be capable of supporting 100Gig backbone trunks availability of 100Gig Ethernet trunking is completed

9) The Core/Building backbone network must support scalable link aggregation from LAN IC rooms to the Core/Backbone network. Link aggregation and trunking building backbone connections will be required where high concentrations of IP nodes are deployed

10) The Core/Building backbone network must be capable of supporting scalable growth and expansion from 10GigE, 40GigE, 40GigE+

11) The Core/Backbone network should be capable of supporting "link aggregated" or "trunked" 10Gig Ethernet trunks (fiber-optic) to provide 20/30/40GigE of throughput and backbone trunking

12) The LAN must support edge devices (i.e., workstations, laptops, IP phones, CCTV IP cameras, etc.) emanating from IC Rooms that aggregate workstation/desktop device connectivity within that zone

13) The LAN must support various end-point devices connected via GigE PoE+ and GigE non-PoE switches supporting real-time and non-real-time IP traffic including VoIP, CCTV IP, and co-mingled data communications on the same physical connection

14) The LAN must support edge connection speeds from 100Mbps/GigE in support of IP end-point connections (i.e., workstations, CCTV IP cameras, IP Phones, servers, etc.)

4. Physical LAN Connectivity Requirements:
   a. The Data Network will be based on the following building blocks:
   1) Core/Backbone Node – the local area network to core/backbone network connection point and network aggregation point where multiple LAN nodes/switches (i.e., IC Rooms with switches) are serviced by a single, geographically located switch within the facility.

   2) Distribution/Server Farm Node (LAN) – the server farm aggregation and network switching point that inter-connects the production system/application servers to the Data Network.

   3) The Contractor must design the network's physical layout in order to provide connectivity and functionality as described in this document. The actual number of switches for Core/Backbone, Distribution/Server Farm, and Access/Edge are specified in this section.

   4) The Contractor must include the following:
      • Physical Network Topology/Hierarchy

- Core/Backbone Network – aggregation of Distribution/Server Farm switches and Access/Edge network switches
- Distribution/Server Farm Network – aggregation of production servers into the Core/Backbone Network
- Access/Edge Network (LAN) – end-point desktop/workstation connectivity from the individual IC Rooms
- When designing Ethernet-based networks, the following network design features and functions must be addressed:
  o Comply with IEEE 802.3 CSMA/CD family of standards and specifications pertaining to all Ethernet-based network technologies
  o Comply with IEEE 802.X ("X" is a wildcard, not a specific standard) family of standards
  o Comply with IETF, Request For Comment (RFC) standards
  o Fixed-port vs. Chassis-based LAN switches – Owner needs both high port density fixed-port switches and chassis-based switches throughout the network hierarchy (i.e., campus, building, LAN, etc.)
  o Port Density – Owner needs high port densities to ensure the lowest cost of LAN connectivity to the Data Network
  o Power over Ethernet/Power over Ethernet + (PoE/PoE+) – support for IP phones and IP CCTV cameras requires PoE/PoE+
  o Layer 2 vs. Layer 3 LAN Switch – depends upon network traffic requirements and whether real-time applications and time-sensitive protocols is required at the LAN end-point
  o Layer 2 resiliency & redundancy – requirements should be driven by real-time applications and whether sub-second failover is required or not, or active/active trunking and connectivity as Layer 2, avoiding convergence issues all together
  o Layer 3 resiliency & redundancy – requirements should be driven by real-time applications and whether sub-second failover is required or not
  o Layer 2 & Layer 3 trunking – backbone trunking, load-balancing, and use of GigE/10GigE/40GigE and link aggregated building backbone node to LAN node trunks will be required especially if access to server farms and real-time applications is required
  o Switch Architecture – the actual hardware architecture used by the Contractor's backplane infrastructure
  o Switch Virtualization – the logical appearance of a single "switch" through virtualization simplifying operations, network management, and providing enhanced connectivity, aggregated throughput/speed, and active/active link aggregation and trunking
  o Use of Application Specific Integrated Circuit (ASIC) technology on the switches physical interfaces
  o High-speed, backplane architectures – maximum aggregate throughput/speed
  o Cut-through versus store-and-forward switching techniques
  o Switch physical and logical security and imbedded IP stateful firewalls, IDS, and IPS modules for chassis-based switches
  o Use of MAC layer address filtering, MAC address port lock-down, and layer 2 traffic enhancements
  o SNMP v2 or v3 for secure, network management connectivity on a dedicated network management VLAN
  o SSHv2 or SSHv3 remote access support

o   Initial quantity and growth of IP host devices per IC Room as per the Node Count Quantities provided in this section

- Flexible and scalable network bandwidth and network connectivity for Access/Edge LAN switches (i.e., stacking, aggregation, etc.) within IC Rooms installed throughout the facility
- Analysis of aggregating network traffic at specific IC rooms based on total number of switches and aggregated uplink bandwidth required

b.   The physical locations for the Data Network equipment will be based on the following room assignments. For the Access/Edge switches, the Contractor should assess and specify if they are proposing a chassis-based Access Switch solution or stackable Access Switch solution to support multiple switches in the same IC Room. The Owner desires the lowest cost of ownership (CAPEX & OPEX). The Vendor is encouraged to specify their lowest cost solution to support the connectivity required along with aggregation of the Fiber Uplink connections. This may include aggregating the Fiber Uplink Modules together (i.e., 2 or 3+ x 10GigE = 1 x 40GigE, etc.).

NOTE: FINAL PORT COUNTS AND DEVICE TYPES WILL BE DETERMINED WITH CHOSEN CONTRACTOR. THE BELOW "MAIN COMM ROOM & DATA CENTER" COUNTS ARE FOR PRICING PURPOSES ONLY AND ARE SUBJECT TO MODIFICATION AS SERVER COUNTS ARE FINALIZED

Main Comm Room & Data Center Server Farm Switch Counts (Level - 01)

The following presents the server farm network connection port counts. Each physical RU or blade server will have 2 NIC cards for redundant network connections to 2 different server farm switches. GigE port connections will be supported by RJ-45 patch cables. 10GigE port connections will be supported by dual, SC-fiber connectors (Tx and Rx). Each server farm switch will have redundant trunk connections (refer to the spreadsheet below for core backbone switches) to both Core Backbone Switches for 100% resiliency.

Connection	Server Type	Server Quanities	Server Connection (1G, 10G)	Copper or Fiber (RJ45 or SC)	100% Redundancy	Total GigE (RJ45)	Total 10GigE (SC)
Tennant/Services							
Building Management Systems (BMS)	**Unknown**	**Unknown**	**Unknown**	**Unknown**	**Unknown**	**Unknown**	**Unknown**
Digital Signage + Ad Panels	**Blade**	**Multiple (3)**	**10GigE**	**SC**	**Yes**		**6**
Digital Menu Boards	**Blade**	**Multiple (3)**	**10GigE**	**SC**	**Yes**		**6**
Facility Administration + Operations	**RU**	**2**	**GigE**	**RJ45**	**Yes**	**4**	
Food Service Administration + Operations	**RU**	**2**	**GigE**	**RJ45**	**Yes**	**4**	
Food Service POS System	**Blade**	**2**	**GigE**	**RJ45**	**Yes**	**4**	
IP Telephone System (IPT)	**Blade**	**Multiple (3)**	**10GigE**	**SC**	**Yes**		**6**
IP Television (IPTV)	**Blade**	**Multiple (3)**	**10+GigE**	**SC**	**Yes**		**6**
Minnesota Sports Facility Authority (MFSA)							
Administration + Operations	**Blade**	**Multiple (3)**	**GigE**	**RJ45**	**Yes**	**6**	
Multi-Purpose + Event Connectivity	**RU**	**2**	**GigE**	**RJ45**	**Yes**	**4**	
National Football League (NFL)	**Blade**	**2+**	**10+GigE**	**SC**	**Yes**		**4**
Press + Media	**Blade**	**2**	**10+GigE**	**SC**	**Yes**		**4**
Retail + Merchandising + Team Store							
Administration + Operations	**Blade**	**2+**	**GigE**	**RJ45**	**Yes**	**4**	
Retail + Merchandising + Team Store POS System	**Blade**	**2**	**10GigE**	**SC**	**Yes**		**4**
Security IP Cameras	**Blade**	**2**	**10GigE**	**SC**	**Yes**		**4**
Security System Controllers	**Blade**	**2**	**10GigE**	**SC**	**Yes**		**4**
Security System Operations + Administration	**Remote /MPLS WAN**	**Remote /MPLS WAN**	**Remote /MPLS WAN**	**Remote /MPLS WAN**	**Remote /MPLS WAN**	**Remote /MPLS WAN**	**Remote /MPLS WAN**
Tennants (others TBD) Administration + Operations	**RU & Blade**	**2+**	**GigE**	**RJ45**	**Yes**	**4**	
Ticketing Operations + Administration	**Blade**	**2**	**10GigE**	**SC**	**Yes**		**4**
Ticket Verification System	**Remote /MPLS WAN**	**Remote /MPLS WAN**	**Remote /MPLS WAN**	**Remote /MPLS WAN**	**Remote /MPLS WAN**	**Remote /MPLS WAN**	**Remote /MPLS WAN**
Video Coaching System	**Blade**	**2**	**10+GigE**	**SC**	**Yes**		**4**
Vikings Business Operations + Administration	**Blade**	**2**	**10+GigE**	**SC**	**Yes**		**4**
Vikings Athletic Operations + Facilities	**Blade**	**2**	**10+GigE**	**SC**	**Yes**		**4**
Visiting NFL Team	**Remote /MPLS WAN**	**Remote /MPLS WAN**	**Remote /MPLS WAN**	**Remote /MPLS WAN**	**Remote /MPLS WAN**	**Remote /MPLS WAN**	**Remote /MPLS WAN**
					Totals:	**30**	**60**

Server Farm Port Counts

GigE Switch Requirements: 2 x 48-Port (18-Ports for Growth), GigE, RJ45 Server Farm Switch (Chassis-Based or Stand-Alone), Redundant Power Supplies, with 2 x 40GigE fiber trunk connection to both Core Backbone Switches.

10GigE Switch Requirements: 2 x 48-Port (36-Ports for Growth), 10GigE, SC-Fiber Connector Server Farm Switch (Chassis-Based or Stand-Alone), Redundant Power Supplies, with 2 x 40GigE Fiber Trunk Connection to Both Core Backbone Switches

For DD Design Purposes Only	Description	Chassis Based or Stand Alone Switch	Redundant Power Supply	Total # of Slots / Available Slots for Blades	Total # of Uplink Trunks to Be Supported	Add 20% Growth for Uplink Trunks	Final # of Uplink Trunks to Be Supported	Core to Core Switch Connections	Total # of 10GigE Fiber Uplink Modules	Total # of 40GigE Fiber Uplink Modules
Core/Backbone Switch 1	Primary Core Data Center Switch w/Power Supply - Main Comm Room	Chassis-Based	Yes				2	2		2
Core/Backbone Switch 2	Redundant Core Data Center Switch w/Power Supply - Data Center	Chassis-Based	Yes				2	2		2
Server Farm Switch: GigE/RJ45 Copper	2 x Server Farm Switches, GigE, RJ45 Copper, 40GigE Trunk Connections to Core Backbone Switches		Yes			N/A	2	2		2
Server Farm Switch: 10GigE/SC Fiber	2 x Server Farm Switches, 10GigE, SC Fiber, 40GigE Trunk Connections to Core Backbone Switches		Yes			N/A	2	2		2

NOTE (1): The Vendor may propose either a Chassis-Based blade/module solution or stand-alone server farm switches. Each server farm switch will have 2 trunk connections to both Core Backbone Switches.

Core/Backbone Switches & Distribution/Server Farm Switches

The Contractor shall be required to appropriately size the Core/Backbone switches based on the total number of 10GigE and 40GigE Uplinks to each of the outer-lying IC rooms where Access/Edge LAN switches are housed. In addition, the Data Network shall support dual, 40GigE Core/Backbone switch to each Distribution/Server Farm switch for 100% redundancy. GigE server connection will connect to an RJ45 copper switch and 10GigE server connections will connect to SC fiber switch for 100% redundancy.

Additional LAN equipment will be required to support broadcast connectivity and will be determined in the procurement process with selected Contractor.

NOTE: FINAL PORT COUNTS, DEVICE TYPES AND IC ROOM NUMBERS WILL BE DETERMINED WITH CHOSEN CONTRACTOR. THE BELOW "BY IC ROOM" COUNTS ARE FOR PRICING PURPOSES ONLY AND ARE SUBJECT TO MODIFICATION TO MATCH FINAL CONSTRUCTION DOCUMENTS.

IC Room 01.05.01 (Level – 01)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	12		2.4	14	
Data - WP	VoIP Wall Phone	13		2.6	16	
Data - V	Data - Video (IPTV)		0	0	0	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	24		4.8	29	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	3		0.6	4	
POS	POS Cash Register		0	0	0	
					62	

Total GigE PoE Ports + Growth:	62	
Total GigE Non-PoE Ports + Growth:	0	

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
1		1		2	2		2

IC Room 01.05.08 (Level – 01)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	42		8.4	50	
Data - WP	VoIP Wall Phone	21		4.2	25	
Data - V	Data - Video (IPTV)		43	8.6	52	
Data - AV	Data - Audio/Visual		3	0.6	4	
Data - WLAN	Data - WLAN (WAP)	31		6.2	37	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	0		0	0	
POS	POS Cash Register		1	0.2	1	
					169	

Total GigE PoE Ports + Growth:	113	
Total GigE Non-PoE Ports + Growth:	56	<<< 20 Ports can connect to the PoE switches, leaving 36 ports used on the 48-port non-PoE switch.

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
1		2		2	2		3
		1		1	1		1

IC Room 01.10.15 (Level – 01)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	18		3.6	22	
Data - WP	VoIP Wall Phone	7		1.4	8	
Data - V	Data - Video (IPTV)		9	1.8	11	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	21		4.2	25	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	4		0.8	5	
POS	POS Cash Register		0	0	0	
					71	
	Total GigE PoE Ports + Growth:	60				
	Total GigE Non-PoE Ports + Growth:	11				

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply	
		1		1	1		1	
	1			1	1		1	

IC Room 01.13.10 (Level – 01)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	25		5	30	
Data - WP	VoIP Wall Phone	19		3.8	23	
Data - V	Data - Video (IPTV)		14	2.8	17	
Data - AV	Data - Audio/Visual		1	1	2	
Data - WLAN	Data - WLAN (WAP)	34		6.8	41	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	5		1	6	
POS	POS Cash Register		1	1	2	
					120	
	Total GigE PoE Ports + Growth:	100				
	Total GigE Non-PoE Ports + Growth:	21				

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
			2	1	1		2
	1			1	1		1

IC Room 01.18.06 (Level – 01)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	35		7	42	
Data - WP	VoIP Wall Phone	33		6.6	40	
Data - V	Data - Video (IPTV)		76	15.2	91	
Data - AV	Data - Audio/Visual		1	1	2	
Data - WLAN	Data - WLAN (WAP)	52		10.4	62	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	5		1	6	
POS	POS Cash Register		9	1	10	
		125	86		253	

Total GigE PoE Ports + Growth:	150	<<< Supporting only 144 connections (25 spare ports)
Total GigE Non-PoE Ports + Growth:	103	<<< Supporting only 96 connections (10 spare ports)

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		3		1		1	3
			2	1		1	2

IC Room 01.23.14 (Level – 01)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count				
Data	Data can be VoIP or PC	2		0.4	2				
Data - WP	VoIP Wall Phone	2		0.4	2				
Data - V	Data - Video (IPTV)		0	0	0				
Data - AV	Data - Audio/Visual		0	0	0				
Data - WLAN	Data - WLAN (WAP)	15		3	18	<<< Includes 11 WAPs from Level-09 Drawings			
CAM	CCTV IP Camera	0		0	0				
POS	POS Cash Register		0	0	0				
					23				
	Total GigE PoE Ports + Growth:		23						
	Total GigE Non-PoE Ports + Growth:		0						

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply		
1				1	1		1		

IC Room 01.27.05 (Level – 01)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	27		5.4	32	
Data - WP	VoIP Wall Phone	26	■	5.2	31	
Data - V	Data - Video (IPTV)	■	43	8.6	52	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	42	■	8.4	50	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	4	■	0.8	5	
POS	POS Cash Register	■	0	0	0	
		99	43		170	
	Total GigE PoE Ports + Growth:		119			
	Total GigE Non-PoE Ports + Growth:		52	<<< 4 ports will connect to the 24-port GigE PoE L3 switch		

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply	
1			2	2	2		3	
			1	1	1		1	

Room 01.36.01 (Level – 01)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	6		1.2	7	
Data - WP	VoIP Wall Phone	9		1.8	11	
Data - V	Data - Video (IPTV)		6	1.2	7	
Data - AV	Data - Audio/Visual		3	0.6	4	
Data - WLAN	Data - WLAN (WAP)	21		4.2	25	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	2		0.4	2	
POS	POS Cash Register		11	2.2	13	
		38	20		70	

Total GigE PoE Ports + Growth:		46
Total GigE Non-PoE Ports + Growth:		24

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		1		1	1		1
	1			1	1		1

IC Room 01.38.03 (Level – 01)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	16		3.2	19	
Data - WP	VoIP Wall Phone	12		2.4	14	
Data - V	Data - Video (IPTV)		0	0	0	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	27		5.4	32	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	4		0.8	5	
POS	POS Cash Register		0	0	0	
		59	0		71	

Total GigE PoE Ports + Growth:		71
Total GigE Non-PoE Ports + Growth:		0

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
1		1		2	2		2

IC Room 01.YY.ZZ (Level – 01). Note that this IC Room no longer exists therefore these nodes will emanate from a TBD IC Room on Level – 01.

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count				
Data	Data can be VoIP or PC	13		2.6	16				
Data - WP	VoIP Wall Phone	4		0.8	5				
Data - V	Data - Video (IPTV)		0	0	0				
Data - AV	Data - Audio/Visual		0	0	0				
Data - WLAN	Data - WLAN (WAP)	76		15.2	91	<<< Includes 11 WAPs from Level-09 Drawings			
CAM	CCTV IP Camera	7		1.4	8				
POS	POS Cash Register		0	0	0				
					120				
	Total GigE PoE Ports + Growth:	120							
	Total GigE Non-PoE Ports + Growth:	0							

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply	
1		2		2	2		3	

IC Room 02.15.02 (Level – 02)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count				
Data	Data can be VoIP or PC	1		0.2	1				
Data - WP	VoIP Wall Phone	2		0.4	2				
Data - V	Data - Video (IPTV)		0	0	0				
Data - AV	Data - Audio/Visual		0	0	0				
Data - WLAN	Data - WLAN (WAP)	14		2.8	17	<<< Includes 11 WAPs from Level-09 Drawings			
CAM	CCTV IP Camera	0		0	0				
POS	POS Cash Register		0	0	0				
					20				
	Total GigE PoE Ports + Growth:	20							
	Total GigE Non-PoE Ports + Growth:	0							

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply	
1				1	1		1	

IC Room 02.16.05 (Level – 02)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	2		0.4	2	
Data - WP	VoIP Wall Phone	3		0.6	4	
Data - V	Data - Video (IPTV)		9	1.8	11	
Data - AV	Data - Audio/Visual	0		0	0	
Data - WLAN	Data - WLAN (WAP)	13		2.6	16	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	0		0	0	
POS	POS Cash Register		11	2.2	13	
					46	
	Total GigE PoE Ports + Growth:		22			
	Total GigE Non-PoE Ports + Growth:		24	**<<< All ports will be serviced from the 48-port PoE, L3 Switch**		

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply	
		1		2	2		1	

IC Room 02.22.03 (Level – 02)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	16		3.2	19	
Data - WP	VoIP Wall Phone	21		4.2	25	
Data - V	Data - Video (IPTV)		85	17	102	
Data - AV	Data - Audio/Visual	0		0	0	
Data - WLAN	Data - WLAN (WAP)	40		8	48	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	3		0.6	4	
POS	POS Cash Register		17	3.4	20	
		80	102		218	
	Total GigE PoE Ports + Growth:		96			
	Total GigE Non-PoE Ports + Growth:		122	**<<< 120 connections will be supported (18 spare ports)**		

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply	
		2		1		1	2	
	1		2	1		1	3	

IC Room 02.23.15 (Level – 02)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	1		0.2	1	
Data - WP	VoIP Wall Phone	5		1	6	
Data - V	Data - Video (IPTV)		3	0.6	4	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	14		2.8	17	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	0		0	0	
POS	POS Cash Register		1	0.2	1	
		20	4		29	

Total GigE PoE Ports + Growth:		24	
Total GigE Non-PoE Ports + Growth:		5	<<< All ports will be serviced from the 24-port PoE, L3 Switch (no spare)

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
1				1	1		1

IC Room 03.05.02 (Level – 03)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	2		0.4	2	
Data - WP	VoIP Wall Phone	7		1.4	8	
Data - V	Data - Video (IPTV)		20	4	24	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	7		1.4	8	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	4		0.8	5	
POS	POS Cash Register		23	4.6	28	
		20	43		76	

Total GigE PoE Ports + Growth:		24	
Total GigE Non-PoE Ports + Growth:		52	<<< 43-ports will be serviced from this L2/L3, PoE, LAN Switch (5 spare ports)

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
1				1	1		1
			1	1	1		1

IC Room 03.13.01 (Level – 03)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	1		0.2	1	
Data - WP	VoIP Wall Phone	2		0.4	2	
Data - V	Data - Video (IPTV)		0	0	0	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	12		2.4	14	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	1		0.2	1	
POS	POS Cash Register		0	0	0	
		16	0		19	

Total GigE PoE Ports + Growth:	19	
Total GigE Non-PoE Ports + Growth:	0	

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
1				1	1		1

IC Room 03.15.08 (Level – 03)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	5		1	6	
Data - WP	VoIP Wall Phone	4		0.8	5	
Data - V	Data - Video (IPTV)		0	0	0	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	17		3.4	20	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	3		0.6	4	
POS	POS Cash Register		0	0	0	
		29	0		35	

Total GigE PoE Ports + Growth:	35	
Total GigE Non-PoE Ports + Growth:	0	

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
1				1	1		1

IC Room 03.27.07 (Level – 03)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	4		0.8	5	
Data - WP	VoIP Wall Phone	5		1	6	
Data - V	Data - Video (IPTV)		15	3	18	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	17		3.4	20	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	2		0.4	2	
POS	POS Cash Register		12	2.4	14	
		28	27		66	

Total GigE PoE Ports + Growth:	34
Total GigE Non-PoE Ports + Growth:	32

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		1		1	1		1
			1	1	1		1

IC Room 03.29.04 (Level – 03)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	3		0.6	4	
Data - WP	VoIP Wall Phone	6		1.2	7	
Data - V	Data - Video (IPTV)		15	3	18	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	24		4.8	29	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	7		1.4	8	
POS	POS Cash Register		22	4.4	26	
		40	37		92	

Total GigE PoE Ports + Growth:	48
Total GigE Non-PoE Ports + Growth:	44

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		1		1	1		1
			1	1	1		1

IC Room 04.01.05 (Level – 04)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	23		4.6	28	
Data - WP	VoIP Wall Phone	17		3.4	20	
Data - V	Data - Video (IPTV)		55	11	66	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	11		2.2	13	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	0		0	0	
POS	POS Cash Register		8	1.6	10	
		51	63		137	

Total GigE PoE Ports + Growth:	61	
Total GigE Non-PoE Ports + Growth:	76	<<< 72-ports to be supported leaving 9 spare ports

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
1		1		1	1		1
	1		1	2	2		1

IC Room 04.08.02 (Level – 04)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	5		1	6	
Data - WP	VoIP Wall Phone	3		0.6	4	
Data - V	Data - Video (IPTV)		20	4	24	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	19		3.8	23	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	2		0.4	2	
POS	POS Cash Register		16	3.2	19	
		29	36		78	

Total GigE PoE Ports + Growth:	35
Total GigE Non-PoE Ports + Growth:	43

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		1		1	1		1
			1	1	1		1

IC Room 04.13.03 (Level – 04)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	4		0.8	5	
Data - WP	VoIP Wall Phone	5		1	6	
Data - V	Data - Video (IPTV)		15	3	18	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	17		3.4	20	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	3		0.6	4	
POS	POS Cash Register		15	3	18	
		29	30		71	

Total GigE PoE Ports + Growth:	35	
Total GigE Non-PoE Ports + Growth:	36	

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		1		1	1		1
			1	1	1		1

IC Room 04.15.13 (Level – 04)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	6		1.2	7	
Data - WP	VoIP Wall Phone	6		1.2	7	
Data - V	Data - Video (IPTV)		6	1.2	7	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	20		4	24	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	0		0	0	
POS	POS Cash Register		8	1.6	10	
		32	14		55	

Total GigE PoE Ports + Growth:	38	
Total GigE Non-PoE Ports + Growth:	17	<<< These ports will be serviced from a shared, 48-port, L2/L3 PoE switch

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		1		1	1		1
	1			1	1		

IC Room 04.18.01 (Level – 04)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	17		3.4	20	
Data - WP	VoIP Wall Phone	14		2.8	17	
Data - V	Data - Video (IPTV)		61	12.2	73	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	39		7.8	47	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	5		1	6	
POS	POS Cash Register		19	3.8	23	
		75	80		186	

Total GigE PoE Ports + Growth:	90
Total GigE Non-PoE Ports + Growth:	96

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		2		2	2		2
			2	2	1		2

IC Room 04.23.04 (Level – 04)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	12		2.4	14	
Data - WP	VoIP Wall Phone	10		2	12	
Data - V	Data - Video (IPTV)		34	6.8	41	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	31		6.2	37	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	5		1	6	
POS	POS Cash Register		25	5	30	
		58	59		140	

Total GigE PoE Ports + Growth:	70
Total GigE Non-PoE Ports + Growth:	71

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
1		1		1	2		1
	1		1	1	1		1

IC Room 04.05.08 (Level – 04)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	5	1	6		
Data - WP	VoIP Wall Phone	9		1.8	11	
Data - V	Data - Video (IPTV)		19	3.8	23	
Data - AV	Data - Audio/Visual	0	0	0		
Data - WLAN	Data - WLAN (WAP)	23		4.6	28	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	2	0.4	2		
POS	POS Cash Register		31	6.2	37	
		39	50		107	

Total GigE PoE Ports + Growth:	47		
Total GigE Non-PoE Ports + Growth:	60	**<<< 2-Ports will be serviced from the L2/L3, PoE LAN Switch**	

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		1		1	1		1
			1	1	1		1

IC Room 04.34.03 (Level – 04)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	9		1.8	11	
Data - WP	VoIP Wall Phone	3		0.6	4	
Data - V	Data - Video (IPTV)		10	2	12	
Data - AV	Data - Audio/Visual	0	0	0		
Data - WLAN	Data - WLAN (WAP)	28		5.6	34	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	8	1.6	10		
POS	POS Cash Register		17	3.4	20	
		48	27		90	

Total GigE PoE Ports + Growth:	58		
Total GigE Non-PoE Ports + Growth:	32	**<<< To be supported by a PoE, L2/L3 LAN Switch**	

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		2		2	2		2

IC Room 04.37.08 (Level – 04)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	41		8.2	49	
Data - WP	VoIP Wall Phone	1		0.2	1	
Data - V	Data - Video (IPTV)		21	4.2	25	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	24		4.8	29	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	5		1	6	
POS	POS Cash Register		1	0.2	1	
		71	22		112	

Total GigE PoE Ports + Growth:		85		
Total GigE Non-PoE Ports + Growth:		26	<<< These ports will be serviced from the L2/L3, PoE LAN Switch	

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		2		1	1		2
	1			1	1		1

IC Room 04.39.03 (Level – 04)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	5		1	6	
Data - WP	VoIP Wall Phone	8		1.6	10	
Data - V	Data - Video (IPTV)		17	3.4	20	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	26		5.2	31	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	4		0.8	5	
POS	POS Cash Register		22	4.4	26	
		43	39		98	

Total GigE PoE Ports + Growth:		52	<<< 5-Spare ports will be provided	
Total GigE Non-PoE Ports + Growth:		47	<<< 8 Spare ports will be provided	

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		1		1	1		1
			1	1	1		1

IC Room 05.05.04 (Level – 05)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	3		0.6	4	
Data - WP	VoIP Wall Phone	6		1.2	7	
Data - V	Data - Video (IPTV)		6	1.2	13	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	18		3.6	22	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	0		0	0	
POS	POS Cash Register		8	1.6	10	
		33	14		55	
	Total GigE PoE Ports + Growth:		32			
	Total GigE Non-PoE Ports + Growth:		23			

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		1		1	1		1
		1		1	1		1

IC Room 05.15.17 (Level – 05)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	40		8	48	
Data - WP	VoIP Wall Phone	2		0.4	2	
Data - V	Data - Video (IPTV)		13	2.6	22	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	24		4.8	29	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	4		0.8	5	
POS	POS Cash Register		0	0	0	
		76	13		106	
	Total GigE PoE Ports + Growth:		84	<<< Only 7 spare ports total in this configuration		
	Total GigE Non-PoE Ports + Growth:		22	<<< These ports will be served by the L2/L3 PoE, LAN Switch		

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		2		2	2		2

IC Room 05.23.03 (Level – 05)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	2		0.4	2	
Data - WP	VoIP Wall Phone	7		1.4	8	
Data - V	Data - Video (IPTV)		18	3.6	28	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	20		4	24	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	2		0.4	2	
POS	POS Cash Register		22	4.4	26	
		37	40		91	
	Total GigE PoE Ports + Growth:			37	<<< 11 Spare ports provided	
	Total GigE Non-PoE Ports + Growth:			54	<<< 8-spare ports provided	

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		1		1	1		1
		1		1	1		1

IC Room 05.34.01 (Level – 05)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	13		2.6	16	
Data - WP	VoIP Wall Phone	2		0.4	2	
Data - V	Data - Video (IPTV)		12	2.4	20	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	18		3.6	22	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	3		0.6	4	
POS	POS Cash Register		0	0	0	
		42	12		64	
	Total GigE PoE Ports + Growth:			43	<<< 6 spart ports will be provided	
	Total GigE Non-PoE Ports + Growth:			20		

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		1		1	1		1
		1		1	1		1

IC Room 05.39.02 (Level – 05)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	15		3	18	
Data - WP	VoIP Wall Phone	8		1.6	10	
Data - V	Data - Video (IPTV)		17	3.4	26	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	31		6.2	37	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	6		1.2	7	
POS	POS Cash Register		14	2.8	17	
		66	31		115	
	Total GigE PoE Ports + Growth:		72			
	Total GigE Non-PoE Ports + Growth:		43			

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
1		1		1	1		2
			1	1	1		1

IC Room 06.05.07 (Level – 06)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	14		2.8	17	
Data - WP	VoIP Wall Phone	19		3.8	23	
Data - V	Data - Video (IPTV)		60	12	78	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	30		6	36	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	3		0.6	4	
POS	POS Cash Register		1	0.2	1	
		72	61		158	
	Total GigE PoE Ports + Growth:		79			
	Total GigE Non-PoE Ports + Growth:		79			

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		2		2	2		2
			1	1	1		2

IC Room 06.07.05 (Level – 06)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	17		3.4	20	
Data - WP	VoIP Wall Phone	18		3.6	22	
Data - V	Data - Video (IPTV)		59	11.8	77	
Data - AV	Data - Audio/Visual	0		0	0	
Data - WLAN	Data - WLAN (WAP)	26		5.2	31	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	4		0.8	5	
POS	POS Cash Register		1	0.2	1	
		71	60		156	

Total GigE PoE Ports + Growth:	78		
Total GigE Non-PoE Ports + Growth:	78	<<< 48-Ports to be Serviced from the 48-Port, L2/L3, PoE LAN Switch	

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
1		2		2	2		3
	1			1	1		1

IC Room 06.13.01 (Level – 06)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	68		13.6	82	
Data - WP	VoIP Wall Phone	4		0.8	5	
Data - V	Data - Video (IPTV)		7	1.4	8	
Data - AV	Data - Audio/Visual	0		0	0	
Data - WLAN	Data - WLAN (WAP)	22		4.4	26	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	6		1.2	7	
POS	POS Cash Register		0	0	0	
		100	7		128	

Total GigE PoE Ports + Growth:	120		
Total GigE Non-PoE Ports + Growth:	8	<<< These ports will be serviced by the L2/L3 PoE, LAN Switch	

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
1		2		2	2		3

IC Room 06.15.05 (Level – 06)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	47		9.4	56	
Data - WP	VoIP Wall Phone	7		1.4	8	
Data - V	Data - Video (IPTV)		24	4.8	29	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	29		5.8	35	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	6		1.2	7	
POS	POS Cash Register		1	0.2	1	
		89	25		137	
	Total GigE PoE Ports + Growth:		107	<<< 7 spare ports will be provided above 89 needed		
	Total GigE Non-PoE Ports + Growth:		30			

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
1		2		2	2		3

IC Room 06.23.07 (Level – 06)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	23		4.6	28	
Data - WP	VoIP Wall Phone	24		4.8	29	
Data - V	Data - Video (IPTV)		84	16.8	101	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	43		8.6	52	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	3		0.6	4	
POS	POS Cash Register		0	0	0	
		93	84		212	
	Total GigE PoE Ports + Growth:		112	<<< Only 3 spare ports are provided with this configuration.		
	Total GigE Non-PoE Ports + Growth:		101	<<< Only 12 spare ports are provided with this configuration.		

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		2		2	2		2
			2	1	1		2

IC Room 06.34.01 (Level – 06)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	0	0	0	0	
Data - WP	VoIP Wall Phone	3		0.6	4	
Data - V	Data - Video (IPTV)		7	1.4	8	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	16		3.2	19	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	3		0.6	4	
POS	POS Cash Register		20	4	24	
		22	27		59	

Total GigE PoE Ports + Growth:	26	
Total GigE Non-PoE Ports + Growth:	32	<<< These ports to be serviced by the L2/L3, PoE, LAN Switch

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply	
		1		1	1		1	
			1	1	1		1	

IC Room 06.39.06 (Level – 06)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	18		3.6	22	
Data - WP	VoIP Wall Phone	22		4.4	26	
Data - V	Data - Video (IPTV)		69	13.8	83	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	37		7.4	44	<<< Includes 11 WAPs from Level-09 Drawings
CAM	CCTV IP Camera	5		1	6	
POS	POS Cash Register		1	0.2	1	
		82	70		182	

Total GigE PoE Ports + Growth:	98	
Total GigE Non-PoE Ports + Growth:	84	

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply	
		2		2	2		2	
			1	1	1		2	

IC Room 07.05.02 (Level – 07)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	8		1.6	10	<<< Includes 08.05.02
Data - WP	VoIP Wall Phone	11		2.2	13	<<< Includes 08.05.02
Data - V	Data - Video (IPTV)		12	2.4	14	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	14		2.8	17	<<< Includes Level 09 WAPs
CAM	CCTV IP Camera	11		2.2	13	<<< Includes Level 09 Cameras
POS	POS Cash Register		24	4.8	29	
		44	36		96	
	Total GigE PoE Ports + Growth:		53	<<< 4-spare ports are provided with this configuration.		
	Total GigE Non-PoE Ports + Growth:		43	<<< 5-spare ports are provided with this configuration.		

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		1		1	1		1
			1	1	1		1

IC Room 07.07.02 (Level – 07)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	8		1.6	10	<<< Includes 08.07.02
Data - WP	VoIP Wall Phone	6		1.2	7	<<< Includes 08.07.02
Data - V	Data - Video (IPTV)		0	0	0	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	17		3.4	20	<<< Includes Level 09 WAPs
CAM	CCTV IP Camera	10		2	12	<<< Includes Level 09 Cameras
POS	POS Cash Register		4	0.8	5	
		41	4		54	

Total GigE PoE Ports + Growth:	49	<<< 48-ports will support both 41 PoE and 4 Non-PoE connections
Total GigE Non-PoE Ports + Growth:	5	<<< These ports to be serviced by the L2/L3, PoE, LAN Switch

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		1		1	1		1

IC Room 07.14.08 (Level – 07)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	4		0.8	6	<<< Includes 08.14.08
Data - WP	VoIP Wall Phone	4		0.8	6	<<< Includes 08.14.08
Data - V	Data - Video (IPTV)		8	1.6	10	
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	19		3.8	23	<<< Includes Level 09 WAPs
CAM	CCTV IP Camera	11		2.2	13	<<< Includes Level 09 Cameras
POS	POS Cash Register		11	2.2	13	
		38	19		71	

Total GigE PoE Ports + Growth:	48	<<< 10-spare ports are provided with this configuration.
Total GigE Non-PoE Ports + Growth:	23	<<< 5-spare ports are provided with this configuration.

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		1		1	1		1
	1			1	1		1

IC Room 07.15.10 (Level – 07)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	42		8.4	55	<<< Includes 08.15.02
Data - WP	VoIP Wall Phone	22		4.4	31	<<< Includes 08.15.02
Data - V	Data - Video (IPTV)		0	0	0	
Data - AV	Data - Audio/Visual		8	1.6	10	
Data - WLAN	Data - WLAN (WAP)	28		5.6	34	<<< Includes Level 09 WAPs
CAM	CCTV IP Camera	10		2	12	<<< Includes Level 09 Cameras
POS	POS Cash Register		4	0.8	5	
		102	12		146	

Total GigE PoE Ports + Growth: 132
Total GigE Non-PoE Ports + Growth: 14 <<< These ports to be serviced by the 48-port, L2/L3, PoE, LAN Switch

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		3		2	2		3

IC Room 07.23.02 (Level – 07)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	9		1.8	17	<<< Includes 08.23.02
Data - WP	VoIP Wall Phone	11		2.2	19	<<< Includes 08.23.02
Data - V	Data - Video (IPTV)		20	4	24	
Data - AV	Data - Audio/Visual		0	0	1	<<< Includes 08.23.02
Data - WLAN	Data - WLAN (WAP)	15		3	18	<<< Includes Level 09 WAPs
CAM	CCTV IP Camera	10		2	12	<<< Includes Level 09 Cameras
POS	POS Cash Register		23	4.6	28	
		45	43		119	

Total GigE PoE Ports + Growth: 66 <<< Single, 48-port, L2/L3, PoE, LAN Switch only supports 3 spare ports
Total GigE Non-PoE Ports + Growth: 53 <<< Single, 48-port, L2/L3, Non-PoE, LAN Switch only supports 5 spare ports

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		1		1	1		1
			1	1	1		1

IC Room 07.24.04 (Level – 07)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count		
Data	Data can be VoIP or PC	5		1	6		
Data - WP	VoIP Wall Phone	3		0.6	4		
Data - V	Data - Video (IPTV)		7	1.4	8		
Data - AV	Data - Audio/Visual		0	0	0		
Data - WLAN	Data - WLAN (WAP)	18		3.6	22	<<< Includes Level 09 WAPs	
CAM	CCTV IP Camera	11		2.2	13	<<< Includes Level 09 Cameras	
POS	POS Cash Register		10	2	12		
		37	17		65		

	Total GigE PoE Ports + Growth:		44	<<< 11 spare ports are provided in this configuration.	
	Total GigE Non-PoE Ports + Growth:		20	<<< 7 spare ports are provided in this configuration.	

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply	
		1		1	1		1	
	1			1	1		1	

IC Room 07.34.02 (Level – 07)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count		
Data	Data can be VoIP or PC	6		1.2	7		
Data - WP	VoIP Wall Phone	1		0.2	1		
Data - V	Data - Video (IPTV)		0	0	0		
Data - AV	Data - Audio/Visual		0	0	0		
Data - WLAN	Data - WLAN (WAP)	18		3.6	22	<<< Includes Level 09 WAPs	
CAM	CCTV IP Camera	14		2.8	17	<<< Includes Level 09 Cameras	
POS	POS Cash Register		2	0.4	2		
		39	2		49		

Total GigE PoE Ports + Growth:		47	<<< 7 spare ports are provided with this configuration
Total GigE Non-PoE Ports + Growth:		2	<<< These ports to be serviced by the L2/L3, PoE, LAN Switch

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply
		1		1	1		1

IC Room 07.39.06 (Level – 07)

For DD Design Purposes Only	Description	Total GigE Node Count (PoE)	Total GigE Node Count (Non-PoE)	Add 20% Growth for GigE Port Count	Total Port Count	
Data	Data can be VoIP or PC	12		2.4	20	<<< Includes 08.39.06
Data - WP	VoIP Wall Phone	19		3.8	30	<<< Includes 08.39.06
Data - V	Data - Video (IPTV)		38	7.6	47	<<< Includes 08.39.06
Data - AV	Data - Audio/Visual		0	0	0	
Data - WLAN	Data - WLAN (WAP)	19		3.8	23	<<< Includes Level 09 WAPs
CAM	CCTV IP Camera	11		2.2	13	<<< Includes Level 09 Cameras
POS	POS Cash Register		56	11.2	67	
		61	94		200	

	Total GigE PoE Ports + Growth:		86	<<< 10 Spare Ports
	Total GigE Non-PoE Ports + Growth:		114	<<< 2 spare ports are provided with this configuration (96 Total Ports)

# of 24 Port GigE PoE L3 Switches	# of 24 Port GigE L3 Switches	# of 48 Port GigE L3 PoE Switches	# of 48 Port GigE L3 Switches	L3 Switch Trunk Connection (BW) to MC	10GigE Fiber Uplinks Modules	40GigE Fiber Uplinks Modules	Redundant PoE Power Supply	
1		1		1	1		2	
			2	2	2		2	

c.   The following present the physical LAN connectivity technical requirements:
1)   The Contractor must design, construct, and implement a network infrastructure based on the IEEE 802.3 family of technical standards and specifications. The Data Network may not be implementing all of the below; however, adherence to the IEEE 802.3 family of technical standards and specifications for physical LAN connectivity (Physical Layer & Data Link Layer) is mandatory.

802.3i	1990	(10Base-T) 10 Mb/s using twisted pair cable
802.3j	1993	(10Base-F) 10 Mb/s using fiber optic cable
802.3u	1995	(100Base-TX, 100Base-T4, 100Base-FX) Fast Ethernet—100 Mbit/s
802.3y	1998	(100Base-T2) 100 Mb/s using low-quality twisted pair cable
802.3z	1998	(1000Base-X) 1 Gb/s using fiber optic cable
802.3ab	1999	(1000Base-T) 1 Gb/s using twisted pair cable
802.3ae	2003	(10GBase-SR, 10GBase-LR, 10GBase-ER, 10GBase-SW, 10GBase-LW, 10GBase-EW) 10 Gb/s using fiber optic cable
802.3af	2003	PoE Switch standard for up to 15.4 watts of power to IP phone
802.3at	2009	PoE+ Switch standard for up to 25.5 watts of power to IP phone
802.3ak	2004	(10GBase-CX4) 10 Gb/s using twin-axial cable
802.3an	2006	(10GBase-T) 10 Gb/s using twisted pair cable
802.3aq	2006	(10GBase-LRM) 10 Gb/s using multi-mode fiber
802.3bg	2011	(40GBase-SM) 40 Gb/s Ethernet Operation Over single-mode fiber

2)   The Contractor must design, construct, and implement a Core/Backbone network that physically inter-connects all the IC Rooms within the facility including connectivity between the Main Comm Room and Data Center Room.
3)   The Contractor must design, construct, and implement a physically redundant, physically resilient Core/Backbone network infrastructure such that any single device loss or cut of a fiber trunk cable will not result in total connectivity loss to the Data Center from any IC Room.
4)   The Contractor must design, construct, and implement a scalable Core/Backbone network infrastructure that can scale with additional IC Room uplink trunks as needed.
5)   The Contractor must design, construct, and implement Access/Edge LAN connectivity within each IC Room that services local connections.
6)   The Contractor must design, construct, and implement Access/Edge LAN switches that can support at least 2 fiber-optic, uplink connections (10GiGE).
7)   The Contractor must design, construct, and implement a scalable LAN switch connectivity solution (i.e., stacking, switch aggregation, etc.) for providing 100Mbps/1000Mbps end-point device physical LAN connectivity.
8)   The Contractor must utilize existing single-mode fiber optic cabling for use in all high-speed building backbone node to LAN switch connections within the IC Rooms.
9)   The Contractor must specify whether it is proposing fixed-port PoE+ Access/Edge LAN switches or chassis-based modular PoE+ Access/Edge LAN switches and include the number of spare ports available for capacity planning.

10) The Contractor must specify how many spare ports, trunking bandwidth, and spare slots are available for growth and expansion for the Core/Backbone, Distribution/Server Farm, and Access/Edge LAN Switches throughout.

d. The following presents the physical LAN Bandwidth technical requirements:

1) The Core/Backbone Node to LAN Node Connections must be comprised of a minimum of 2, 10GBase-LRM, IEEE 802.3aq Ethernet links IEEE 802.3bg Ethernet link supporting a stacked or aggregated LAN node switches using single-mode fiber cabling.

2) The Core/Backbone Node to LAN Node Connections must be capable of supporting a redundant and resilient building backbone trunking configuration in aggregated bandwidth links of 10GigE, 10GigE x # of Trunks up to 4, supporting a link aggregation of up to 40GigE.

3) The Core/Backbone, Distribution/Server Farm, and Access/Edge LAN Switches shall utilize single-mode fiber optic communication uplinks and associated fiber-optic transceivers all based on industry standards from the following groups: IEEE 802.3 Family of Standards, EIA/TIA, and ANSI. No proprietary solutions will be accepted by the Owner.

4) The LAN Node (i.e., IC Room Access/Edge LAN switches) and its end-point device connections must support 100Mbps/1000Mbps Ethernet based connections via RJ-45 physical connectors.

5) The LAN Node to end-point device connection will be based on 100Mbps/1000Mbps PoE+ (IEEE 802.3at) RJ45-connector fixed-port or chassis-based LAN switches based on the Contractor's recommendation for each IC Room.

6) For LAN Node switches that have more than 1 x 10GigE fiber-optic uplink trunk connection to the Core/Backbone Node switch, link aggregation must be supported (i.e., 2 x 10GigE fiber-trunks link aggregated for 20GigE trunk connection).

9) For IC Rooms that must support larger quantities of IP devices, additional LAN Node switches are to be installed each having its own 1 x 10GigE fiber-optic trunk connection to the Core/Backbone Node switch.

10) For LAN Node switches that utilize chassis-based architecture, link aggregation from the single chassis must have at least one redundant 1 x 10GigE fiber-optic backbone trunk connection from that chassis capable of being link aggregated.

11) The LAN Node switches included a 20% port growth factor. For those IC Rooms that had small connection populations minimal or no growth was provided (Refer to the details provided in the IC Room Node Count charts.

12) The Distribution/Server Farm switches (chassis-based or fixed-port) must have redundant, 2 x 40GigE connections to each of the Core/Backbone switches.

e. The following presents the Network Availability technical requirements:

1) The Core/Backbone Node will be comprised of one or multiple redundant switches with physically redundant fiber optic trunks to outer-lying LAN Node locations in IC Rooms.

2) The Core/Backbone Node switches will incorporate redundant processor modules, routing engines, cooling fans/blowers, and power supplies such that a failure of the primary or master will not deem the switch as inoperable.

3) The Core/Backbone Node switches will incorporate redundant ac power supplies and connections per switch to two different electrical distribution systems where installed.

4) The Core/Backbone Node switch's fiber optic backbone modules must be hot-removable and hot-insertable such that the switch does not need to be power-cycled or re-booted to activate.

5) The Core/Backbone to LAN Node network infrastructure must have a minimum monthly network availability factor of 99.95% for each Building Backbone Node to LAN node connection. Based on a 30-day calendar month this equates to 21 minutes of scheduled or un-scheduled network downtime per LAN Node With a physically redundant solution, including alternate fiber-optic cabling, this can be achieved even with a physical fiber trunk cable cut or core switch failure. Note that this network availability factor must be calculated for the entire building backbone node to LAN node connection/link.

6) The Distribution/Server Farm Node and LAN Node switch's fiber-optic backbone modules must be hot-removable and hot-insertable such that the switch does not need to be power-cycled or re-booted to activate.

7) The LAN Node switch's connectivity to the end-point device must have a minimum monthly network availability factor of 99.95% for each Building Backbone Node to LAN node connection. Based on a 30-day calendar month this equates to 21 minutes of scheduled or un-scheduled network downtime per LAN switch.

f. The following presents the Layer 2 Networking technical requirements:

1) The layer 2 network switches that are proposed by the Contractor must support both Ethernet v2.0 and IEEE 802.3 CSMA/CD data link layer frame formats.

2) The layer 2 copper, RJ-45 network switch ports that are proposed by the Contractor must support 10/100/1000 Mbps frame synchronization as per IEEE 802.3 standards and specifications.

3) The layer 2 copper, RJ-45 network switch ports that are proposed by the Contractor must support auto-negotiation to align port speed and frame synchronization with the network interface card (NIC) port speed that is connected to it.

4) The layer 2 copper, R-45 network switch ports that are proposed by the Contractor must support full-duplex configurations and be auto-sensing if NIC cards are only half-duplex enabled – "M"

5) The layer 2 network switches that are proposed by the Contractor must support logical link control (LLC) sub-layer functions including error detection (erred data link layer frames, etc.) and canceling of erroneous packets.

6) The layer 2 network switches that are proposed by the Contractor must support these media access control (MAC) sub-layer requirements:

a) Multiple access protocols: CSMA/CD (collision detection).

b) Physical MAC addressing and MAC address port security lock-down.

c) LAN switching with MAC address filtering.

d) Data packet queuing or buffering if congestion occurs.

e) Wire-speed throughput and performance at the physical RJ-45 connection port level.

f) Cut-through-switching technique with equal interface speeds on port and NIC card.

g) Store and forward switching technique to eliminate transmission of erred frames/packets.

h) Adaptive switching technique to dynamically select cut-through or store-and-forward switching.

i) DHCP snooping to prevent spoofing of a DHCP server.

j)   Address Resolution Protocol (ARP) snooping.
k)   Dynamic ARP inspection.
l)   Link Access Control Protocol (LACP).
m)   Internet Group Management Protocol (IGMP).

7)   The layer 2 network switches that are proposed by the Contractor must support the IEEE 802.1p specification enabling Layer 2 switches to prioritize traffic and perform dynamic multicast filtering.

8)   The layer 2 network switch solution must support up to 4,096 unique VLAN definitions as per the 12-bit VLAN Identifier (VID) in the TCI.

9)   The layer 2 network switch must support the following types of VLANs:
   a)   Port-Based VLAN: each physical switch port is configured with an access list/tag specifying membership in a VLAN(s).
   b)   MAC-based VLAN: a switch is configured with an access list mapping individual MAC addresses to VLAN membership.
   c)   Protocol-based VLAN: a switch is configured with a list of mapping layer 3 protocol types or sub-networks to VLAN membership - thereby filtering IP traffic where needed.

10)   The layer 2 network switch solution must support the larger, Ethernet frame size up to 1522 bytes as per IEEE 802.3ac such that errors are not reported to the SNMP network manager.

11)   The layer 2/3 network switches must support a maximum transmission unit (MTU) of up to 9000 bytes, with a maximum Ethernet frame size of 9018 bytes (Jumbo frames).

12)   The layer 2 network switches must support "trunking" such that multiple VLANs and their "Tags" can be transported to VLAN-aware end-points throughout the MSFA infrastructure (Core/Backbone, LAN Node switches).

13)   The layer 2 network switches should support protocol-based VLANs such that the switch segregates or forwards traffic from a port to other ports that speak the same protocol.

14)   The layer 2/3 network switches must support Multi-Protocol-Label-Switching (MPLS) such that MPLS labels and "tunnels" can be configured throughout the MSFA infrastructure.

15)   The layer 2/3 network switches must support Quality of Service (QoS).

16)   The layer 2/3 network switches should support a hardware based network access control (NAC) solution.

17)   The layer 2/3 network switches should support an agent-based network access control (NAC) solution that fully interoperates with the layer 2/3 network switches.

18)   The layer 2/3 network switches should support identification, authorization, and authentication as per the IEEE 802.1x standard and interoperate with a future RADIUS, TACACS+, or other Authentication server.

19)   The layer 2/3 network switches should support Ethernet over MPLS, L2TPv3 (Pt. – to - Pt.), or GRE as per RFC 4761 and RFC 4762.

20)   The layer 2/3 network switch should support a layer 2, fully-meshed configuration for VPLS using BGP (RFC 4761) or Label Distribution Protocol (LDP – RFC 4762).

21)   The layer 2/3 network switches being proposed must support SNMP v3.

22)   The layer 2 network switches that are proposed by the Contractor must support the IEEE 802.1p specification enabling Layer 2 switches to prioritize traffic and perform dynamic multicast filtering.

23)   The layer 2 network switch solution must support up to 4,096 unique VLAN definitions as per the 12-bit VLAN Identifier (VID) in the TCI.

g.   The following presents the Layer 3 Networking technical requirements:

1)   The layer 3 network switches/routers that are proposed by the Contractor must be capable of supporting only IPv6 addressing schemas and functionality throughout (i.e., Building Backbone Node, LAN Node) - "M".

2)   The layer 3 switches/routers that are proposed by the Contractor must support the following IPv6 features and functions according to the following IETF, RFCs throughout (i.e., Building Backbone Node, LAN Node):

a)   Path MTU Discovery for IPv6 as per RFC 1981.

b)   Internet Protocol v6 (IPv6) specification as per RFC 2460.

c)   IPv6 Dynamic Host Configuration Protocol for IPv6 (DHCPv6) as per RFC 3315.

d)   IPv6 Stateless Address Auto-configuration as per RFC 2462.

e)   IPv6 Scoped Address Architecture and multicast zone boundaries as per RFC 4007.

f)   Unique Local IPv6 Unicast Addresses as per RFC 4193.

g)   Basic transition mechanisms for IPv6 Hosts and Routers as per RFC 4213.

h)   IP Version 6 Addressing Architecture as per RFC 4291.

i)   Internet Control Message Protocol ICMPv6 as per RFC 4443.

j)   Multicast Listener Discovery (MLD) versions 1 for IPv6 as per RFC 2710, snooping.

k)   Multicast Listener Discovery (MLD) version 2 for IPv6 as per RFC 3810, snooping.

l)   Transmission of IPv6 Packets over Ethernet Networks as per RFC 2464.

3)   The layer 3 network switches/routers must support Open Shortest Path First (OSPF) version 2 (v2) for IPv4 as per RFC 2328, for routing functionality of IPv4 throughout (i.e., Building Backbone Node, LAN Node).

4)   The layer 3 network switches/routers must support Open Shortest Path First (OSPF) version 3 (v3) for IPv6 as per RFC 2740, for routing functionality of IPv6 throughout (i.e., Building Backbone Node, LAN Node).

5)   The layer 3 network switches/routers should support OSPFv3, Graceful Restart for IPv6 as per RFC 5187.

6)   The layer 3 network switches/routers must support OSPFv3, secure authentication, integrity, and confidentiality as per RFC 4552.

7)   The layer 3 network switches/routers must support Border Gateway Protocol version 4 (BGP4) within the Core/Backbone Node switches/routers for both IPv4 and IPv6.

8)   The layer 3 network switches/routers must support IPv6 Address Specific BGP Extended Community Attributes as per RFC 5701.

9)   The Core/Backbone switches/routers must support multi-protocol extensions for BGP4 as per RFC 2858.

10)   The Core/Backbone backbone switches/routers must support BGP multi-protocol extensions for IPv6 inter-domain routing.

11)   The layer 3 network switches/routers should support IS-IS for IPv4, as per RFC 1142, within the Building Backbone Node and LAN Node switches/routers.

12)   The layer 3 network switches/routers should support IS-IS for IPv6, as per RFC 5308, within the Building Backbone Node and LAN Node switches/routers.

13)   The layer 3 network switches/routers must support IP Multicast PIM v2, SSM for IPv4/IPv6, PIM-DM and PIM-SM for IPv4 and IPv6.

14) The layer 3 network switches/routers should support IS-IS for IPv6, as per RFC 5308, within the Core/Backbone Node and LAN Node switches/routers.

15) The layer 3 network switches/routers must support Quality of Service (QoS) within the Core/Backbone Node and LAN Node switches/routers.

16) The layer 3 network switches/routers proposed for the Core/Backbone Node & LAN Node must support Integrated Services (IntServ) for IPv6 guaranteeing services, as per RFC 2212, assuring bandwidth and latency with no losses within the switches/routers.

17) The layer 3 network switches/routers proposed for the Core/Backbone Node & LAN Node must support Integrated Services (IntServ) for IPv6 controlled load service, as per RFC 2211, for light loads, less guarantees, predictive service.

18) The layer 3 network switches/routers proposed for the Core/Backbone Node & LAN Node must support Integrated Services (IntServ) for IPv6 best effort service.

19) The layer 3 network switches/routers proposed for the Core/Backbone Node & LAN Node must support Resource Reservation Protocol (RSVP) as per RFC 2205.

20) The layer 3 network switches/routers proposed for the Core/Backbone Node & LAN Node must support Resource Reservation Protocol (RSVP) + IntServ as per RFC 2210.

21) The layer 3 network switches/routers proposed for the Core/Backbone Node & LAN Node must support Differentiate Services (DiffServ) as per RFC 2475.

22) The layer 3 network switches/routers proposed for the Core/Backbone Node & LAN Node must support IP unicast routing protocols (OSPF v2/v3) including static routes.

23) The layer 3 network switches/routers proposed for the Building Backbone Node & LAN Node should support policy based routing (PBR).

24) The layer 3 network switches/routers proposed for the Building Backbone Node & LAN Node must support Virtual Router Redundancy Protocol (VRRP) version 3, as per RFC 5798.

25) The layer 3 network switches/routers proposed for the Building Backbone Node & LAN Node must support Internet Group Management Protocol (IGMP) version 3, as per RFC 3376.

26) The layer 3 network switches/routers proposed for the Building Backbone Node, & LAN Node must support internetworking of IEEE 802.1q VLANs (i.e., inter-VLAN routing, etc.).

27) The layer 3 network switches/routers proposed for the Building Backbone Node, & LAN Node must support internetworking of IEEE 802.1q VLANs (i.e., inter-VLAN routing, etc.).

28) The layer 3 network switches/routers proposed for the Building Backbone Node, & LAN Node must support filtering, access control lists, and traffic permit/denies on all inbound and outbound physical interfaces.

29) The layer 3 network switches/routers proposed for the Building Backbone Node & LAN Node must support IGMP filtering.

30) The layer 3 network switches/routers proposed for the Building Backbone Node & LAN Node must support secure system administration functions, including SSHv3 remote access, TACACS+, and RADIUS authentication.

31) The layer 3 switches/routers proposed for the Building Backbone Node, & LAN Node must support hot-insertable and hot-removable blades and modules without having to power cycle the switch to enable.

32) The layer 3 switches/routers proposed for the Building Backbone Node, & LAN should support virtualization technology such that at least 2 switches can act as a single virtual switch to enhance operational functionality and performance.

33) The layer 3 switches/routers proposed should support real-time traffic statistics and traffic monitoring such that the Owner can utilize an SNMP Manager such as SolarWinds ORION® and network performance monitor (NPM).

34) The layer 2/3 switches/routers proposed for the Building Backbone Node, & LAN Node must support both SNMP v2 and SNMP v3 such that a dedicated Network Management VLAN can be deployed for all SNMP dialogue between the installed switches/routers and the MSFA's Solarwinds ORION® SNMP Manager.

35) The proposed SNMP EngineID as per SNMP v3 must be uniquely created for each SNMP entity throughout the Core/Backbone Node & LAN Node environment.

36) The SNMP v3 encryption standard utilized must conform to a minimum of DES encryption in order to secure the SNMP payload message

37) The SNMP v3 deployment for the Building Backbone Node & LAN Node must support authentication using keys created from the EngineID.

38) The layer 2/3 switches/routers proposed must support Voice over IP (VoIP) and Session Initiation Protocol (SIP) as per RFC 3261 and RFC 6157 IPv6 Transition using SIP.

h. The following presents the Core/Backbone & LAN Connectivity & Resiliency technical requirements:

1) The Core/Backbone Node and LAN Node switches shall support IEEE 802.3ad link aggregation.

2) The Core/Backbone Node and LAN Node switches shall support IEEE 802.1ax, Link Aggregation Control Protocol (LACP).

3) The Core/Backbone Node to LAN Node fiber-optic, trunk connections must support link aggregation, such that multiple, or parallel, active/active connections can be enabled throughout the backbone network environment.

4) The Core/Backbone Node to LAN Node fiber-optic trunk connections, that are link aggregated in an Active/Inactive configuration, must support a convergence time of 50mSec or less.

5) The Core/Backbone Node to LAN Node fiber-optic trunk connections must support link aggregation, such that at least 4 trunks can be link aggregated in a parallel, active/active configuration.

6) The Core/Backbone Node to LAN Node fiber-optic trunk connections should support link aggregation beyond the directly connected switches.

7) The following layer 2 resiliency standards and solutions must be supported:

a) Spanning Tree Protocol (IEEE 802.1d).
b) Link Aggregation (IEEE 802.3ad).
c) Rapid Spanning Tree Protocol (IEEE 802.1w).
d) Multiple Spanning Tree Protocol (MSTP/IEEE 802.1s).
e) Active/Active Link Aggregation Solution up to 4 trunks.
f) Non-looping, Active/Inactive Link Aggregation Solution with 50mSec or less convergence time   for primary/back-up.
g) Dynamic Link Aggregation Group (LAG).
h) Trunk Client End Point (TCEP) – IEEE 802.3ad LAG.
i) IP/Multi-Protocol Label Switching (MPLS) Failover/Convergence.

8) The following layer 3 resiliency standards and solutions must be supported:

   a) Virtual Router Redundancy Protocol (VRRP) can be enabled in Ethernet, MPLS, IPv4/IPv6 network infrastructures – IETF, RFC 5789.

   b) Bi-Directional Forwarding Detection (BFD) is used to detect faults between 2 forwarding engines for Ethernet, VCs, tunnels, and MPLS Label Switched Paths – IETF, RFC 5880, RFC 5881.

   c) OSPF v3 Fast Hello and Link State Advertisements with configurable timers.

   d) OSPF Bootstrap Communications to BFD where BFD notifies OSPF of failures, outages.

   e) MPLS Fast ReRoute (FRR) – one to one and many to one backup link protection and bode protection.

   f) MPLS Fast ReRoute Backup Protection Label Switch Paths (LSPs).

   g) Equal-cost multi-path routing (ECMP) is a routing strategy where next-hop packet forwarding to a single destination can occur over multiple "best paths". It potentially offers substantial increases in bandwidth by load-balancing traffic over multiple paths; however, there can be significant problems in its deployment in practice – IETF, RFC 2991.

i. The following presents the IP Multicasting technical requirements. Major design factors that the Contractor should consider include, but are not limited to:

   - The architecture of the network infrastructure (e.g. Layer 2 or Layer 3).

   - The location of the IP multicasting "rendezvous points" for traffic aggregation and distribution.

   - Bandwidth requirements between "rendezvous points" and LAN switches that support IP multicasting.

   - Link aggregation solutions that will support of the required IP multicasting traffic.

   - Sub-second failover and resiliency requirements to support IP Multicasting traffic from the LAN switch to "rendezvous points" Core/Backbone Node switches

1) The Data Network must support an IP Multicasting capability throughout the entire IP data network infrastructure from the Core/Backbone Node to and LAN Switch Node.

2) The Data Network must support an IP Multicasting service based on an IPv6 addressing schema and environment.

3) The Data Network must support an IP Multicasting service throughout the hierarchy of the Core/Backbone Network Node and LAN Switch Node.

4) The Data Network must support an IP Multicasting service where Host-to-Switch and Switch--to-Switch signaling uses IETF industry standards (i.e., RFC documents and standards) and protocols (i.e., IGMP v1/v2/v3, PIM-DM, PIM-SM, etc.).

5) If the Data Network is based on a layer 3 deployment, the IP Multicasting service should utilize PIM-SM (Sparse Mode) enabled at "rendezvous points" throughout the MAC network infrastructure (i.e., Building Backbone Switch Nodes, etc.).

6) The Data Network's IP Multicasting service must be manageable and be capable of supporting detailed Network Performance Management reporting as part of the on-going network management and operations performed by the Owner and use of their SNMP management platform.

7) The Data Network may support either a layer 2 or layer 3 IP Multicasting delivery solution, but regardless of the network architecture, ease of on – going management for configuration, performance, fault, and security administration is required.

8) The Data Network may support either layer 2 or layer 3 sub-second failover and resiliency no greater than 50 mSec between trunking and link aggregation connections.

9) The Data Network should support non-looping, non-broadcast storm link aggregation, redundancy, and resiliency in an active/active mode of operation such that no link, fiber-optic transceivers are in a dormant or idle mode.

10) The Data Network's IP Multicasting solution must minimize protocol overhead and maximize bandwidth efficiency by incorporating "rendezvous points" to aggregate and maximize bandwidth efficiency throughout the Building Backbone Nodes and LAN Switch Nodes.

11) The Data Network's IP Multicasting solution must incorporate the identical minimum acceptable performance requirements and network availability requirements as defined in this RFP document.

12) The Data Network's traffic throughput, bandwidth, scalability, and capacity planning for trunking and link aggregation between Core/Backbone Nodes and LAN Switch Nodes will incorporate the required CCTV IP-camera traffic estimates as coordinated with the CCTV vendor in addition to a minimum 25% over-subscription for capacity planning and growth between trunk connections.

13) The Data Network must support layer 2/3 VLANs as per IEEE 802.1q VLAN standards and specifications configured to support the specific requirements that will be coordinated with the CCTV vendor.

j. The following presents the IP Address Space technical requirements:

1) The Contractor is required to design an IPv6 private addressing schema as part of its design deliverables.

2) The Contractor will be required to design a logical, IPv6 addressing schemas for the new Data Network according to the following:
   a) Physical layout of the facility.
   b) # of IC Rooms.

3) The Contractor must develop an IPv6 addressing schema that can support the existing, future, and long-term growth of IP host devices throughout the Data Network.

4) The Contractor must provide a spreadsheet softcopy (in Microsoft Excel *.xls format) of the IPv6 addressing schema design and layout being proposed for the Data Network. This must also include the allocation of IP host addresses for all proposed network components.

5) The layer 2/3 switches/routers proposed must support the draft RFP Standard for IPv6 to IPv6 Network Address Translation (NAT66).

6) The layer 2/3 LAN Node switches/routers proposed must support the Basic Requirements for IPv6 Customer Edge Routers as per RFC 6204.

k. The following presents the Internet, DMZ, Layered Security technical requirements:

1) The proposed perimeter IP stateful firewall solution and security appliance solution must be chassis-based allowing for scalable growth and support from 4 to 8 10/100/1000BaseT RJ45-ports.

2) The proposed perimeter IP stateful firewall solution and security appliance solution should support from 0 to 4 1000Base-F SFP Ports.

3) The proposed perimeter IP stateful firewall solution and security appliance solution should support a firewall throughput of at least 3 Gbps aggregate.

4) The proposed perimeter IP stateful firewall solution and security appliance solution should support a VPN throughput of at least 400Mbps aggregate.

5) The proposed perimeter IP stateful firewall solution and security appliance solution should support an IPS throughput of at least 2Gbps aggregate.

6) The proposed perimeter IP stateful firewall solution and security appliance solution should support at least 1.2M concurrent user sessions.

7) The proposed perimeter IP stateful firewall solution and security appliance solution should support at least 25K connections per second.

8) The proposed perimeter IP stateful firewall solution and security appliance solution should support at least 1024 VLANs.

9) The proposed perimeter IP stateful firewall solution and security appliance solution should support at least 4GB of memory.

10) The proposed perimeter IP stateful firewall solution and security appliance solution must support load balancing and/or redundant connections such that secured and filtered traffic can be distributed among multiple firewall/IPS connections.

11) The proposed perimeter IP stateful firewall solution and security appliance solution must support access control lists from layer 3 – layer 7, accounting management, system logging, connection/session rate monitoring, general security checks, updating IPS digital signature files (i.e., vulnerabilities, scanning, exploits, attacks, DoS, etc.), support remote access via SSHv3 using encryption, NAT, CIFs resources, and TCP sequence verification.

12) The proposed perimeter IP stateful firewall solution and security appliance solution must support dynamic IPSec VPN connections.

13) The proposed perimeter IP stateful firewall solution and security appliance solution must support access control lists on physical interfaces, synchronization status, firewall policy creation and status, and firewall/IPS process status monitoring/reporting in real-time.

14) The proposed perimeter IP stateful firewall and security appliance solution must be FIPS 140-2 compliant.

15) The proposed perimeter IP stateful firewall solution and security appliance solution must support IP stateful firewall functionality.

16) The proposed perimeter IP stateful firewall solution and security appliance solution should support Identify Awareness.

17) The proposed perimeter IP stateful firewall solution and security appliance solution must support advanced networking including OSPF v2, v3 and BGP4.

18) The proposed perimeter IP stateful firewall solution and security appliance solution should support mobile access.

19) The proposed perimeter IP stateful firewall solution and security appliance solution should support a software enabled Intrusion Detection System (IDS).

20) The proposed perimeter IP stateful firewall solution and security appliance solution should support software enabled Intrusion Prevention System (IPS)

21) The proposed perimeter IP stateful firewall solution and security appliance solution should support Application Control.

22) The proposed perimeter IP stateful firewall solution and security appliance solution should support data leakage prevention.

23) The proposed perimeter IP stateful firewall solution and security appliance solution should support web content filtering and URL filtering.

24) The proposed perimeter IP stateful firewall solution and security appliance solution should support anti-virus software protection.

25) The proposed perimeter IP stateful firewall solution and security appliance solution should support anti-spam and e-mail content filtering and security.

26) The proposed perimeter IP stateful firewall solution and security appliance solution should support web security.

27) The proposed perimeter IP stateful firewall solution and security appliance solution should support anti-Bot.

28) The proposed perimeter IP stateful firewall solution and security appliance solution must support network policy management for security management and security operations.

29) The proposed perimeter IP stateful firewall solution and security appliance solution must support audit trails, logging, and status.

30) The proposed perimeter IP stateful firewall solution and security appliance solution should support real-time monitoring.

31) The proposed perimeter IP stateful firewall solution and security appliance solution should support an HTTPS:// web-enabled management portal.

32) The proposed perimeter IP stateful firewall solution and security appliance solution should support end-point policy management as part of an identity asset management system.

33) The proposed perimeter IP stateful firewall solution and security appliance solution should support a chassis-based, clustering solution where multiple, IP Stateful Firewalls and IPS blades/modules can be inserted for scalable, easy to manage firewall deployments

34) The proposed perimeter IP stateful firewall solution and security appliance solution must support dynamic threat management where digital signatures and traces are "learned", analyzed, and assist in the baseline definition of normal versus abnormal traffic or anomalies.

35) The proposed perimeter IP stateful firewall solution and security appliance solution must support real-time, software updates and pre-emptive security updates into the physical architecture such that the device does not have to be taken off-line or re-booted.

36) The proposed perimeter IP stateful firewall solution and security appliance solution must support vulnerability and exploit signatures, protocol validation and anomaly detection.

37) The proposed perimeter IP stateful firewall solution and security appliance solution must support behavior-based detection, multi-element correlation, with on-going protection updates for client and server vulnerabilities, exploits, protocol misuse, outbound malware communications, tunneling attempts, application control, generic attack types without predefined signatures, and preemptive security functions.

38) The proposed perimeter IP stateful firewall solution and security appliance solution must support application layer protections and controls include Instant Messaging and Peer-to-Peer communications.

39) The proposed perimeter IP stateful firewall solution and security appliance solution must support enhanced protections against DoS/DDoS attacks.

40) The proposed perimeter IP stateful firewall solution and security appliance solution must support customizable signatures that can be created using the open signature language and incorporated into the layered security solution as part of the software configuration.

41) The proposed perimeter IP stateful firewall solution and security appliance solution must support SNMP v2 and v3 management and SNMP traps,

          alarms, and dialogue between the security appliance and the Owner's SNMP Manager.

l.   The following presents the Internet, DMZ, Layered Security technical requirements:

1)   The Contractor must develop a layered, secure architecture to protect the Data Network from network-based attacks and other internal and external threats in accordance with the Owners overall Network Security and Administration Policies.

2)   For Core/Backbone Node switches/routers that are proposed by the Contractor that incorporate the use of hot-insertable and hot-removable firewall blades, the Contractor is encouraged to provide these internal IPS blades/modules as part of their overall solution.

3)   For Core/Backbone Node switches/routers that are proposed by the Successful Proponent that incorporate the use of hot-insertable and hot-removable Intrusion Prevention System (IPS) blades, the Contractor is encouraged to provide these internal IPS blades/modules as part of their overall solution. If the IPS is software based in conjunction with the IP Stateful firewall solution, then include this as part of your overall layered security solution.

4)   The IP Stateful Firewall and IPS solution provided by the Successful Proponent, if part of the Building Backbone Node switches/routers, must be FIPS 140-2 compliant.

5)   The layered security solution Firewalls/IPS/Gateway Blades/Modules or separate appliances and software that are incorporate must support the layer 2 and layer 3 technical requirements as presented in this RFP (i.e., IEEE, RFCs, and other "Mandatory" requirements as defined).

6)   The layered security solution Firewalls/IPS/Gateway Blades/Modules or separate appliances and software should support load balancing and/or redundant connections such that secured and filtered traffic can be distributed among multiple firewall/IPS connections.

7)   The layered security solution Firewalls/IPS/Gateway Blades/Modules or separate appliances and software must support access control lists from layer 3 – layer 7, accounting management, system logging, connection/session rate monitoring, general security checks, updating IPS digital signature files (i.e., vulnerabilities, scanning, exploits, attacks, DoS, etc.), support remote access via SSHv3 using encryption, NAT, CIFs resources, and TCP sequence verification.

8)   The layered security solution Firewalls/IPS/Gateway Blades/Modules or separate appliances and software must support dynamic IPSec VPN connections.

9)   The layered security solution Firewalls/IPS/Gateway Blades/Modules or separate appliances and software must support access control lists on physical interfaces, synchronization status, firewall policy creation and status, and firewall/IPS process status monitoring/reporting in real-time

10)   The layered security solution Firewalls/IPS/Gateway Blades/Modules or separate appliances and software should support internal VLANs and VLANs Firewall/IPS/Gateway security solutions from within the Building Backbone Node switches/routers.

11)   The layered security solution Firewalls/IPS/Gateway Blades/Modules or separate appliances and software should support internal 1 GigE, 5GigE, and 10GigE RJ-45 and/or fiber-optic modules for layering security solutions within.

12)   The layered security solution Firewalls/IPS/Gateway Blades/Modules or separate appliances and software should support a chassis-based,

clustering solution where multiple, IP Stateful Firewalls and IPS blades/modules can be inserted for scalable, easy to manage firewall deployments internal to the Data Network.

13) The layered security solution Firewalls/IPS/Gateway Blades/Modules or separate appliances and software must support dynamic threat management where digital signatures and traces are "learned", analyzed, and assist in the baseline definition of normal versus abnormal traffic or anomalies.

14) The layered security solution Firewalls/IPS/Gateway Blades/Modules or separate appliances and software must support real-time, software updates and pre-emptive security updates into the physical architecture such that the device does not have to be taken off-line or re-booted.

15) The layered security solution Firewalls/IPS/Gateway Blades/Modules or separate appliances and software must support vulnerability and exploit signatures, protocol validation and anomaly detection.

16) The layered security solution Firewalls/IPS/Gateway Blades/Modules or separate appliances and software must support behavior-based detection, multi-element correlation, with on-going protection updates for client and server vulnerabilities, exploits, protocol misuse, outbound malware communications, tunneling attempts, application control, generic attack types without predefined signatures, and preemptive security functions.

17) The layered security solution Firewalls/IPS/Gateway Blades/Modules or separate appliances and software must support application layer protections and controls include Instant Messaging and Peer-to-Peer communications.

18) The layered security solution Firewalls/IPS/Gateway Blades/Modules or separate appliances and software must support enhanced protections against DoS/DDoS attacks.

19) The layered security solution Firewalls/IPS/Gateway Blades/Modules or separate appliances and software must support customizable signatures that can be created using the open signature language and incorporated 'into the layered security solution as part of the software configuration.

20) The layered security solution Firewalls/IPS/Gateway Blades/Modules or separate appliances and software must support SNMP v2 and v3 management and SNMP traps, alarms, and dialogue between the security appliance and the Owner's SNMP Manager (i.e., SolarWinds Orion®, etc.).

m. The following presents the Centralized Network Management technical requirements. It is envisioned that the Owner will implement the following or something similar as follows:

- HELP DESK acting as single point of contact for all Level 1 trouble calls, end-user requests, and logging security incidents submitted by MSFA end-users.

- MSFA IT and Vendor Support Team acting as the Level 2 support for trouble calls, end-user requests, and supporting Level 3 security incident response team (SIRT) functions when needed.

- SIRT acting as a Level 3 security incident response team providing real-time response to critical and major incidents that may occur throughout the MAC IT infrastructure environment.

- SolarWinds ORION® as an enterprise Network Management System (SNMP Manager) platform providing full FCAPS management solutions for addressing the new MAC network infrastructure.

- New IT & IT security policy framework and policy definitions that define policies, standards, procedures, and guidelines throughout the Data Network environment.

a) The proposed Core/Backbone Node, Distribution/Server Farm, and LAN Node switches/routers must support RFC 3411 - An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks.

b) The proposed Core/Backbone Node, Distribution/Server Farm, and LAN Node switches/routers must support RFC 3412 - Message Processing and Dispatching for the Simple Network Management Protocol (SNMP).

c) The proposed Core/Backbone Node, Distribution/Server Farm, and LAN Node switches/routers must support RFC 3413 - SNMP Applications.

d) The Core/Backbone Node switch must support real-time link integrity monitoring for all fiber optic (MM or SM) network interfaces and connections such that Solarwinds Network Performance Monitor can identify status up-time, and calculate monthly availability.

e) The Core/Backbone Node switch must support real-time monitoring of the primary power supply such that Solarwinds Network Performance Monitor can identify status, up-time, and calculate monthly availability.

f) The Core/Backbone Node switch must support real-time monitoring of the redundant power supply such that Solarwinds Network Performance Monitor can identify status, up-time, and calculate monthly availability.

g) The Core/Backbone Node switch's fiber optic (MM or SM) connection must support real-time monitoring of the physical link integrity such that Solarwinds Network Performance Monitor can identify status, up-time, and calculate monthly availability.

h) The Core/Backbone Node switch must support real-time availability monitoring such that Solarwinds Network Performance Monitor can identify status, up-time, and calculate monthly availability.

i) The Core/Backbone Node switch must support real-time link integrity monitoring for all fiber optic (MM or SM) network interfaces and connections such that Solarwinds Network Performance Monitor can identify status up-time, and calculate monthly availability.

j) The Core/Backbone Node switch must support real-time monitoring of the primary power supply such that Solarwinds Network Performance Monitor can identify status, up-time, and calculate monthly availability.

k) The Core/Backbone Node switch must support real-time monitoring of the redundant power supply such that Solarwinds Network Performance Monitor can identify status, up-time, and calculate monthly availability.

l) The Core/Backbone Node switch's and LAN Node switch's fiber optic (MM or SM) connection must support real-time monitoring of the physical link integrity such that Solarwinds Network Performance Monitor can identify status, up-time, and calculate monthly availability.

m) The LAN (Access/Edge LAN Switch) Node switch must support real-time availability monitoring such that Solarwinds Network Performance Monitor can identify status, up-time, and calculate monthly availability.

n) The LAN Node switch must support real-time link integrity monitoring for all fiber optic (MM or SM) network interfaces and connections such

that Solarwinds Network Performance Monitor can identify status up-time, and calculate monthly availability.

o) The LAN Node switch must support real-time monitoring of the primary power supply such that Solarwinds Network Performance Monitor can identify status, up-time, and calculate monthly availability.

p) The LAN Node switch must support real-time monitoring of the redundant power supply such that Solarwinds Network Performance Monitor can identify status, up-time, and calculate monthly availability.

q) The LAN Node switch's workstation port connections must support real-time monitoring of the link integrity between the Ethernet network interface card (i.e., RJ-45 100/1000BaseT connector) and the RJ-45 PoE port connection on the LAN Node switch.

n. The following presents the Configuration Management technical requirements. Configuration Management is the process within Network Operations responsible for maintaining a database of technical information on all network components. This information enables NOC technicians to provide timely troubleshooting functions as well as maintain up-to-date and accurate element management for components within the network infrastructure.

Configuration Management gives network technicians critical information for the problem isolation, definition, and resolution processes, and assists network support analysts for design and implementation.

1) The Configuration Management service offering shall include Rack-level elevation CAD drawings (*format to be provided to Successful Proponent*) for the physical network infrastructure from the Core/Backbone Node switches to the LAN Node switches.

2) The Configuration Management offering will provide a comprehensive asset management/inventory database of all network hardware and software installed in the network infrastructure such that it can be uploaded into Solarwinds to include the following:

Building/LAN Node Switch
Part Name / Description
Model # / Part #
Serial #
Operating System Software Version #
Maintenance Agreement #

3) The Configuration Management offering will require all installed routers, switches, firewalls, and other network component operating system files within the Solarwinds NCM database. Tracking of revisions for all installed software for network devices will be handled by Solarwinds NCM.

4) The Configuration Management offering will require all installed routers, switches, firewalls, and other network component software configuration files within the Solarwinds NCM database. Tracking of revisions for all installed software for network devices will be handled by Solarwinds NCM.

5) The uploading and downloading of a network device software configuration files to/from Solarwinds NCM must be implemented securely whether that is solved by pre-configuring and testing during staging, on-site technician upload via laptop direct cable connection, dedicated network management VLAN, use of encryption, etc. Use of TFTP is not acceptable for uploading or downloading production configuration files to/from Solarwinds NCM.

      6) Performing back-ups and/or software configuration updates to production network devices must be implemented securely whether that be solved by pre-configuring and testing during staging, on-site technician upload via laptop direct cable connection, dedicated network management VLAN, use of encryption, etc. Use of TFTP through a production network is not acceptable for uploading or downloading production configuration files to/from Solarwinds NCM.

      7) The Configuration Management service offering must include all logical IP networking addresses allocated for production use, IP sub-network numbers, VLANs names and ID #s, and multicast VLANs that are configured throughout the network infrastructure.

      8) The Configuration Management service offering must include audit trails for logging for local and remote access and alarms for any attempted but failed access or configuration file manipulation on all network infrastructure devices.

5. Class of Service (CoS)

The CoS shall ensure quality of service (QoS) throughout the IP Data Networking Infrastructure. QoS shall be enabled to allow specific network traffic (both uni-cast and multi-cast) to be prioritized relative to its importance, and provide priority-indexed treatment through congestion avoidance and queuing techniques.

6. Internet Protocol (IP) Addressing and Dynamic Host Control Protocol (DHCP):

   a. The Contractor shall coordinate IP addressing and DHCP requirements with Owner, Users, Building System Installers, etc.

   b. The Contractor shall develop and provide an IP/DHCP Matrix that indicates the addressing scheme and methodology for all systems connected to the data network. The Contractor and Owner will work together to define an IP addressing standard and allocation for DHCP IP host address ranges throughout.

7. Virtual Local Area Networks (VLANs):

   a. VLANs shall be determined and configured by the Contractor based on coordination with the Owner and analysis of all converged systems to virtually segment, secure, establish class of service (CoS), traffic engineering, and bandwidth requirements for data systems converged on the Data Network.

   b. The Contractor shall coordinate, evaluate, and determine network bandwidth requirements for all systems connected to the Converged Data Network.

   c. The Contractor shall develop and provide a VLAN matrix based on the systems to be virtually segmented and secured.

   d. The VLAN Matrix shall establish CoS requirements including bandwidth priority and allocation for each VLAN.

   e. Provided below is a basic list of anticipated VLAN assignments that shall be confirmed and coordinated by the Contractor, but not limited to:

      1) Building Managements System (HVAC and Lighting Control)
      2) IPTV (TV, Digital Signage, and Food Menu Boards)
      3) Multipurpose Communications (Layer 2)
      4) Administrative
      5) Point Sale (POS)
      6) Public Internet
      7) Security Systems (Surveillance, Access Control, and Administrative Monitoring/Control)
      8) Sound Systems
      9) VoIP Communications System
      10) Wireless (Administrative)
      11) Wireless (Multi-purpose/Event)
      12) Wireless (POS)
      13) Wireless (Public Internet)

        14)   Home Team
        15)   Visiting Team
        16)   Sports Authority
        17)   Food Service
        18)   Ticketing
        19)   Press/Media Internet
        20)   Others to be determined

B.   Base Network Equipment

    1.   Switches
        a.   Domain Controllers.
        b.   Core/Backbone Switches.
            1)   (1) Primary
            2)   (1) Redundant
        c.   Access/Ed Switches.
        d.   Internet and DMZ Network Switches.
        e.   Data Center Distribution/Server Farm Switches.
    2.   Firewall Appliance.
    3.   Layered Security Appliance/Solution.
    4.   Centralized Network Management Application.
    5.   Patch Cords
        a.   Fiber Optic LC Patch Cables.
        b.   CAT6A Patch Cables.
    6.   Uninterruptable Power Supply (UPS)
        a.   Provided by different specification. Coordination and verification of connection shall be provided by this contractor based on equipment indicated in this specification.
    7.   Electrical Power Overload Protection.
    8.   Out-Of-Band (OOB) Management.
    9.   Spare Parts
        a.   Manufacturer and Contractor to propose items.

C.   Add Alternate Equipment

    1.   Contractor proposed alternates.
    2.   Manufacturer proposed alternates.

D.   Maintenance

    1.   24-7 (4-hour response).
    2.   Next Business Day.

E.   Network System Support and Management

    1.   Onsite
    2.   Remote
    3.   Term Options
        a.   Year-1
        b.   Year-2
        c.   Year-3
        d.   Year-4
        e.   Year-5

2.3   EQUIPMENT SPECIFICATIONS

A.   Domain Controllers

1.   The Owner currently has existing Domain Controllers that will be used as part of this work. The Contractor shall coordinate, inventory and evaluate existing systems and integrate them into the data network. The Contractor shall inform Owner of any equipment requiring upgraded and/or replacement to meet implementation of Data Network and other project requirements. The Contractor shall specifically identify and document these components and forward to Owner.
2.   The Contractor shall recommend and provide server hardware, software, licenses, etc.

B.   Core/Backbone Switches (Primary and Redundant)

1.   Primary and Redundant Core Switches in a virtual chassis configuration shall be provided.
2.   Core switches shall be chassis type and modular.
3.   Core Switches shall be modular and accept 1 Gbps and 10 Gbps Ethernet fiber port line cards as well as 40Gbps and 100Gbps.
4.   24-port and/or 48-port 10/100/1000Mbps copper Ethernet line cards.
5.   Core Switches shall be mountable in 19-inch EIA standard rack or cabinet.
6.   Core Switches shall be provided at the Main Communications Rooms, where building fiber optic 10Gbps and 10/100/1000MBps cable terminates.
7.   All uplinks to Access Switches and Data Center Switches shall be fiber optic based 10Gbps as necessary to interface all Switches plus (2) spare 10-Gbps ports per core switch.
8.   Core Switches shall have Multi-Layer switching/routing capability.
9.   Core Switch configuration shall be as such that with the network designed in such a manner so that the failure of any Core Switch will not interrupt service.
10.   Each Core Switch will have primary and redundant uplinks to each Access Switches located at the Intermediate Communications Room.
11.   Core Switches must have N+1 redundant hot swappable power supplies and hot swappable fans.
12.   Core Switches shall have redundant processors for L2 and L3 operations; there shall be no single point of failure for the operation of the switch.
13.   Furnish, engineer and install sufficient trunks between the primary and redundant core switches to support virtual chassis architecture.
14.   Each core switch must have at least (2) open line card slots for future growth.
15.   Minimum System Requirements, contractor shall detail unanswered items in submittal and bid documents:
       a.   Quantity: (2) Switches (Primary and Redundant)
       b.   Switching Service: Layer-2 and Layer-3
       c.   Class: Data
       d.   Type: Modular Chassis
       e.   Chassis Configuration:
              1)   Front Interfaces: Required Design Slots +2 Spare Minimum
              2)   Rear Interfaces: Contractor Shall Detail In Submittal, Per Manufacturer
              3)   Backplane Bandwidth: Contractor Shall Detail In Submittal, Per Manufacturer
              4)   Slot Bandwidth: Contractor Shall Detail In Submittal, Per Manufacturer
              5)   Cable Management: Contractor Shall Detail In Submittal, Per Manufacturer

6)   Door: Contractor Shall Detail In Submittal, Per Manufacturer

f.   Operating System: Data Class Software / Advanced Layer 2 and Layer 3 features; Contractor shall Detail In Submittal, Per Manufacturer

g.   Feature Resources:

1)   Total VLANs: Contractor Shall Detail In Submittal, Per Manufacturer

2)   Total VLAN IDs: Contractor Shall Detail In Submittal, Per Manufacturer

3)   Switched Virtual Interfaces: Contractor Shall Detail In Submittal, Per Manufacturer

4)   Routed Ports per Stack: Contractor Shall Detail In Submittal, Per Manufacturer

5)   Jumbo Frames Support: Contractor Shall Detail In Submittal, Per Manufacturer

6)   Support for Netflow: Contractor Shall Detail In Submittal, Per Manufacturer

7)   Network Access Control: Contractor Shall Detail In Submittal, Per Manufacturer

8)   Policy Management: Contractor Shall Detail In Submittal, Per Manufacturer

9)   Per port Firewall: Contractor Shall Detail In Submittal, Per Manufacturer

h.   Processing Module:

1)   Chassis Architecture: Contractor Shall Detail In Submittal, Per Manufacturer

2)   Configuration: Contractor Shall Detail In Submittal, Per Manufacturer

3)   Processor Cards:

a)   DRAM: Contractor Shall Detail In Submittal, Per Manufacturer

b)   Flash: Contractor Shall Detail In Submittal, Per Manufacturer

c)   VNRAM: Contractor Shall Detail In Submittal, Per Manufacturer

d)   Logging Size: Contractor Shall Detail In Submittal, Per Manufacturer

i.   Fabric Switching Modules:

1)   Chassis Architecture: Contractor Shall Detail In Submittal, Per Manufacturer

2)   Configuration: Contractor Shall Detail In Submittal, Per Manufacturer

3)   Bandwidth Per Module: Contractor Shall Detail In Submittal, Per Manufacturer

j.   Ethernet Interface Modules:

1)   Copper (RJ45):   48-ports 10/100/1000BASE-T line rate per port for entire module (no shared ports).

2)   1 Gbps Fiber-(SFP):   48-duplex ports 1000BASE to support MMFO and SMFO

3)   10 Gbps Fiber (SFP):   10GBASE SMFO support. SFP based modular mix and match design at line rate per port for the entire module (no shared ports)

4)	Support for 40Gbps:	Contractor Shall Detail In Submittal, Per Manufacturer
5)	Support for 100Gbps:	Contractor Shall Detail In Submittal, Per Manufacturer

k. Service Modules: Contractor Shall Detail In Submittal, Per Manufacturer

l. Management Port:

1)	Ethernet Management:	Contractor Shall Detail In Submittal, Per Manufacturer
2)	Console Management:	Contractor Shall Detail In Submittal, Per Manufacturer

m. Power Supply:

1)	General:	Integrated, Upgradeable and Hot-Swappable; Must be N+1 to provide power to the whole system.
2)	Quantity:	Contractor Shall Detail In Submittal, Per Manufacturer
3)	Voltage:	100 to 240 VAC Auto-Sensing
4)	Frequency:	50 to 60 Hz
5)	Phase:	1-Phase
6)	Load:	Contractor Shall Detail In Submittal, Per Manufacturer
7)	Cords:	Contractor Shall Detail In Submittal, Per Manufacturer
8)	Receptacle Type:	Contractor Shall Detail In Submittal, Per Manufacturer

n. Fans:

1)	General:	Integrated, Variable Speed, Hot-Swappable w/ Tray
2)	System/Chassis Quantity:	Contractor Shall Detail In Submittal, Per Manufacturer
3)	Fabric Switch Quantity:	Contractor Shall Detail In Submittal, Per Manufacturer
4)	Fan Speed:	Contractor Shall Detail In Submittal, Per Manufacturer
5)	Air Flow:	Contractor Shall Detail In Submittal, Per Manufacturer
6)	Air Filter:	Contractor Shall Detail In Submittal, Per Manufacturer
7)	Maintenance Access:	Contractor Shall Detail In Submittal, Per Manufacturer

o. Physical

1)	Size (H x W x D):	Contractor Shall Detail In Submittal, Per Manufacturer
2)	Rack Units	19-inch EIA, Contractor Shall Detail In Submittal, Per Manufacturer
3)	Weight (fully configured):	Contractor Shall Detail In Submittal, Per Manufacturer
4)	Module Orientation/Location:	
	a) Processor Modules:	Contractor Shall Detail In Submittal, Per Manufacturer
	b) I/O Modules:	Contractor Shall Detail In Submittal, Per Manufacturer

           c)   Fabric Cards: Contractor Shall Detail In Submittal, Per Manufacturer

           d)   Power Supplies: Contractor Shall Detail In Submittal, Per Manufacturer

           e)   Fans: Contractor Shall Detail In Submittal, Per Manufacturer

     5)   Acoustic Noise: Contractor Shall Detail In Submittal, Per Manufacturer

     6)   MTBF: Contractor Shall Detail In Submittal, Per Manufacturer

     7)   Warranty: Contractor Shall Detail In Submittal, Per Manufacturer

   p.   Environmental

     1)   Operating Temperature: Contractor Shall Detail In Submittal, Per Manufacturer

     2)   Storage Temperature: Contractor Shall Detail In Submittal, Per Manufacturer

     3)   Relative Humidity: Contractor Shall Detail In Submittal, Per Manufacturer

   q.   Operating Altitude: Contractor Shall Detail In Submittal, Per Manufacturer

   r.   Other and Misc. Components: Manufacturer and Contractor shall include and recommend all necessary components for a complete and fully functioning system. Component noted above are minimum performance and/or requirements for general reference of major parts only. *Refer to equipment schedules shown on technology drawings for module types and quantities.*

C.   Access/Edge LAN Switches

   1.   System Requirements:

      a.   Type: Chassis-type or Stackable with "virtual switch" capability

      b.   Switching Service: Layer-2 and Layer-3

      c.   Class: Standard

      d.   Switching Fabric Capacity: Contractor Shall Detail In Submittal, Per Manufacturer

      e.   Stacking/Backplane Bandwidth: Contractor Shall Detail In Submittal, Per Manufacturer

      f.   Stack-Forwarding Rate: Contractor Shall Detail In Submittal, Per Manufacturer

      g.   Station Connectivity

        1)   Port Count: 48-Ports

        2)   Media: Copper, Unshielded Twisted Pair (UTP)

        3)   Connectors: RJ45

        4)   Bandwidth: 10/100/1000-Mbps Ethernet

        5)   Ethernet: 1000BASE-T

        6)   PoE+ Per Port: Enhanced IEEE 802.3at (PoE+)

        7)   Watts per PoE+ Port: Contractor Shall Detail In Submittal, Per Manufacturer

      h.   Backbone Uplink Connectivity

        1)   Port Count: (1) Primary and (1) Redundant SFP per switch Minimum

        2)   Port Types:;   10Gbps modular SFP/LC; SMFO support

        3)   Connectors: LC

        4)   Ethernet: 10Gbps fiber optic

i.   Memory:

    1)   DRAM: Contractor Shall Detail In Submittal, Per Manufacturer

    2)   Flash: Contractor Shall Detail In Submittal, Per Manufacturer

    3)   VNRAM: Contractor Shall Detail In Submittal, Per Manufacturer

j.   Feature Resources:

    1)   Total VLANs: Contractor Shall Detail In Submittal, Per Manufacturer

    2)   Total VLAN IDs: Contractor Shall Detail In Submittal, Per Manufacturer

    3)   Switched Virtual Interfaces: Contractor Shall Detail In Submittal, Per Manufacturer

    4)   Routed Ports per Stack: Contractor Shall Detail In Submittal, Per Manufacturer

    5)   Jumbo Frames Support: Contractor Shall Detail In Submittal, Per Manufacturer

    6)   Support for NetFlow: Contractor Shall Detail In Submittal, Per Manufacturer

    7)   Network Access Control: Contractor Shall Detail In Submittal, Per Manufacturer

    8)   Policy Management: Contractor Shall Detail In Submittal, Per Manufacturer

    9)   Per Port Firewall: Contractor Shall Detail In Submittal, Per Manufacturer

k.   Management Port

    1)   Ethernet Management: Contractor Shall Detail In Submittal, Per Manufacturer

    2)   Console Management: Contractor Shall Detail In Submittal, Per Manufacturer

l.   Indicators:

    1)   Indication Lights: LED

        a)   Per Port: Contractor Shall Detail In Submittal, Per Manufacturer

        b)   System Status: Contractor Shall Detail In Submittal, Per Manufacturer

m.   Operating System: Data Class Software; Advanced Layer-2 and Layer 3 Features; Contractor Shall Detail In Submittal, Per Manufacturer

n.   Power Supply

    1)   Quantity: Two or More; Contractor Shall Detail In Submittal, Per Manufacturer

    2)   N+1 Design: Contractor Shall Detail In Submittal, Per Manufacturer

    3)   Switch Wattage: Contractor Shall Detail In Submittal, Per Manufacturer

    4)   PoE Wattage: Contractor Shall Detail In Submittal, Per Manufacturer

    5)   Max PoE Per Port: Contractor Shall Detail In Submittal, Per Manufacturer

    6)   Voltage: Contractor Shall Detail In Submittal, Per Manufacturer

	7)	Frequency:	Contractor Shall Detail In Submittal, Per Manufacturer
	8)	Phase:	Contractor Shall Detail In Submittal, Per Manufacturer
	9)	Load:	Contractor Shall Detail In Submittal, Per Manufacturer
	10)	Power Cord:	(1) per Power Supply, coordinate length and type.
	11)	Receptacle Type:	Coordinate length and type.
o.	Fans		
	1)	General:	Contractor Shall Detail In Submittal, Per Manufacturer
	2)	Hot-Swappable:	Contractor Shall Detail In Submittal, Per Manufacturer
p.	Physical		
	1)	Size:	Contractor Shall Detail In Submittal, Per Manufacturer
	2)	Rack Units:	19-inch EIA, 1U. Contractor Shall Note In Submittal
	3)	Weight:	Contractor Shall Detail In Submittal, Per Manufacturer
	4)	Acoustic Noise:	Contractor Shall Detail In Submittal, Per Manufacturer
	5)	MTBF:	Contractor Shall Detail In Submittal, Per Manufacturer
	6)	Warranty:	Contractor Shall Detail In Submittal, Per Manufacturer
q.	Environmental		
	1)	Operating Temperature:	Contractor Shall Detail In Submittal, Per Manufacturer
	2)	Storage Temperature:	Contractor Shall Detail In Submittal, Per Manufacturer
	3)	Relative Humidity:	Contractor Shall Detail In Submittal, Per Manufacturer
	4)	Operating Altitude:	Contractor Shall Detail In Submittal, Per Manufacturer

  r. Other and Misc. Components: Manufacturer and Contractor shall include and recommend all necessary components for a complete and fully functioning system. Components above are for general reference and major parts only.

 2. Product Specification:
  a. Contractor shall submit products for approval, with all requested information above included.

D. Internet and DMZ Switches

 1. System Requirements:

a.	Type:	Stackable with "virtual switch" capability
b.	Switching Service:	Layer-2 and Layer-3
c.	Class:	Standard
d.	Switching Fabric Capacity:	Contractor Shall Detail In Submittal, Per Manufacturer
e.	Stacking/Backplane Bandwidth:	Contractor Shall Detail In Submittal, Per Manufacturer

  f. Stack-Forwarding Rate: Contractor Shall Detail In Submittal, Per Manufacturer

  g. Station Connectivity
    1) Port Count: 48-Ports
    2) Media: Copper, Unshielded Twisted Pair (UTP)
    3) Connectors: RJ45
    4) Bandwidth: 10/100/1000-Mbps Ethernet
    5) Ethernet: 1000BASE-T
    6) PoE+ Per Port: Enhanced IEEE 802.3at (PoE+)
    7) Watts per PoE+ Port: Contractor Shall Detail In Submittal, Per Manufacturer

  h. Backbone Uplink Connectivity
    1) Port Count: (1) Primary and (1) Redundant SFP per switch Minimum
    2) Port Types: 10Gbps modular SFP/LC; SMFO support
    3) Connectors: LC
    4) Ethernet: 10Gbps fiber optic

  i. Memory:
    1) DRAM: Contractor Shall Detail In Submittal, Per Manufacturer
    2) Flash: Contractor Shall Detail In Submittal, Per Manufacturer
    3) VNRAM: Contractor Shall Detail In Submittal, Per Manufacturer

  j. Feature Resources:
    1) Total VLANs: Contractor Shall Detail In Submittal, Per Manufacturer
    2) Total VLAN IDs: Contractor Shall Detail In Submittal, Per Manufacturer
    3) Switched Virtual Interfaces: Contractor Shall Detail In Submittal, Per Manufacturer
    4) Routed Ports per Stack: Contractor Shall Detail In Submittal, Per Manufacturer
    5) Jumbo Frames Support: Contractor Shall Detail In Submittal, Per Manufacturer
    6) Support for NetFlow: Contractor Shall Detail In Submittal, Per Manufacturer
    7) Network Access Control: Contractor Shall Detail In Submittal, Per Manufacturer
    8) Policy Management: Contractor Shall Detail In Submittal, Per Manufacturer
    9) Per Port Firewall: Contractor Shall Detail In Submittal, Per Manufacturer

  k. Management Port
    1) Ethernet Management: Contractor Shall Detail In Submittal, Per Manufacturer
    2) Console Management: Contractor Shall Detail In Submittal, Per Manufacturer

  l. Indicators:
    1) Indication Lights: LED
      a) Per Port: Contractor Shall Detail In Submittal, Per Manufacturer
      b) System Status: Contractor Shall Detail In Submittal, Per Manufacturer

m.   Operating System: Data Class Software; Advanced Layer-2 and Layer 3 Features; Contractor Shall Detail In Submittal, Per Manufacturer

n.   Power Supply

     1)   Quantity: Two or More; Contractor Shall Detail In Submittal, Per Manufacturer

     2)   N+1 Design: Contractor Shall Detail In Submittal, Per Manufacturer

     3)   Switch Watts: Contractor Shall Detail In Submittal, Per Manufacturer

     4)   PoE Watts: Contractor Shall Detail In Submittal, Per Manufacturer

     5)   Watts Per Port: Contractor Shall Detail In Submittal, Per Manufacturer

     6)   Voltage: Contractor Shall Detail In Submittal, Per Manufacturer

     7)   Frequency: Contractor Shall Detail In Submittal, Per Manufacturer

     8)   Phase: Contractor Shall Detail In Submittal, Per Manufacturer

     9)   Load: Contractor Shall Detail In Submittal, Per Manufacturer

     10)   Power Cord: (1) per Power Supply, coordinate length and type.

     11)   Receptacle Type: Coordinate length and type.

o.   Fans

     1)   General: Contractor Shall Detail In Submittal, Per Manufacturer

     2)   Hot-Swappable: Contractor Shall Detail In Submittal, Per Manufacturer

p.   Physical

     1)   Size: Contractor Shall Detail In Submittal, Per Manufacturer

     2)   Rack Units: 19-inch EIA, 1U. Contractor Shall Note In Submittal, Per Manufacturer

     3)   Weight: Contractor Shall Detail In Submittal, Per Manufacturer

     4)   Acoustic Noise: Contractor Shall Detail In Submittal, Per Manufacturer

     5)   MTBF: Contractor Shall Detail In Submittal, Per Manufacturer

     6)   Warranty: Contractor Shall Detail In Submittal, Per Manufacturer

q.   Environmental

     1)   Operating Temperature: Contractor Shall Detail In Submittal, Per Manufacturer

     2)   Storage Temperature: Contractor Shall Detail In Submittal, Per Manufacturer

     3)   Relative Humidity: Contractor Shall Detail In Submittal, Per Manufacturer

r.   Operating Altitude: Contractor Shall Detail In Submittal, Per Manufacturer

s. Other and Misc. Components: Manufacturer and Contractor shall include and recommend all necessary components for a complete and fully functioning system. Components above are for general reference and major parts only.

2. Product Specification:
a. Contractor shall submit products for approval, with all requested information above included.

E. Data Center Distribution/Server Farm Switches (Primary and Redundant)

1. System Requirements:
a. Quantity: (##) Switches
b. Type: Stackable with "virtual switch" capability
c. Switching Service: Layer-2 and Layer-3
d. Class: Standard
e. Switching Fabric Capacity: Contractor Shall Detail In Submittal, Per Manufacturer
f. Stacking/Backplane Bandwidth: Contractor Shall Detail In Submittal, Per Manufacturer
g. Stack-Forwarding Rate: Contractor Shall Detail In Submittal, Per Manufacturer
h. Station Connectivity
   1) Port Count: 24-Ports or 48-Ports
   2) Media: Copper, Unshielded Twisted Pair (UTP)
   3) Connectors: RJ45
   4) Bandwidth: 10/100/1000-Mbps Ethernet
   5) Ethernet: 1000BASE-T
   6) PoE+ Per Port: Enhanced IEEE 802.3at (PoE+)
   7) Watts per PoE+ Port: Contractor Shall Detail In Submittal, Per Manufacturer
i. Backbone Uplink Connectivity
   1) Port Count: (1) Primary and (1) Redundant SFP per switch Minimum
   2) Port Types: 10Gbps modular SFP/LC; SMFO support
   3) Connectors: LC
   4) Ethernet: 10Gbps fiber optic
j. Memory:
   1) DRAM: Contractor Shall Detail In Submittal, Per Manufacturer
   2) Flash: Contractor Shall Detail In Submittal, Per Manufacturer
   3) VNRAM: Contractor Shall Detail In Submittal, Per Manufacturer
k. Feature Resources:
   1) Total VLANs: Contractor Shall Detail In Submittal, Per Manufacturer
   2) Total VLAN IDs: Contractor Shall Detail In Submittal, Per Manufacturer
   3) Switched Virtual Interfaces: Contractor Shall Detail In Submittal, Per Manufacturer
   4) Routed Ports per Stack: Contractor Shall Detail In Submittal, Per Manufacturer
   5) Jumbo Frames Support: Contractor Shall Detail In Submittal, Per Manufacturer

	6)	Support for NetFlow:	Contractor Shall Detail In Submittal, Per Manufacturer
	7)	Network Access Control:	Contractor Shall Detail In Submittal, Per Manufacturer
	8)	Policy Management:	Contractor Shall Detail In Submittal, Per Manufacturer
	9)	Per Port Firewall:	Contractor Shall Detail In Submittal, Per Manufacturer
l.	Management Port		
	1)	Ethernet Management:	Contractor Shall Detail In Submittal, Per Manufacturer
	2)	Console Management:	Contractor Shall Detail In Submittal, Per Manufacturer
m.	Indicators:		
	1)	Indication Lights: LED	
		a) Per Port:	Contractor Shall Detail In Submittal, Per Manufacturer
		b) System Status:	Contractor Shall Detail In Submittal, Per Manufacturer
n.	Operating System:		Data Class Software; Advanced Layer-2 and Layer 3 Features; Contractor Shall Detail In Submittal, Per Manufacturer
o.	Power Supply		
	1)	Quantity:	Two or More; Contractor Shall Detail In Submittal, Per Manufacturer
	2)	N+1 Design:	Contractor Shall Detail In Submittal, Per Manufacturer
	3)	Switch Watts:	Contractor Shall Detail In Submittal, Per Manufacturer
	4)	PoE Watts:	Contractor Shall Detail In Submittal, Per Manufacturer
	5)	Watts Per Port:	Contractor Shall Detail In Submittal, Per Manufacturer
	6)	Voltage:	Contractor Shall Detail In Submittal, Per Manufacturer
	7)	Frequency:	Contractor Shall Detail In Submittal, Per Manufacturer
	8)	Phase:	Contractor Shall Detail In Submittal, Per Manufacturer
	9)	Load:	Contractor Shall Detail In Submittal, Per Manufacturer
	10)	Power Cord:	(1) per Power Supply, coordinate length and type.
	11)	Receptacle Type:	Coordinate length and type.
p.	Fans		
	1)	General:	Contractor Shall Detail In Submittal, Per Manufacturer
	2)	Hot-Swappable:	Contractor Shall Detail In Submittal, Per Manufacturer
q.	Physical		
	1)	Size:	Contractor Shall Detail In Submittal, Per Manufacturer
	2)	Rack Units:	19-inch EIA, 1U. Contractor Shall Note In Submittal, Per Manufacturer

   3) Weight: Contractor Shall Detail In Submittal, Per Manufacturer

   4) Acoustic Noise: Contractor Shall Detail In Submittal, Per Manufacturer

   5) MTBF: Contractor Shall Detail In Submittal, Per Manufacturer

   6) Warranty: Contractor Shall Detail In Submittal, Per Manufacturer

  r. Environmental

   1) Operating Temperature: Contractor Shall Detail In Submittal, Per Manufacturer

   2) Storage Temperature: Contractor Shall Detail In Submittal, Per Manufacturer

   3) Relative Humidity: Contractor Shall Detail In Submittal, Per Manufacturer

  s. Operating Altitude: Contractor Shall Detail In Submittal, Per Manufacturer

  t. Other and Misc. Components: Manufacturer and Contractor shall include and recommend all necessary components for a complete and fully functioning system. Components above are for general reference and major parts only.

 2. Product Specification:

  a. Contractor shall submit products for approval, with all requested information above included.

F. Firewall Appliance

 1. A primary and redundant Firewall Appliance Devices shall be provided.

 2. Firewall Appliance shall support services including Firewall, SSL, DTLS, and IPsec VPN, IPS, and content security services to meet the need of specific environments within the Data Network.

 3. The Firewall Appliance shall support the following key elements:

  a. Security and VPN Capabilities: Full featured, high performance firewall, intrusion prevention (IPS), content security, and Secure Socket Layer/IP Security (SSL/IPsec) VPN technologies delivering robust application security, user based and applications based access control, worm and virus mitigation, malware protection, content filtering, and remote user/site connectivity.

  b. Clientless Network Access: Provide clientless remote access to network applications and resources, regardless of location, without need of desktop VPN client software.

 4. System Requirements (minimums):

  a. Quantity:

   1) Equipment: (#) Firewall

   2) Client Licenses: (##) User Licenses

  b. Type: Rack Mount Appliance

  c. Firewall Bandwidth: 300 Mbps

  d. VPN Bandwidth: 170 Mbps

  e. IPsec VPN Peers: 250

  f. SSL VPN Peers: 250

  g. Concurrent Connections: 50,000

  h. Maximum Security VLANs: 50

  i. Power Supply:

   1) General: Integrated.

   2) Quantity: Primary

   3) Voltage: 100 to 240 VAC Auto Sensing.

4)   Frequency: 50 to 60 Hz

5)   Phase: 1-Phase.

6)   Load: Submit, Per Manufacturer

7)   Cords: Submit, Per Manufacturer

8)   Receptacle Type: Submit, Per Manufacturer

j.   Fans:

     1)   General: Integrated.

     2)   Quantity: Submit, Per Manufacturer

k.   Ethernet Interfaces:

     1)   10/100 Mbps Copper: 3-Ports

     2)   10/100/1000 Mbps Copper: 2-Ports

l.   VLAN Interfaces: 50

m.   Expansion Slot: Submit, Per Manufacturer

n.   User Accessible Flash Slot: Submit, Per Manufacturer

o.   USB Ports: Submit, Per Manufacturer

p.   Serial Ports: Submit, Per Manufacturer

q.   Memory: Submit, Per Manufacturer

r.   Minimum System Flash: Submit, Per Manufacturer

s.   System Bus: Submit, Per Manufacturer

t.   Physical

     1)   Size (H x W x D):   Submit, Per Manufacturer

     2)   Rack Units   19-inch EIA, 1 U.

     3)   Weight: Submit, Per Manufacturer

u.   Environmental

     1)   Operating Temperature: 32 to 104 °F (0 to 40 °C)

     2)   Storage Temperature: -13 to 158 °F (-25 to 70 °C)

     3)   Relative Humidity: 0 to 90%, non-condensing.

     4)   Operating Altitude: 9800 ft (3000 m).

v.   Other and Misc. Components: Manufacturer and Contractor shall include and recommend all necessary components for a complete and fully functioning system. Components above are for general reference and major parts only.

     5.   Product Specification: Contractor shall submit products for approval, with all requested information above included.

     G.   Centralized Network Management Application

     1.   Provide scope and price as a separate line item for Owner review and approval.

     2.   A Centralized Network Management Software and Hardware shall be provided for setting up and managing the network.

     3.   Centralized Network Management Applications shall be an integrated software suite of management tools to simplify configuration, administration, monitoring, and troubleshooting of the Data Network Switching and Routing System.

     4.   The Application shall enable Network Operators to manage the network through a browser-based interfaced that can be accessed from anywhere within the network including remotely via the VPN.

     5.   The Application shall maintain a centralized list of network devices and their credentials.

     6.   The Application shall have a portal that enables functional views that can be configured by the Network Operator to meet specific needs.

     7.   The Centralized Network Management Application shall be setup, configured, and fully operational. The Contractor shall coordinate and inventory all network devices and ensure they are integrated into this application as part of this project.

     8.   The Management Application shall be provided to the Owner on a DVD.

     9.   The Management Application shall have three default view including the following:

      a.   Functional View:
             Provides a list of applications and corresponding functions.

      b.   System View:
             Provides status of various system-level attributes, including job status, backup information, system-level events, application-related details, etc.

      c.   Network View:
             Provides quick visibility into various network-level reports for quick troubleshooting of network-related problems, etc.

10.   The Management Application shall have a customizable view that allows the Network Operator to configure specific views.

11.   System and Management Application Requirements

      a.   Real-time fault detection, analysis, and reporting using device knowledge and fault rules based on best practices for each device.

      b.   Layer 2 tools for device and connectivity discovery, detailed topology views, end-point tracking, Layer 2 and 3 path analysis.

      c.   Tools for managing network devices using inventory-change and device-change management, network-configuration and software-image management, network availability, and system log analysis.

      d.   Network response-time and availability troubleshooting application. The tool will allow Network Operator to proactively troubleshoot network performance using real-time and historical reports.

      e.   Graphical User Interface (GUI): Back-panel and front-panel displays of devices in dynamic color-coded graphical display.

      f.   Common Services: Provides common management desktop experience and the service for securing access to all applications. Includes a common device and credentials repository for all applications as it populates the repository after running discovery over the managed network.

      g.   Application Portal: Provides for an Internet and Web Based access point to the Management Application.

      h.   Assistant: Provides workflows for simplifying setup of the Centralized Network Management Application and faster troubleshooting of device-related issues.

11.   Product Specification:

      a.   Contractor shall submit products for approval, with all requested information above included.

G.   Patch Cords

1.   Patch cords shall be provided and installed as part of this work for connectivity to every network equipment port (fiber, copper, stack cables, etc.). This includes ALL equipment and/or device that are connected to the network as well as connecting the network equipment themselves. This is typical of Station Devices to Equipment (IPTV Decoders, POS, Computer, IP Telephone, etc.); IP Telephone to Computer Equipment; Patch Panels to Access Level Switches; Patch Panels to Core Level Switches, and Interconnection of Network Components (Routers, Firewalls, DMZs, Data Center Switches, Servers, Service Provider Demarc (WAN and PSTN), Analog Telephone Gateways, etc.).

2.   Exact patch cord lengths shall be determined during field coordination and coordinated with Owner. Contractor shall coordinate with Owner on selection of colors of the patch cords.

3.   All patch cords shall be labeled on each end to match cable system scheme or as directed by Owner.

4.   All patch cords shall be neatly grouped, organized, and wrapped to together.

5.   Communication Rooms:
      The following minimum patch cords quantities shall be provided to interconnect Data

Network Equipment to other Data Network Equipment and Data Network Equipment to patch panels in the Main Communications Rooms, Data Center, and Intermediate Communications Rooms.
   a. Single-Mode Fiber Optic Cable: Duplex LC Connectors with 2-strands single-mode fiber optic cable. Contractor shall review Fiber Optic patch cord requirements against provided SFP optics and all installed systems. Contractor shall provide 20% spare additional cables, for owner use at system turn over.
   b. Cat 6A: (#) RJ45/RJ45 Cat. 6A, 4-pair patch cords.
   c. Quantities: Patch cord quantities shall be field verified to provide full connectivity plus 20% spare.
6. Station Equipment:
   a. Cat 6A: (#) RJ45/RJ45 Cat. 6A, 4-pair patch cords.
   b. Quantities: Patch cord quantities shall be field verified to provide full connectivity plus 20% spare.
7. Products:
   cords shall be from same manufacturer awarded communications infrastructure. Contractor shall coordinate with Construction Manager to confirm type selected. Requirements shall meet Division 27 requirements.

H. UPS Systems

   1. Intermediate Communications Rooms:
      a. UPS equipment is being provided as part of separate specification section.
      b. Each intermediate communications room shall be installed with a UPS device capable of 10-minutes under full load as necessary. UPS devices shall be connected to emergency power provided in these rooms.
      c. Contractor shall coordinate and calculate UPS requirements with equipment vendors providing UPS equipment.
      d. Data Network Contractor shall interface Data Network equipment to electrical receptacles.

I. Electrical Power Overload Protection: Overload protection shall be provided by fuses, circuit breakers or other protective devices. Fusing and protective devices shall be easily accessible and shall be designed to provide automatic alarm capabilities.

J. Wireless Data Network System

   1. Wireless system is being provided as part of a separate specification section.
   2. Contractor shall coordinate all wireless system requirements and note any concerns to Owner and Engineer, in writing, immediately.
   3. Refer to 27 21 01 for Wireless Data System specification.

H.   Out-Of-Band (OOB) Management Network

   4. Provide break out scope and price for Owner review and approval.
   5. Contractor and Equipment Manufacturer shall provide and recommend options for Out-of-Band Management Network.
   6. Exact requirements to be coordinated with Owner.

PART 3 – EXECUTION

3.1   GENERAL

A.   Provided below are general requirements and milestones for executing work. Additional requirements may be necessary to complete work.

1.   Overall Execution Requirements
  a.   Provide a single project team that will install all systems and applications listed above. Any subcontractors must be detailed in the proposal.
  b.   Attend multiple client meetings to discuss specific applications and functionality and their applicability to the customer.
  c.   Provide a single project manager for duration of project.
  d.   Prepare, maintain and update the Project Timeline.
  e.   Attend weekly project meetings on-site.
  f.   Create meeting minutes for all meetings.
  g.   Site survey reviews and inspections. Notify Owner, Construction Manager, and General Contractor of any problems.
  h.   Coordinate work with other trades, 3rd party resources and/or subcontractors.
  i.   Contractor is responsible for all network equipment to be installed until system acceptance by Owner.

2.   Owner Coordination and Review
  a.   Provide submittals as outlined in this specification and additional information
  b.   Design, review, and coordinate system parameters such as DHCP, TFTP, DNS, IP addressing scheme and other parameters with Owner, Users, Tenants, and other building systems being interfaced. Contractor shall recommend changes (in writing) to insure QoS and a robust IP network.
  c.   Coordinate equipment availability and procurement dates with Manufacturer. Information shall be submitted in a schedule format for review with Owner.
  d.   Review room ready dates with Construction Manager and Owner.
  e.   Coordinate 3rd party applications and integrate into system.
  f.   Prepare implementation, phasing, cutover and testing plans.
  g.   Prepare design of all equipment, components, and options required.
  h.   Coordinate physical and support systems of the proposed and selected data network equipment and components.
  i.   Notify Owner of any potential PoE problems with devices planned for the data network, including power consumption.
  j.   Prepare Visio network diagram of proposed connectivity.
  k.   Submit bill of materials for Owner approval.
  l.   Review construction schedule with Construction Manager and Owner.
  m.   Provide Manufacturer's recommended spare parts list in accordance with the delivery schedule set forth in the contract.
  n.   Coordinate 802.1Q VLAN Trunking scheme.

3.   Implementation
  a.   Order and procure all equipment authorized by Owner.
  b.   Receive and inventory equipment.
  c.   Record serial numbers and provide to Owner.
  d.   Setup, program, and test all equipment and components offsite at Contractor's labs.
  e.   Coordinate and develop security levels and access privileges.
  f.   Coordinate and develop routing plan.
  g.   Coordinate, develop and configure security settings and backup processes.
  h.   Configure IP address for management interface.
  i.   Configure SNMP community names.

       j.   Establish, determine, and configure VLAN(s).

       k.   Configure and develop 802.1Q VLAN Trunks.

4. Installation

    a.   Deliver equipment to secured location at job site.

    b.   Configure, Test and Integrate system with the WAN Data Service Provider and coordinate with Service Provider for additional requirements for a complete and functional system.

    c.   Physically install all equipment and components in racks and cabinets.

    d.   Connect equipment and components to electrical power and UPS.

    e.   Patch all equipment and components within room to backbone infrastructure, inter-equipment connections, and end-point (station) device patching to wall outlets.

    f.   Install the data network equipment and components as specified by Manufacturer and relevant to construction schedule and phasing plan.

    g.   Enable Quality of Service on all switches to support critical application and systems.

    h.   Implement, enable and configure QOS settings on LAN infrastructure.

5. Evaluation

    a.   Perform a complete LAN network assessment as necessary to guarantee a robust environment of critical applications and systems including IP Telephony, IP surveillance and IPTV. This should be performed after the necessary network upgrades have been installed. Submit network assessment results to the customer.

    b.   Test fail-over and redundancy of network.

    c.   Test power failure conditions to ensure both UPS systems and generator operates as planned and maintains network functionality.

    d.   Fail Test System.

    e.   Cutover systems.

    f.   Troubleshoot and Correct.

6. Go-Live and Testing

    a.   Test all systems and 3rd party applications.

    b.   First 7 days of in-service coverage.

    c.   Staff help desk for 7 days.

    d.   Technicians and engineers must attend first practice event and first full event.

    e.   Troubleshoot and Correct.

7. Finalization

    a.   Prepare Owner acceptance matrix for equipment.

    b.   Get sign off on each piece of equipment by Owner.

    c.   Turn over complete system documentation to customer.

    d.   Prepare a complete system ready checklist, compliance list, and commission system accordingly.

    e.   Receive final Network Acceptance Letter from Owner, prior to warranty start.

8. Training

    a.   Conduct Classroom training on system configuration and administration for all users.

    b.   Coordinate with client to design and prepare customized 1 page "Cheat Sheet" for network administration features.

    c.   Perform system administration training on all systems.

3.2   EXAMINATION

A.   Contractor shall coordinate with the Construction Manager to ensure that acceptable conditions exist for installation of all equipment and components.

B.   Proceed with installation only after unsatisfactory conditions have been corrected. Provide detailed site survey to ensure acceptable conditions exist.

C.   Examine all rooms and areas where equipment and components will be installed. Check all elements for compliance with space allocations, installation tolerances, hazards to equipment installation, and other conditions affecting installation.

D.   Examine walls, floors, roofs, and roof supports for suitable conditions where equipment is to be installed.

E.   Examine all support systems such as air-conditioning, electrical panels, receptacles, UPS, lighting, etc. are installed and functioning correctly.

F.   Examine all equipment racks and cabinets installations to ensure acceptable conditions exist for installation of all equipment and components.

G.   Ensure that all rooms and any areas where equipment and components are installed are physically secured at all times from theft, vandalism, etc.

H.   Report unacceptable installation or unsafe conditions to the Construction Manager.

I.   Under no condition shall the Contractor install any equipment or component that will void Manufacturer warranty or such conditions that will reduce equipment performance, longevity, and life.

3.3   MAINTENANCE

A.   Maintenance is to be provided on a complete service basis. Maintenance costs, other than those covered under warranty, shall be listed separately from the cost of equipment and shall include the costs of all parts and labor. The initial maintenance contract will be for a 1-year period starting at the conclusion of the warranty service period. The 1-year maintenance cost must be included as a separate cost in the basic offering. Maintenance cost shall be provided for 1-year, 2-years, 3-years, 4-years, and 5-years.

B.   The Contractor's response shall indicate if Contractor plans to provide total system maintenance or subcontract the system maintenance or any part thereof. In the event the use of subcontract maintenance is planned, the Contractor shall indicate what portion(s) of the system maintenance will be provided by the subcontractor and shall furnish proof of an agreement or that a tentative agreement has been negotiated with the subcontractor to provide maintenance on the proposed system. The Contractor shall also provide sufficient documentation that indicates the subcontractor is properly trained and has been certified by the equipment Manufacturer to provide maintenance on the proposed system or any part thereof.

C.   Maintenance will include coordination with Data Circuits procured from Telecommunication Service Providers network access trunks, WAN circuits, Internet circuits, and access devices. This coordination will include the resolution of problems involving the Telecom Service Provider's circuitry and will be a part of the Provider's warranty service and maintenance contract responsibilities as Owner's agent.

D.   Emergency maintenance response time shall be within 4-hours after receipt of an emergency maintenance call from Owner's designated representative. Emergency maintenance is defined as:

    1.   System Failure

    2.   Failure of a Common Control Unit
    3.   Failure of 20% or More Network Ports and Uplinks
    4.   Failure of a Power Supply
    5.   Any System Failure that impacts events and/or business operations with no work-around

E.   Routine maintenance response time shall be within 12-hours after receipt of a routine maintenance call from Owner's designated representative. Routine maintenance is defined as any occurrence that does not meet the criteria of emergency maintenance

F.   For evaluation purposes only, unit prices will be multiplies by Service supplied factors based on equipment lines indicated in Part-2 System Requirements. Furnish the labor rate and escalation factor to be used to provide a 5-year price forecast of equipment changes and relocations.

G.   Emergency/critical requirements above may necessitate shorter time intervals. Manufacturer and Contractor shall submit options for Owner review and approval.

H.   Contractor shall propose spare parts list and training that the Owner's onsite staff can acquire that could benefit response time and reduce maintenance cost. Options shall be proposed for Owner review and approval.

3.4   EVALUATION CRITERIA

A.   Maintenance Staffing: Contractor shall provide information on the number of certified technicians on its staff to service the type of the Data Network being proposed and the total number of that type of in the Contractor's local service area. Contractor must provide a letter of recommendation for the proposed product from manufacturer.

B.   Escalation Procedures: Contractor shall furnish a chart, which shows the escalation procedures to be followed to resolve problems or procedures.

C.   Preventative Maintenance: Contractor shall list the type and frequency of preventative maintenance procedures that will be provided under warranty and included in Contractor's maintenance contract.

D.   Remote Maintenance and Diagnostic Testing: Contractor shall list the type, capabilities and frequency of these procedures.

E.   Technical Support: Contractor shall provide information on the type of technical support, who will provide the technical support and the hours when technical support will be available.

F.   Service Area: Contractor shall supply the name, street address, city, state, zip code, and telephone number of Contractor's local service center. Indicate the distance from this local service center to Owner's Premise in road miles and driving time.

G.   Contact for Maintenance: Contractor shall indicate who the Owner's telephone coordinator will contact to obtain service for the Data Network and Routing System.

H.   Maintenance Response Time: Contractor shall list the response time and the availability of emergency and routine maintenance.

I.   Dispatching of Technicians for Requests for Maintenance: Contractor shall provide the methods used to dispatch technical staff to respond to Owner's calls for service.

J.   Maintenance Records: Contractor shall indicate the type of maintenance records maintained and the location of these records.

K.   Spare Parts: Contractor shall supply information on the geographical location of replacement spare parts and indicate the distance from this parts depot to Owner's facility in road miles and driving time. In addition, list the emergency backup location for spare parts and indicate the distance from that location for spare parts and indicate the distance from that location to Owner's facility in road miles and driving time or the time required to get parts from that depot to Owner's facility.

L.   System Implementation Schedule: Contractor shall provide a Data Network and Routing System implementation schedule for the project.

3.5   SOFTWARE AGREEMENT

Reasonable licensing terms and conditions will be presented to Owner for review and approval related to any proprietary system software and operating systems required to be delivered under the terms of any contract resulting from this RFP.

Bidders must provide cost of the next two versions of firmware and software upgrades.

3.6   INSTALLATION

A.   General:

1.   This Section describes the installation locations for the products and materials, as well as methods associated with the Data Network system portions of the Project including all equipment, components, and cabling. These Specifications, along with the drawings shall be followed during the course of the installation.
2.   Examine areas and conditions under which equipment, components, and cabling are to be installed. Notify Owner, Construction Manager, Architect, and Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to installer.
3.   The Contractor shall be knowledgeable of work to be performed by other trades and take necessary steps to integrate and coordinate their work with other trades.
4.   The Contractor shall be responsible for furnishing all equipment, components, and cabling as specified herein and as indicated on the drawings.
5.   The Contractor shall verify space requirements and locations before starting installation of equipment, components, and cabling. Inappropriate conditions shall be immediately reported to Construction Manager, Owner, Architect, and Engineer prior to initiating installation.
6.   All equipment, components, and cabling shall be installed in a manner neatly and consistent with this type of work.
7.   All equipment, components, and cabling shall be installed for optimal performance.
8.   All equipment, components, and cabling shall be installed to allow for easy adds, moves, and other changes in the future.
9.   Final labeling scheme shall be coordinated with the Owner and Engineer during the shop drawings process, prior to initiating work. Labeling scheme shall include all equipment, components, and cabling with all appropriate references such as communications rooms, cabinets, racks, cable terminal blocks, patch panels, antennas, outlets, cables, etc.
10.   Construction within communication rooms must be substantially complete before the installation of equipment, components, and cabling. This includes, but is not limited to, the installation of plywood backboard, cable tray or ladder rack, electrical outlets, light fixtures, sprinklers and ductwork. All walls shall also be painted before the installation.

11. All equipment, components, and cable noted in this Specification and associated drawings shall be provided and completely setup and installed.
12. The Contractor is required to coordinate their efforts with the other trades and sub-contractor who may be working within the same vicinity to avoid conflict and lost time.
13. The Contractor shall supply all necessary tools, equipment, accessories, safety equipment, protective clothing, etc., as customary for the craft and necessary for the installation.
14. The contractor shall not install any component in a manner or condition that will void Manufacturer and/or Contractor warrantees. Any such conditions that prevent an acceptable install shall be immediately reported to Construction Manager, Owner, Architect, and Engineer prior to initiating installation. All mis-installed components will be removed and replaced with new at the Contractors expense. No additional cost will be submitted to Owner.
15. All equipment shall be installed in a neat and workmanlike manner, arranged for convenient operation, testing and future maintenance.
16. Communication rooms must be free from dust, dirt, and other foreign materials before the installation of any equipment and components. The door to the communication rooms must be installed and closed during termination.

B.   Cable and Patch Cord Installation:

1. All Data Network cable and patch cords shall be provided and installed per Division 27 specifications.
2. All Data Network and communications cables and patch cords routed within communications rooms shall be bundled and combed with Velcro to provide a neat and organized appearance. This includes horizontal and vertical cables routed on cable tray, d-rings, vertical cable managers, equipment rack cable managers, etc. Cables shall be bundled using only manufacturer and industry approved Velcro ties with tensions that do not deform and damage cable resulting in loss of transmission or performance. Any bundles and combing methods used shall not exceed manufacturer or industry standards recommendations for that cable type.
3. Within communications rooms, cables and patch cords shall be snugly wrapped using Velcro reusable cable ties, a minimum of every 3'-0" for cable organization. Velcro ties shall be tightened so as not to deform cable jackets and thus affect cable performance. Plastic cable tie wraps shall not be used and will prevent system acceptance.
4. Cable bends shall not be less than that recommended by the manufacturer of the cable. Do not exceed manufacturer's minimum bending radii and other cable requirements. Provided below are some examples but all requirements shall be verified.
5. Care shall be taken so as not to damage cable and patch cords during the installation process and that the manufacturer's and industry standard's pull tension specification is not exceeded.
6. Do not install bruised, kinked, scored, deformed, or abraded cable or patch cords. Remove and discard cable if damaged during installation and replace it with new cable.
7. All cables and patch cords shall be installed in vertical and horizontal cable management within cabinets and racks.
8. Cable and patch cords routed outside of racks and cabinets shall be in cable tray and ladder rack. Fiber optic patch cords shall be routed in fiber trough.
9. Provide independent circuit grounding recommended by manufacturer.
10. Under no circumstances shall the cable or patch cords be painted, treated, or covered with other material unless approved by manufacturer, Owner and Engineer.

C.   Equipment Installation:

1. Contractor shall evaluate each space prior to equipment installation. Room shall be free from dust and debris; room shall be complete and sealed against further dust and debris. Contractor shall notify Owner, Engineer and Construction manager of any rooms that don't meet this requirement.
2. Install surge suppressors where ac-power-operated devices are not protected against voltage transients by integral surge suppressors specified in UL1449. Install surge suppressors at the devices' power-line terminals. Comply with Division 26 Section "Transient Voltage Suppression."
3. Point of Interface Equipment: Mount electronic equipment in the types of cabinets recommended by manufacturer. Group related items in methodical sequence.
4. Arrange equipment to facilitate access for maintenance and to preserve headroom and passage space.
5. All equipment and interfaces shall be labeled.

D. Network Management and Monitoring Software Installation:

1. Install all system management software on Owner provided computers, if provided as part scope of work.
2. Coordinate computer and data network requirements with Owner's IT Group. This should include MAC and IP addressing, VLAN assignment, bandwidth requirements, class of service (CoS), quality of service (QoS), VPN requirements, etc.
3. The system management and monitoring software shall be fully setup, programmed, and configured including but not limited to the following:
4. Date and Time.
5. Network end points including but not limited to switches, routers, wireless access points, routers, firewalls, etc.
6. Graphical user interface (GUI) including facility maps indicating interactive icons for all equipment locations, wireless antennae points, and uplinks.
7. Web portals, user access, and VPN.
8. Administrator accounts, passwords, and security levels.
9. User accounts, passwords, and security levels.
10. Device thresholds, status, alarm points, alerts, and notification.
11. Remote diagnostics.
12. System Inventory.
13. Event reporting protocol.
14. System logs including status, performance, alarms, history, and others.
15. Maintenance log, schedules, and notification.

3.7   CONSTRUCTION PHASING

A. The Data Network and communications infrastructure installation shall be provided, installed and phased as necessary to meet construction schedule.

B. The contractor shall meet with the Construction Manager and Owner to review the construction schedule and associated areas of work.

C. All necessary labor, cable, terminations, components, equipment, and components shall be provided to accommodate temporary, phased, and final conditions and requirement.

D. Coordinate project schedule, installation schedule, phasing and any other requirements deemed necessary with Owner, Construction Manager and all necessary Trades to ensure successful completion of work.

3.8   COORDINATION

A.   Design Coordination: All components proposed by the Contractor shall be coordinated with the Owner and Architect. Provided below is a general list of major items that shall be documented in a table and coordinated. The list provided below is to be used as an example and not intended to be all inclusive or limit items required to be reviewed and coordinated.

1.   Equipment Type, Physical Size, and Weight.
2.   Rack Units required per location.
3.   Electrical Power (voltage, amp, loads, and receptacle types).
4.   UPS (connectivity and runtime.
5.   HVAC (heat dissipation and equipment operating temperature range).
6.   Wireless Access Point Types and Locations.

B.   Installation Coordination: The Contractor shall field coordinate all work with Construction Manager and other Sub-Contractors and Trades as necessary to minimize conflicts. This shall include reviewing each Trades and Sub-Contractor's shop drawings and resolving conflicts.

C.   Schedule: The Contractor shall coordinate the project schedule with the Owner and Construction Manager including but not limited to the following:

1.   RFP Response
2.   Submittals
3.   Construction and Phasing
4.   Room Ready Dates
5.   Installation
6.   Substantial Completion
7.   Final Completion
8.   System Acceptance
9.   Training

3.9   IDENTIFICATION

A.   General Label Requirements:

1.   The labeling scheme provided by the Contractor and coordinated with the Owner and Architect prior to finalizing and initiating any work. A sample scheme shall be submitted for approval.
2.   Mechanically print and install all labels.
3.   Format: Select font size to be readable and to fit all information required without overlap of text.
4.   Use all capital letters.
5.   All labels shall be consistent font type, size, and color throughout project.
6.   Labels shall be white with black text.
7.   Clean all surfaces prior to attachment of any label. Follow manufacturer's recommendations for cleaning and affixing labels.
8.   Method: Brady cable labels appropriately sized or approved equal.

B.   Cable:

1.   Label Location: Within 0.5 inches (25 mm) of each termination.
2.   Near-End Label Information: Cable No. XXX. Where XXX is the cable infrastructure number on the patch panel or inter-equipment port number.

3. Far-End Label Information: Cable No. XXX. Where XXX is the cable infrastructure number on the patch panel or inter-equipment port number.

C. Equipment:

1. Labeling shall be submitted to Owner for review and approval.
2. Label all major equipment and components.
3. Label Information: Equipment No., Type (or Short Description), and Manufacturer part number or equipment series.

3.10 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Contractor shall engage a Manufacturer-authorized service representative to inspect field-assembled components and equipment installation, and supervise pre-testing, testing, and adjusting of equipment.

B. Inspection: Contractor shall verify that equipment and components are properly installed, connected, setup, configured, and programmed.

C. Pre-testing: Contractor shall adjust system and pretest equipment, components, wiring, and functions to verify that they comply with specified requirements. Replace all malfunctioning or damaged items. Retest until satisfactory performance and conditions are achieved.

D. Operational Tests: Contractor shall perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

E. Test Schedule: Contractor shall schedule tests after Operational testing has successfully been completed and system has been in normal functional operation for at least 7-days. Provide a minimum of 7-days' notice of test schedule. Contractor may have to compress testing schedule to meet project phasing deadlines and must accommodate all overtime and work after hours to meet schedule.

F. Test Results: Contractor shall record test results and publish in electronic and hard copies for distribution to Owner.

G. Re-Test: Contractor shall correct all deficiencies identified by tests and observations, and re-test until specified requirements are met.

H. Commissioning: Contractor shall create and submit a checklist for commissioning system equipment and components. The list shall include the following categories.

1. Validate Procured Components
2. Physical Installation and Location
3. Equipment Connectivity and Inter-Connectivity
4. Support Systems Functioning (HVAC, electrical, and UPS)
5. System Setup and Operation
6. VLAN Assignment and Quality of Service (QoS)
7. Testing
8. Fail Testing

I. Onsite Event Support: Provide onsite support for each major event for the first 90-days following the final installation. A major event shall be any event with an attendance exceeding

15,000 attendees. The term limit will start after system acceptance by Owner. The Contractor shall provide onsite support for all events prior to system acceptance by Owner.

3.11   FAIL TESTING

A.   General:

1.   An Equipment Fail Test of all major equipment and components shall be performed by the Contractor and observed by the Owner. The system Manufacturer shall have appropriate personnel onsite to assist with testing.
2.   Real-time visual proof shall be provided using HD Video Displays with live feeds from the IPTV system connected to the core switch and access layer. Additionally, a computer workstation with connectivity shall be used to check connectivity to the Internet and WAN.
3.   Intent of Equipment Fail Test is to confirm system availability, uptime, redundancy, and failover vital to system operation. All redundant Data Network equipment and equipment with redundant components shall be failed test to validate failover.
4.   Fail testing shall be completed on the fully functioning Data Network system after Contractor and Manufacturer has completed all system setup, programming, and configuration, standard testing, troubleshooting, replaced all faulty components, and validated system performance and operation.
5.   The Contractor shall coordinate Equipment Fail Testing schedule with Owner.

B.   The installed Data Network must demonstrate its capability of providing the services enumerated in the contract. Test equipment required for demonstration will be Contractor provided. Contractor will also provide documented test results.

C.   Component Failure Tests: Contractor shall submit a schedule for testing after final completion of network and attached systems. IPTV and other systems, must be up and running on network to verify actual network performance for failure under stress.

1.   Power Cord (each, separately)
2.   Power Supply (each, separately)
3.   Supervisor (each, separately)
4.   Uplinks (each, separately)
5.   Switch Stack (stack type switches only)

D.   Equipment and Components: Fail testing shall be completed on each of the following components:

1.   Core Switches
    a.   Primary Switch
    b.   Redundant Switch
2.   Access Switches
3.   Data Center Switches
4.   Edge & DMZ Switches
5.   Firewall Appliances

3.12   CLEANING

A.   Contractor shall clean all equipment and components using methods and materials recommended by manufacturer.

B.   Equipment cleaning shall be completed prior to final site observation by Owner and final system acceptance.

3.13   DEMONSTRATION AND TRAINING

A.   Provide (80) hours per technology implemented (Access, Security, Management, etc.) of onsite administrative and user training on the live Data Network system.

B.   Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment.

   1.   Conduct training as specified in instructions to Owner's employees in Division 1 Section "Contract Closeout" or Division 26 Section "General Electrical Requirements." This shall include training with System Maintenance and Monitoring Software System.
   2.   Review the system architecture, setup, configuration, connectivity, and location of all equipment and components.
   3.   Provide general description of function for each individual equipment and component.
   4.   Train Owner's maintenance personnel on procedures and schedules for system administration, routine use, troubleshooting, servicing, and maintaining equipment.
   5.   Demonstrate methods of determining optimum setup, configuration, and adjustment of equipment and components for system controls and function.
   6.   Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data", Division 26 Section "General Electrical Requirements" and Division 27 Section "General Technology Requirements".
   7.   Schedule training with Owner with at least 14-days advance notice.

C.   Provide, as an Alternate, costs for (2) Classes for (2) people per class for Manufacturer training from and Owner approved trainer for the following types of courses:

   1.   Introduction to Converged Networks
   2.   Network Administration, Maintenance, and Troubleshooting.
   3.   IP Telephony Administration, Maintenance, and Troubleshooting.
   4.   Basic Switching and Routing.
   5.   Advanced Switching and Routing.
   6.   Other Applications proposed by Owner such as E911, ACD, XML, etc.

3.14   RECORD DOCUMENTATION

A.   All Record documentation shall be submitted to the Owner by the Contractor at the completion of the Data Network installation. The contractor shall submit all information necessary to operate and maintain system including but not limited to the following:

   1.   As-Built Documents
   2.   Operations and Maintenance Manuals
   3.   Maintenance Schedule
   4.   Maintenance Company Contact Information
   5.   Trouble Shooting Guide
   6.   Product Data and Manufacturer Cut-Sheets
   7.   Warranty Information and Contact
   8.   Manufacturer's Product and Installation Certificate
   9.   Log (troubleshooting, replacement, expansion, and replacements)
   10.   Labeling Scheme
   11.   Spare Parts Lists
   12.   Network Information: Contractor shall provide full network information document for submittal to Owner at the conclusion of the project. Each room shall be documented as a

separate document amended to an overall architecture document. It shall be provided in Visio format and include, but not be limited to:

    a.   Detailed Installation Information:
        1)   Settings
        2)   VLANs
        3)   IP Addressing
        4)   Routing Information
        5)   QoS, CoS, settings
        6)   Etc.
    b.   Equipment Information:
        1)   Serial Number
        2)   Part Number
        3)   Warranty Expiration
    c.   Backup Configuration of all equipment at final acceptance
    d.   Backups of all Software installed as part of this work
    e.   Breakdown of Identification/Labeling Scheme

B.   Maintain current record documents at the construction site.

C.   Refer to Submittal Section of this Specification for additional requirements.

END OF SECTION