

DATA AND COMMUNICATIONS SPECIFICATIONS

OUSD Technology Services

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INTRODUCTION

The Technology Implementation Specifications within this document represent the standards of the Oakland Unified School District (OUSD) for the provisioning and implementation of Information Technology and related systems. Collectively, these specifications address a broad range of technologies, specifically:

- Data Network (e.g., LAN/WAN) Infrastructure - Wired and Wireless
- Voice-over-IP (VoIP) Telecommunication Infrastructure
- Clock & Speaker Infrastructure
- Security Camera & Infrastructure
- Audio/Visual Standards - Draft

Please note that, wherever a specific manufacturer and/or product is listed, the words “or approved equal” shall be understood to be appended. Such equivalents, however, are subject to OUSD approval.

This version supersedes all previous versions of this document. The shorter four page “OUSD Standard Network Build Specification” document is obsolete.

DOCUMENT CHANGE HISTORY

Version Number	Revision Date	Summary of Changes
1.7	1/10/2015	Base document
1.8	3/20/2015	Added document change history. Removed page numbers in TOC. They will return in a future version. Replaced fiber LC connectors with SC-Duplex connectors. Removed non-metallic raceway. Clarified ethernet cable colors. Updated Meraki AP model for outdoor and industrial applications
1.9	11/5/2015	Clarified separation of telecom and datacom cabling within wiring closets. Changed multimode cabling to single mode. Removed requirement for wiremold in classroom
2.0	6/16/2017	Converged Telecommunications requirements. Updated enclosures and cable specs. Upgraded to Cat 6a
2.1	9/30/2018	Converged Telecommunications requirements. Updated enclosures and cable specs. Upgraded to Cat 6a. MDF/IDF Room Requirements; New & Existing Construction.. Updated room types and drop counts per room. Installation of wiremold in classrooms & offices. Installation height of wall mounted IDF enclosures. Underground PVC conduit sizes and schedules. Security camera equipment. Data drop counts for conference rooms, offices, storage closets, and AV closets

Version Number	Revision Date	Summary of Changes
20.0	5/15/2020	AV Standards. Added Multi-Band Antenna. Updated Section 2.4 Switch Architecture Characteristics - Current Standards. Added Fluke Test Reports to be provided by Contractor. OUSD Technology Services Approval of all Submittals. Updated drop counts in K-12 & Administrative sites. Electrical outlets adjacent to data drops. Updated required certifications to be held by designer, contractor and installer.. Updated warranty time for cabling. Updated approval from OUSD Technology Services and OUSD representative for contractor deviations from design. Updated departments for training services. Updated Manufacturer Catalog Data to include Audio Visual. Updated Requirements for Contractor provided shop drawings.. Updated Statements under Drawings in Section 1.4 to include attic stock of cabling, network equipment, and components.. Updated the percentage of spare switch ports.. Updated Pre-installation testing for fiber optic cable and documentation. Updated Final Verification Testing to include loss measurement rates for singlemode fiber-optic cable.. Updated Section 1.12 As-Built Documentation. Updated Section 1.13 Miscellaneous Specifications - Ordering Equipment & Materials and Training Requirements. Updated Section 2.5 Power Protection - Updated UPS model number and requirements. Updated Security Camera to Vivotek MA8391-ETV
21.0 DRAFT	2/24/2021	Formatting updates. Added option to view standards in web format. Added innerduct requirement (TBD) Removed current equipment list for cabling, link was broken. Section 3 Security removes some verbosity in specifications. The models remain the same. (TBD) Section 4 AV standards now official and no longer draft.

1.0 TELECOMMUNICATIONS CABLING INFRASTRUCTURE

1.1 OVERVIEW

The Telecommunications Cabling Infrastructure or Structured Cabling is designed to be a distributed star topology with all data, voice and video services originating from a Main Distribution Frame (MDF). From the MDF, cables shall extend to various Intermediate Distribution Frame (IDF) locations distributed throughout the campus. To the extent possible, all MDFs, IDFs shall be located in secured areas and/or enclosures; all such locations shall be subject to approval by OUSD technology and facilities departments. An extensive conduit system extends throughout most of the larger campuses and provides communication pathways to each of the buildings.

Connectivity between these facilities shall be via fiber optic and/or copper cables. For all new implementations, the following represents OUSD Standard:

- 12-strand 9/125 microns, Single Mode ARMORED Plenum-rated Fiber Optic Riser Cables Indoor/Outdoor, Tight Buffer with SC-Duplex Connectors with ceramic ferrule, 9/125 microns. This is for connecting MDF to IDF.
- Category 6a Unshielded Twisted Pair Copper Cables, with Category 6a RJ45 Connectors

- B40-MB50 Multi-Band Antenna, The B40-MB50 Multi-Band Antenna shall be routed in a dedicated ½” minimum EMT conduit. The antenna shall be exterior wall mounted at roof level.

Alternate standards may be approved by OUSD on a case-by-case basis where existing cable will be supplemented by new cables.

Separate parallel systems exist only for the following: fire alarm, intrusion alarm, and building controls (e.g. BACnet). These parallel systems often interconnect with the data network for remote monitoring and intersite communication. The contractor shall take great care to not to disturb these systems in any way. The Technology Standards herein are intended to cover data, security cameras, audio/visual, voice and video (VOIP) connectivity provided as a service to the district as a whole and managed by the Technology Services Department.

Unspecified Equipment & Material

Any item of equipment or material not specifically addressed on the drawings or in this document and required to provide a complete and functional installation shall be provided in a level of quantity and quality consistent with other specified items.

This section provides a description of technical and/or performance specifications relative to OUSD’s installation pricing requirements. Specifically, this section has been arranged to present information in the following order:

Click to expand

- Basic Contractor Responsibilities
- Contractor Qualifications
- Panduit design and installation certifications
- Provisioning by Contractor
- Provisioning by Others
- Pathways Installations
- Submittals/Variances
- Acceptance and Subsequent Support
- Other Contractor Responsibilities
- System Documentation and Standards
- Standards, Guidelines and Practices
- System Certification and/or Warranties
- Products
- MDF/IDF Room Build outs
- Pathways
- Backbone Cables and Terminations
- Horizontal Cables and Terminations
- Other
- Installation
- Overview
- MDF/IDF Room Buildouts
- Pathways
- Backbone Cables and Terminations
- Horizontal Cables and Terminations
- Miscellaneous Cable Requirements
- Labeling Schemes
- Testing Procedures
- As-Built Documentation
- Miscellaneous OUSD Installation Requirements

1.2 DEFINITION - TELECOMMUNICATIONS CABLING INFRASTRUCTURE

TELECOMMUNICATIONS CABLING INFRASTRUCTURE is defined as all required equipment and cabling including the following: cabinets, racks, splice enclosures, termination blocks, cross-connect wire or cordage, patch panels, patch cords, telecommunication outlets, mounting hardware, wire management, shielded and unshielded twisted pair, sub-duct (innerduct), coaxial and optical fiber cable installed and configured to provide computer data and voice connectivity from each data or voice device to the network file server or voice network/switch designated as the service point of the local area network.

Cables and terminations shall be provided and located as shown and in the quantities indicated in the Scope of Work and supported by the drawings. Fiber cables shall terminate in modular patch panels located in all demarcation and termination points shown on the drawings. All cables and terminations shall be identified at all locations. All cables shall terminate in an alphanumeric sequence at all termination locations. All copper cable terminations shall comply with, and be tested to TIA/EIA 568A and TSB-67 standards for Category 6a for data cabling and telephone installations. Station cables shall terminate on appropriate station termination hardware, surface mount or flush mount, equipped as shown on the drawings.

1.3 BASIC CONTRACTOR RESPONSIBILITIES

The Contractor shall, at a minimum, possess the following attributes:

- The Oakland Unified School District (“District”) has determined that contractors on future projects (“Contractor(s)” or “Firm(s)”) must be prequalified prior to submitting a bid or proposal on the District’s state-funding eligible and lease-leaseback projects. To become pre-qualified, follow this link or copy and paste into your browser www.ousd.org/Page/243.
- Current manufacturer certification as a certified designer and as a certified installer of the product to be installed, which shall remain valid during the entire course of the installation agreement, with no known pending action or intent by manufacturer and/or the Contractor to terminate or limit status as a manufacturer certified designer and installer.

NOTE: Pending Respondent status as a certified designer and installer is unacceptable. Proof of this certification must be included in all bid packets submitted to the district in order for a vendor to be qualified for selection.

Required Certifications to be held by Designer, Contractor and Installers

1. Juniper (Elite)
2. Cisco (Gold Partner) - includes Meraki
3. Panduit (Silver or Gold)

- At least one prior year of certified status with the manufacturer for the products to be installed, including the right and ability to deliver a completed installation conforming to the manufacturer’s warranty program requirements; additionally, the Contractor must have completed at least five similar projects as a certified designer and installer for the products to be installed.
- Five years of cabling and pathway implementation experience under its current organizational structure, either directly or under wholly owned predecessor entities.
- Profitable status for at least the two preceding fiscal years (three years if privately held and not submitting financial statements).
- No significant pending litigation, which may subject the company to financial risk exceeding twenty percent of its value.

- Insurance coverage as required by OUSD (such as, but not limited to, workers compensation), as well as professional liability coverage of not less than \$1,000,000 per occurrence.
- At least one Registered Communication Distribution Designer (RCDD) certified by Building Industries Consultant Services International, including the willingness and intent to assign such personnel to this project as project engineer or project manager.
- Personnel specifically trained and certified under the manufacturer's installation training program, including the willingness and intent to assign installation project resources in a manner which utilizes certified personnel for each and every project manager and foreman/supervisor position associated with providing services to meet these installation requirements.

Provisioning by Contractor It shall be the responsibility of the Contractor to provide shop drawings of any cable path engineering and cable system engineering in conjunction with the drawings issued by OUSD for the subject installation. OUSD, OUSD Technology Services or OUSD's representative, prior to cable placement, must approve any shop drawings of engineered pathways not already depicted on the drawings. The Contractor shall provide a designated project manager to coordinate engineering and construction activity with OUSD or OUSD's representative throughout the course of this engagement.

The Contractor, except as otherwise indicated herein, shall also:

- Provide and install all materials including, but not limited to: communications cable; station jacks, inserts and faceplates; device boxes and brackets; cable support apparatus; cable runways; cable raceways; conduits, sleeves, firestopping, underground pull boxes, junction boxes, grounding, coring and patching, equipment racks, equipment cabinets, MDF/IDF termination components; labeling; testing; etc.
- Provide and furnish all supplemental labor and related services, including, but not limited to: design/engineering, operating system configuration, testing, and test equipment, as-built documentation in AutoCAD printed drawings and software file copy format, contract administration, etc., as applicable to expeditiously completing installations at OUSD facilities in accordance with requirements of this Technical Specification
- Provide Fluke tests reports prior to termination of any and all cabling
- Acquire OUSD Technology Services review & approval for all submittals prior to installation
- Provide and furnish all permits
- Satisfy all shipping, tax and other expenses reasonably associated with the Implementation
- Provide and furnish completely installed and certified systems, inclusive of as-built documentation, cable test documentation, manufacturer's warranties, as well as any and all regulatory sign-offs associated with the Implementation.
- Provide and furnish completed lien waivers and lien releases for each supplier or trade subcontractor utilized during the course of the project.
- Coordinate as necessary with OUSD facilities personnel, campus faculty, OUSD's Representative, and other OUSD contractors, as well as execute installations in accordance with demands of OUSD's requirements.

OUSD reserves the right to define other Contractor responsibilities before executing a final contract.

Provisioning by Others Within the fulfillment of each OUSD installation requirement, certain responsibilities are borne by others. The following bullets generally outline the duties of OUSD, OUSD Technology Services and OUSD's representative.

- OUSD's Representative: For purposes of OUSD's installation requirements, OUSD Representative's overall responsibilities include: providing OUSD with advice and design services relative to the communications infrastructure; oversight and/or project management specifically relevant to OUSD's installation requirements; serve as a liaison between OUSD, the Contractor, campus faculty, various OUSD facilities personnel, and others as applicable but specifically relevant to design, engineering and implementation of OUSD's infrastructure.

Installation It is intended that all unshielded twisted pair (UTP) cabling will be installed, tested and certified to meet the latest available draft of TIA/EIA requirements for Category 6a cabling installations, as well as other industry standards, guidelines and practices. Fiber optic cabling implemented pursuant to OUSD's installation requirements shall likewise be installed, tested and certified to meet the latest applicable standards, guidelines and practices. Furthermore, each installation shall be certified to meet the latest available manufacturer's requirements for an extended warranty of Twenty Five (25) years minimum duration.

These Standards and associated documents may specify various required materials, components and processes. To the extent the Contractor intends to deviate from any written or intended specification, a written request and submittal must be provided to OUSD/OUSD Technology Services/OUSD's Representative and written OUSD and OUSD Technology Services approval must be granted prior to proceeding with any variance.

Acceptance and Subsequent Support Prior to each installation's final acceptance, the Contractor will perform complete system tests under the supervision of OUSD, OUSD Technology Services and/or OUSD's Representative. The Contractor will furnish all necessary test equipment and perform all work required to determine or modify performance to meet specifications as described herein. This work shall include, but not be limited to, the following at no extra cost:

- Complete testing of each and every cable pair or fiber strand in accordance with TIA/EIA standards and guidelines and provide a Fluke test report.
- Submission of detailed, computer generated test results to OUSD/OUSD Technology Services/OUSD's Representatives as required within this Technical Specification
- Adjustment of all components for optimum quality operation as well as for maximum manageability and aesthetic quality
- Development and provision of complete as-built drawings and other documentation as required within this Technical Specification
- Provision of complete instruction to OUSD's personnel in the proper operation of the cabling by a qualified representative of the Contractor at a time suitable to OUSD; complete instructions, diagrams and drawings necessary to ensure the success of the training shall be developed by the Contractor and will become the property of OUSD prior to acceptance
- Provide at a minimum of (2) training sessions for a total of (4) hours each on new network architecture for all OUSD personnel within the Technology, Telecom, and Security, and Audio Visual Departments. The first training session will commence within (10) days after final completion and the second will occur within 1 year after final completion.

OUSD shall either accept the network in writing or notify the Contractor in writing, specifying in reasonable detail, those particulars, which OUSD deems unacceptable. With respect to any such particulars, which OUSD deems are unacceptable, the Contractor shall immediately proceed to correct them, and after correction thereof, OUSD shall accept or reject the

modifications in writing.

Other Contractor Responsibilities In addition to the above, the Contractor shall also abide by the following responsibilities:

- Site Cleaning. Throughout the progress of each OUSD installation, the Contractor shall keep the working areas free from debris of all types and shall remove from the premises all refuse resulting from any work performed by the Contractor. On a daily basis and at the completion of its work, the Contractor shall, to the extent possible, leave the premises in a clean and finished condition.
- Safety Requirements. The Contractor will utilize appropriate personnel and display warning signs, signals, flags and/or barricades at the work site to ensure adherence to OUSD, State and industry safety regulations and as prudence requires. Costs for such safety provisions shall be included within each unit pricing cost.

Specification Status All specifications and requirements related to this project will not be “frozen”, but are subject to change by OUSD, OUSD Technology Services and/or OUSD’s Representative.

1.4 STANDARDS AND SUBMITTALS

Standards, Guidelines and Practices As stated earlier, installation and certification of all unshielded twisted pair (UTP) cabling in accordance with the latest available TIA/EIA requirements for Category 6a cabling installations is required.

Structured Communication Cable Systems and Pathways shall be installed in a “neat and workmanlike manner” as specified by ANSI/NECA/BICSI 568-2001 and National Electrical Code, Sections 110-12 and 800-6.

The contractor shall adhere to and comply with the latest versions and/or revisions of each applicable standard. Among the various standards, guidelines and practices applicable to this project are the following:

Click to expand

- BUILDING INDUSTRY CONSULTING SERVICES INTERNATIONAL:
- BICSI Telecommunications Distribution Methods Manual
- CALIFORNIA BUILDING STANDARDS COMMISSION:
- California Electrical Code (1998) Title 24, Part 3
- FEDERAL COMMUNICATIONS COMMISSION (FCC):
- FCC Part 68.5: Establishment of Telephone Premises Wiring Attestation List
- INSULATED CABLE ENGINEERS ASSOCIATION (ICEA):
- ANSI/ICEA S-80-576: Communication Wire and Cable for Wiring of Premises (1994)
- NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA):
- NEMA WC 63: Telecommunications Cables (1994)
- NATIONAL FIRE PROTECTION ASSOCIATION (NFPA):
- NFPA 70: National Electrical Code (1999)
- PUBLIC WORKS STANDARDS, INC.
- Green Book Standard Specifications For Public Works Construction (2000)
- RURAL ELECTRIFICATION ADMINISTRATION (REA)
- REA 345-165: Digital Stored Program Controlled Central Office Equipment (Form 522) (1989)
- REA TECM 823: Electrical Protection by Use of Gas Tube Arrestors (1980)
- TELECOMMUNICATIONS INDUSTRY ASSOCIATION/ELECTRONIC INDUSTRIES ALLIANCE (EIA)

- TIA/EIA-455-21: FOTP-21 Mating Durability of Fiber Optic Interconnecting Devices (1988)
- EIA-492AAAA: 62.5 uM Core Diameter/125 uM Cladding Diameter Class Ia Multimode, Graded-Index Optical Waveguide Fibers (1989)
- TIA/EIA-526-14A: Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant - OFSTP-14 (August 1998)
- TIA/EIA-568-B.1: Commercial Building Telecommunications Cabling Standard Part 1: General Requirements (May 2001)
- TIA/EIA-568-B.2: Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components (May 2001)
- TIA/EIA-568-B.3: Optical Fiber Components Standard (April 2000)
- TIA/EIA-569: Commercial Building Standard for Telecommunications Pathways and Spaces (June 2001)
- TIA/EIA-570: Residential Telecommunications Wiring Standard (October 1999)
- TIA/EIA-598: Optical Fiber Cabling Color Coding (May 1995)
- TIA/EIA-606: Administration Standard for the Telecommunications Infrastructure of Commercial Buildings (February 1993)
- TIA/EIA-607: Commercial Building Ground and Bonding Requirements for Telecommunications (August 1994)
- TIA/EIA TSB-75: Additional Horizontal Cabling Practices for Open Offices (1996)
- TIA/EIA TSB-758: Customer-Owned Outside Plant Telecommunications Cabling Standard (April 1999)
- UNDERWRITERS LABORATORIES INC. (UL)
- UL 444: Communications Cables (1994; R 1995, Bul. 1995 and 1996)
- UL 467: Grounding and Bonding Equipment (1993; Bul. 1994 and 1996, R 1996)
- UL 497: Safety Protector for Paired Conductor Communication Circuit (1995)
- UL 514C: Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers (1988; R 1989, Bul. 1993 and 1994)
- UL 910: Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air (1995; R 1995, Bul. 1995 and 1996)
- UL 969: Marking and Labeling Systems (1995)
- UL 1286: Office Furnishings (1993)
- UL 1581: Electrical Wires, Cables, and Flexible Cords (1991; Bul. 1993, 1994, 1995, and 1996, R 1996)
- UL 1666: Flame Propagation Height of Electrical and Optical-Fiber Cables Installed in Vertical Shafts (1991; Bul. 1995 and 1996)
- UL 1863: Communication Circuit Accessories (1995)

Federal, state, local, and OUSD codes, rules, regulations and ordinances governing the work, as well as various additional standards, guidelines and practices, may apply and shall be incorporated as part of these Technical Specifications.

In reviewing the various Contract Documents, the Contractor shall be responsible for noting conflicts between proposed design/concepts and the applicable standards, guidelines and practices. A written Request for Information (RFI) shall be developed by the Contractor and submitted to OUSD, Technology Services and/or OUSD's Representative prior to commencing any work impacted by such conflicts; such RFIs shall describe the conflict/violation and, if appropriate, recommend alternative solutions with associated costs. OUSD, Technology Services and/or OUSD's Representative warrants it will diligently strive to address such RFIs in order to minimize negative impact on each installation completion schedule.

Where the requirements of the Contract Documents are more stringent than applicable codes, rules, regulations, ordinances, standards, guidelines and practices, the Contract Documents shall apply. In all other instances, the most current standards, guidelines and practices shall

apply.

System Certification and/or Warranty The installation must be certified to meet the manufacturer's latest available warranty program requirements and delivering to OUSD an extended warranty of at least twenty-five (25) years duration. At minimum, such warranty shall, at no additional cost to OUSD, provide a system warranty covering the installed cabling against defects in workmanship, components and performance. General features of the warranty shall, at a minimum, include:

- An installation warranty extending to protecting OUSD against defects in workmanship for a period of at least one year from the date of system acceptance. Such warranty shall provide all labor and materials necessary to correct a failed portion of the system and to demonstrate performance within original specifications after the repairs are accomplished.
- A system performance warranty extended by the component manufacturer for a period of not less than fifteen (15) years from date of system acceptance. The performance warranty shall warrant the installed horizontal copper and, as applicable, the installed horizontal and backbone fiber optic portions of the system. All such links and segments shall be warranted in accordance with the latest applicable requirements as defined by TIA/EIA.

As outlined herein, OUSD and OUSD Technology Services intends that the resulting cabling will be warranted under the extended warranty provisions extended by the manufacturer. The Technical Specification is based on the products being manufactured by Panduit and others. The warranty shall extend to UTP and fiber optic portions of the installation to the fullest extent allowed by the manufacturer.

Contractor Submittals/Variations OUSD's installations require the submittal of various items as part of the project process. The Contractor is to submit the following prior to construction for OUSD & OUSD Technology Services approval unless otherwise noted:

Manufacturer Catalog Data ¹

- Identification of and specifications regarding any specification variance (see Variations, below)
- 12-strand 9/125 microns, Single Mode ARMORED Plenum-rated Fiber Optic Riser Cables Indoor/Outdoor, Tight Buffer with SC-Duplex Connectors with ceramic ferrule, 9/125 microns. Fiber optic cable test results from each cable spool.
- Current test equipment calibration certifications for each specific test device
- Detailed cable test result and final network testing results documentation
- CAT 6a cabling to be used as well as the color of cabling for each specific use.
- MDF & IDF Enclosures
- Power Strips
- Cable Hangers
- Cable Trays
- External Mounted Raceways
- Floor outlet boxes or modules
- Firestopping Material NFPA 70 & UL 1479 Approved
- Fiber optic type SC connectors
- Telecommunications outlet/connector assemblies (RJ-11 and RJ-45 jacks)
- uninterruptible power supply (UPS)
- Security Cameras and manufacturer recommended installation guides
- Intercom system
- Desktop Computer Monitoring system

- AV Equipment (projectors, TVs, projection screens, mixing boards, microphones, speakers, etc)

Drawings ¹²³ Contractor to provide shop drawings of all cable pathways, outlet placement, and equipment installation and connection for review and approval from OUSD & OUSD IT Department prior to installation to show clear understanding of engineer drawings provided by OUSD. To the extent the Contractor intends to deviate from any written or *intended* specification, a written request and submittal must be provided to OUSD/OUSD Technology Services/OUSD's Representative and written OUSD & OUSD Technology Services approval must be granted prior to proceeding with any variance.

- Shop Drawings in AutoCAD locating the pathways and outlet placement, inclusive of proposed outlet numbering layout
- Support details for each pathways system to be installed by Contractor
- Proposed location of termination block(s) supporting MPOE/Tie Cable services at each building MPOE.
- Sample labels for the following; outlet & patch panel terminations, cable & switches, MDF & IDF Cabinets
- MDF&IDF cabinet elevation drawings: Provide shop drawings showing layouts of applicable equipment including incoming IDF racks, patch panels and LAN equipment.
- Provide BICSI RUDD-approved drawings complete with wiring diagrams and details required to prove that the distribution system shall properly support connectivity from the MDF to the IDF to the telecommunications work area outlets.
- Show the layout of cabling and pathway runs, MDF, IDF and ground system.
- Drawings shall depict final telecommunications cabling configuration, including location, gage, pair assignment and patch panels after telecommunications cable installation.
- Provide a plastic laminated schematic of telecommunications cable system showing cabling, MDFs, IDFs, SMALL IDFs, and equipment rooms keyed to floor plans by room number.
- Provide one (1) electronic copies of as-built drawings to OUSD; such files shall leverage Autodesk AutoCAD 2013 or later and will be delivered on USB Flash Drive.

Statements ³

- Written notice of scheduled testing (to be delivered at least three business days in advance)
- Operation & Maintenance manuals
- Contractor & Manufacturer warranties
- Attic stock of cabling, network equipment and components
- Submit network architecture set-up at the completion of construction and including training on network architecture.
- Installer qualifications
- Test plan
- Professional References

¹ Constitutes an initial submittal to be provided no later than the date/time specified by OUSD.

² To be submitted as necessary prior to commencing affected work.

³ To be submitted within ten days after final completion of each installation (unless otherwise noted).

1.5 PRODUCTS AND MINIMUM PROVISIONS

The Contract Documents generally outline industry standard components to be installed as part of OUSD's installation requirements. Such identification is intended to be general in

nature rather than exhaustive; all quantities, if stated, are subject to validation by Respondent. Respondent is reminded that differences between estimated quantities and those reasonably derived based from the Contract Documents (as well as through bid conferences, job walks, RFB addendums, and other distribution of information) shall be the responsibility of the Contractor; there shall be no additional cost incurred by OUSD for complying with the specifications and requirements of the Contract Documents.

Any variance from those components identified on the drawings and/or below shall be submitted to OUSD/OUSD's Representatives for approval prior to ordering and installation; the risk for all costs incurred by the Contractor for materials ordered prior to such written approval shall be borne entirely by the Contractor. Nonetheless, it is imperative that the Contractor determine the availability of necessary materials and propose equivalent substitutes as necessary to meet all installation milestones; delays in installations due to lack of product availability are unacceptable. As catalog numbers change frequently, the Contractor must verify all part numbers prior to ordering materials. Clarifications will be issued in response to written Requests for Information (RFIs)

All UTP, fiber optic cabling, innerduct and cable ties, where required, will be plenum-rated (i.e., CMP, ONFP). Copper and fiber optic backbone cable intended for installation within conduit, riser shafts and chases, etc., shall be at a minimum, rated CMR (riser rated). Unrated cable (such as filled ASP) shall not be installed within the structure except when placed within EMT, IMC, PVC or RGS conduit.

Delivery and Storage Contractor shall provide protection from weather, moisture, dirt, dust and other contaminants for telecommunications cabling and pathway equipment placed in storage.

Components Components shall be UL or third party certified. Provide a complete system of telecommunications cabling and pathway components using star topology and support structures, pathways, and spaces complete with conduits, pull wires, raceways, junction boxes, underground pull boxes, outlets, and cables, as per OUSD District Standards. Fixed cables and pathway systems for telecommunications systems shall be UL listed or third party independent testing laboratory certified, and shall comply with NFPA 70. Horizontal cable shall be General or Mohawk or Technology Services approved equivalent, and termination equipment shall be Panduit or Technology Services approved equivalent and installed and certified so as to provide a 25-year warranty.

Pathways (Backbone & Horizontal) Pathways shall consist of conduits; pull boxes, sleeves, cable runway, raceways, ceiling hangers, J-Hooks and outlet boxes as per the drawings. Provide grounding and bonding as required by TIA/EIA-569 and TIA/EIA-607.

Distribution Frames Provide main distribution facilities (MDFs) and intermediate distribution facilities (IDFs), as required per each installation site walk for terminating and cross connecting permanent cabling links.

1.5.1 NEW CONSTRUCTION

Distribution Frame Room for New Construction Room Dimensions: Main Distribution Frame (MDF) & Intermediate Distribution Frame (IDF) room design shall allow for a minimum 36" (from inside face of finish to inside face of finish) around a freestanding MDF/IDF enclosure or in the case of an MDF at a highschool where there are multiple enclosures ganged together creating one large MDF that 36" minimum spacing shall be around the whole unit and not between each individual enclosure.

MDF Room Minimum Dimentions

Room Type	Minimum LxWxH
High School MDF	14' x 10' x 10'
Middle School MDF	12' x 10' x 10'
Elementary School MDF	12' x 10' x 10'

IDF Room Minimum Dimentions

Room Type	Minimum LxWxH
High School IDF	9' x 9' x 10'
Middle School IDF	9' x 9' x 10'
Elementary School IDF	9' x 9' x 10'

Cooling and Ventilation for New Construction Each room shall include proper ventilation for the exhausting of heated air created by the equipment in each enclosure and also provide cooling only. Cooling can consist of the building's HVAC system or by wall mounted commercial grade ductless mini-split air conditioning systems (refer to District Standards for approved systems). Air vents in the ceiling will be located near the front of the enclosures while exhaust vents in the ceiling will be located in the rear of the enclosures. Architect to confirm orientation of the enclosures with the Information Technology Department prior to finalizing mechanical drawings.

Electrical - MDF for New Construction Each MDF room will have a minimum of (4) four 30 amp outlets located (1) One outlet per wall on each wall. These 30amp outlets will serve and support the large UPS that will be placed in the room for the MDF equipment.

Electrical - IDF for New Construction Each IDF room will have a minimum of (4) four standard 15 amp outlets located (1) One outlet per wall on each wall. In addition to the 15 amp outlet they will also include a 20 amp outlet located next to the standard 15 amp outlet for a total of 8 outlets in each IDF room.

1.5.2 EXISTING CONSTRUCTION

In the case where an existing site is undergoing a modernization and rooms are being renovated for new finishes and NOT a reconfiguration or if new IT infrastructure is being installed the following criteria for deciding an MDF & IDF room shall be used:

MDF for Existing Construction Locate new MDF enclosure and equipment at existing MDF location if possible and/or at Main Point of Entry (MPOE) of fiber from Service Provider. If this is not possible or achievable, locate at an Administration Building or at a centralized location at the site.

IDF for Existing Construction Cluster buildings together to minimize the number of IDFs keeping in mind that Category 6a cabling can only reach a maximum of 100m from IDF in all directions (includes all vertical & horizontal runs to reach room). IDFs should not be placed in a classroom if at all possible nor should they be placed in a location where water would be present such as a custodial closet with a mop sink or in a storage room where chemicals are being stored.

AC Units for Existing Construction IDF & MDF locations where AC is not already present, independent ductless mini-split AC units shall be installed. The architect shall determine this based on the size of the room and size of the enclosure located in the room if AC unit will be required (refer to District Standards for approved systems at www.ousd.org → Offices → Facilities Planning & Management Department → For Contractors and Developers)

The Project Manager, Architect, and if possible an Technology Services Department representative shall walk the site prior to design to determine the locations of MDF & IDF rooms and determine if the ventilation in those rooms will be adequate for exhausting the heated air.

1.5.3 NEW AND EXISTING CONSTRUCTION

Freestanding Equipment Enclosures (MDF & IDF) Freestanding equipment enclosures shall consist of frame, sides, top, front door and back door. Perforated doors shall be provided for all enclosures unless otherwise specified. Lockable front and louvered/perforated lockable back doors are required. Cabinet finish color shall be determined by Technology Services, modular type steel construction and treated to resist corrosion.

The following additional requirements apply:

- Enclosure Top Panel is to be perforated to allow for heat exhaust as well as adaptable for fan assembly options.
- Enclosure should have three (3) cable access panels located at the base of the cabinet on each side and at the back for cable access when the cabinet may not be on a raised floor or cable entry is not coming from the ceiling.
- Enclosure shall have a minimum 1,000 pound loading capacity.
- A 315 CFM top mount fan assembly enclosed within a fan housing and supplied with 6 foot power cord shall be provided within all enclosures.
- The equipment enclosure shall be Middle Atlantic DRK 19-44-XX-K Series 30" wide with a cage nut rail (XX=Depth) or Technology Services approved equal.

Wire Management All equipment enclosures both freestanding and wall mounted shall provide both vertical and horizontal wire management organizers.

Horizontal Wire Managers All horizontal wire managers shall be heavy duty painted black metal units designed specifically to connect to equipment frames. All vertical wire managers shall be aluminum with a black finish. All wire managers shall be secured to the frames and shall provide a clear and unobstructed pathway in which to route the cables. Each UTP and fiber optic patch panel will have one (1) 2RU horizontal wire manager above and below.

Vertical Wire Managers Vertical wire managers shall be six inches wide and seven feet tall. Vertical wire hangers shall have evenly spaced wire rings designed to maintain jumper, patch, or cross-connect wire in place.

Vertical wire managers shall be designed to extend past the frame to allow placement of equipment in any position within the rack. When mounted between equipment frames, they shall be designed to direct cables into either frame and shall be securely mounted to both units. Vertical wire managers shall be equipped with cable restraint latches.

Wall Mounted Enclosure (IDF Only-Cabinet size will be determined on a project-by-project basis) Wall-mounted equipment cabinets shall be fully enclosed and consist of frame, sides, top, front door and back door. Perforated doors shall be provided for all enclosures unless otherwise specified. Lockable front and louvered/perforated lockable back doors

are required. Cabinet finish color shall be determined by Technology Services, modular type steel construction and treated to resist corrosion

The following additional requirements apply:

- Enclosure Top Panel is to be perforated to allow for heat exhaust as well as adaptable for fan assembly options.
- Enclosure should have three (3) cable access panels located at base of the cabinet on each side and at the back for cable access when the cabinet may not be on a raised floor or cable entry is not coming from the ceiling.
- Enclosure to be mounted no more and no less than 7'-0" above the floor.
- Enclosure shall have a minimum 1,000 pound loading capacity.
- A 315 CFM top mount fan assembly enclosed within a fan housing and supplied with a minimum 6 foot power cord shall be provided within all enclosures.
- The equipment enclosure shall be Middle Atlantic CWR-XX-32PD Series with a cage nut rail (XX=Rack Units or RU) or Technology Services approved equal.

At Technology Services designated wall-mount IDF cabinet locations, the Contractor shall install 3/4-inch thick, Grade A/C, void-free, fire rated plywood of adequate height and width to support the mounting of wall mount cabinets and in accordance with the latest California Building Code, painted to match adjacent surface or to match the color of the equipment cabinet. Fire rating of plywood shall not be painted over and plywood shall exceed the cabinet size by not more than 1" on each side.

Cable Runway Cable runways (ladder rack) shall be provided to permit installation of communications, computer, CATV, paging, distribution system cables and other low voltage system cables. Cable Runway: Runway (ladder rack) shall be constructed of an open bottom with 1 1/2" cable bearing surface 12" on center. Side rails shall be minimum 1 1/2" high and constructed of tubular steel. Finish shall be black baked enamel.

Accessories and special transitions shall be provided for all changes in direction and offsets. Use manufacturer's standard fittings, including bolting assemblies for all end-to-end connections. Provide transverse and longitudinal seismic restraints as required. Provide plastic trough dropout bushings at each location where cables will descend into the equipment racks.

Cable runway wall angle supports shall be steel angles, black baked enamel finish. Ends to be smooth without hooks or projections. Brackets shall be able to support an end load of 600 lb. with a safety factor of 1.65.

Cable runway elbows, tee's, 90 degree bends and crosses: All horizontal and vertical 90 degree elbows, tees, 90 degree bends and crosses shall be made with right angle couplings which clamp to the runway without the need for drilling or cutting.

Cable runway shall be manufactured by Middle Atlantic Products or Technology Services approved equal.

Pathway & Raceway Specifications Summary All cable pathways within a building shall be concealed whenever possible either within the walls or above the ceiling, such as in new construction. Surface mounted raceway is however permitted in classroom and office situations only. If the pathway is above the ceiling either cable tray or cable hangers are to be utilized. In the event that the pathway is unable to be concealed such as in a retrofit project the following is to be observed (See Section 1.6 Pathways Installation):

Surface Mounted Metallic Raceway Surface mounted metallic raceway is to be utilized in dry interior locations only as covered in Article 352 part B of the National Electrical Code, as adopted by the National Fire Protection Association and as approved by the American

National Standards Institute. All surface-mounted raceway shall be listed as suitable for use in applications having up to 600 volts between conductors by Underwriters Laboratories, Inc., when screw secured and installed per instructions.

Metallic surface mounted raceway shall be Wiremold 4000-type metallic or Hubbell 4000 series metallic surface mounted raceway. A full complement of fittings shall be available including but not limited to mounting clips and straps, couplings, flat, internal and external elbows, cover clips, tees, entrance fittings, conduit connectors and bushings.

A series of inserts shall also be available for retrofit applications that provide a controlled 2" cable bend radius which meets the specifications for Fiber optic and UTP/STP cabling and exceeds the TIA 569 requirements for communications pathways.

Notching or modifications of raceway and fittings will not be permitted.

Copper Patch Panels Patch panels shall consist of a metal patch panel with four (4) or six (6) port faceplates, which are removable from the front. Such panels shall:

- Accommodate Category 6a cabling
- Mount to standard EIA 19" racks
- Be modular, accepting all modules designed for that product line
- Be available with labels that follow TIA/EIA 606 labeling standards.
- Be manufactured by Panduit or Technology Services approved equal.

One patch panel port shall be provided for each workstation cable served from the MDF and IDF with a minimum of 12 spare ports required. The Contractor shall supply and install as many patch panels as necessary to service all workstations, plus the required spare count. Quantities of modules shall be based on the number of UTP cables originating at wall outlets and terminating at the patch panel.

Fiber Optic Patch Panels The Contractor shall provide fiber optic patch panels as necessary for the maintenance and cross connecting of fiber optic cables. Such panels shall be constructed of 0.125-inch minimum aluminum and shall have connectors which interface the inside plant fiber optic jumper cable with the outside plant fiber optic cable. These units will terminate the fiber optic cables, provide a place for jumper cables and will provide room to terminate additional optics.

Panels shall be sized to support a minimum of 100% growth. Rack-mounted and wall-mounted fiber patch panels shall be equipped to terminate or splice the incoming inter-building fiber and any required backbone or interconnect cables. Each fiber optic cable must be properly dressed.

All rack-mounted fiber optic patch panels shall be Panduit FRME36EBL, FRME54EBL or FRME72EBL or OUSD approved equal. All wall-mounted fiber optic patch panels shall be Panduit FWME12EBL, FWME24EBL or FWME48EBL or OUSD approved equal.

The fiber optic patch panel connections shall provide 0.4 dB or less insertion loss. All fiber optic connectors will be Panduit FSCMBL type SC or Technology Services approved equivalent.

Wire Management All equipment racks, wall-mount racks, and wall-mount cabinets shall be equipped with horizontal wire management. All horizontal wire managers shall be heavy duty painted black metal units designed specifically to connect to equipment frames. All vertical wire managers shall be aluminum with a black finish. All wire managers shall be secured to the frames and shall provide a clear and unobstructed pathway in which to route the cables.

Each UTP and fiber optic patch panel will have one (1) horizontal wire manager above and below. The in-frame horizontal managers shall be 2RU in height and shall extend from side rail to side rail. Horizontal wire managers shall be equipped with a 3" X 3" slotted duct and cover on front and a 2" X 5" slotted duct and cover on back. Horizontal wire managers shall be equipped with bend radius control clips and strain relief clips. Horizontal wire managers shall be Panduit-WMPH2 or Technology Services approved equivalent.

Communications Cabling All communications cabling used throughout this project shall comply with the requirements as outlined in the National Electric Code (NEC) Articles 725, 760, 770, and 800 and the appropriate local codes. All copper cabling shall bear CM, CMP (Plenum Rated), CMR (Riser Rated) and/or appropriate markings for the environment in which they are installed. All optical fiber cabling shall bear OFN, OFNP (Plenum Rated), OFNR (Riser Rated) and/or appropriate markings for the environment in which they are installed. Indoor/Outdoor rated cable shall be used where required.

Fiber Optic Backbone Cabling

- Fiber optic cabling will only be used to connect between MDF to IDF and IDF to IDF. Fiber optic cabling will not be used for any other purpose unless otherwise specified
- 12-strand 9/125 microns, Single Mode ARMORED Plenum-rated Fiber Optic Riser Cables Indoor/Outdoor, Tight Buffer with SC-Duplex Connectors with ceramic ferrule, 9/125 microns for all new installations manufactured by Corning or AMP/Pirelli or Technology Services approved equivalent.
- The Contractor shall provide all required count (per Technology Services requirements) optical fiber cables.
- All fiber optic cables for interior use shall be tight buffered, and shall be marked OFNP per NEC Table 750-50 (e.g., non-conductive plenum rated).
- Fiber optic warning tags shall be placed on exposed fiber optic backbone cables.
- Fiber optic warning tags shall be orange in color.
- Fiber optic warning tags shall contain "Caution Fiber Optic Cable". The text shall be permanent, black, block, letters, at least 3/16" high.

Fiber Optic SC-style Connectors

- All fiber optic termination connectors will be type SC.
- The fiber optic patch panel connections shall provide 0.4 dB or less insertion loss.
- The fiber optic LC-style connectors shall be manufactured by Panduit or Technology Services approved equivalent.

Fiber Optic Patch Cables

- Fiber Optic Patch Cables shall be 12-strand 9/125 microns, Single Mode ARMORED Plenum-rated Fiber Optic Riser Cables Indoor/Outdoor, Tight Buffer with SC-Duplex Connectors with ceramic ferrule, 9/125 microns patch cords pre-made to connect fiber optic equipment with fiber optic cross connects, interconnects and outlets.
- The fiber optic patch cables (jumpers) shall be impact-resistant duplex fiber cables, with SC-Duplex connectors as appropriate for installed equipment, of the same performance characteristics as the singlemode fiber backbone being connected.
- These fiber optic patch panel connections shall provide 0.4 dB or less insertion loss and provide connection between the Active LAN devices and the Fiber Optic patch panel. Quantities for 100% population plus 10% Spares.
- The fiber optic patch cables shall be available in 2-meter lengths.
- The fiber optic patch cables shall be manufactured by Panduit or Technology Services approved equivalent.

Horizontal Cabling

- Category 6a shall not be used to connect MDF to IDF or IDF to IDF. Category 6a cabling shall be used to connect keystone jack to IDF/MDF and as patch cables unless otherwise specified.
- Horizontal cabling shall comply with NFPA 70, NEMA WC 63, EIA TSB-36, EIA TSB40-A, ANSI/ICEA S-80-576, EIA TSB-67 and performance characteristics in TIA/EIA-568-B.1 and B.2 standards for UTP, four-pair 100 ohm cabling.
- Horizontal cabling shall provide four each individually twisted pair, 24 AWG conductors enclosed by an overall jacket.
- Overall diameter of four pair cable shall not exceed 0.25 inches.
- Ultimate breaking strength shall be minimum 90 pounds.
- Four pair cable shall withstand a bend radius of one-inch minimum at a temperature of minus 20 degrees C maximum without jacket or insulation cracking.
- Conductors shall be color coded and polarized in accordance with TIA/EIA-568-B.1 and B.2.
- Category 6a cable for telephone systems and local area networks shall exceed TIA/EIA-568-B.1 and B.2 standards and requirements.
- Conductor shall be 24 AWG solid annealed copper.
- Cable shall be plenum rated where required and shall comply with NFPA 70, UL 444, and UL 910.
- Category 6a cable jacket color be according to the cable color specifications below:
 - Cable, patch cable and keystone jack is *blue* for data jacks in work areas and classrooms.
 - Cable, patch cable and keystone jack is *orange* for Wireless APs
 - Cable, patch cable and keystone jack is *red* for building systems, including fire alarm, environmental systems
 - Cable, patch cable and keystone jack is *green* for security cameras
 - Cable, patch cable and keystone jack is *white* for voice and bell/clock systems
- Horizontal cabling shall be manufactured by General, Mohawk, or Technology Services approved equivalent.
- Category 6a cable runs for data shall not exceed 100 meters in length.

Workstation Outlet Assemblies

- Jacks shall comply with FCC Part 68.5, and TIA/EIA-568-B.1 and B.2.
- Jacks shall accommodate UTP or OFN and work in concert with Wiremold metallic raceway. Non-metallic raceway is not permitted.
- UTP jacks for data shall be RJ-45 designation T568B type, UL 1863 listed, eight position, constructed of high impact rated thermoplastic housing rated for Category 6a service.
- UTP jacks for data shall be Category 6a hardware and shall comply with the attenuation requirements contained in TIA/EIA-568-B.1 and B.2.
- UTP Jacks for data shall be blue in color **except for AP which is orange on both wall and patch panel.**
- UTP jacks shall be Panduit Category 6a Mini-Com CJ688OT3R or Technology Services approved equivalent.
- UTP jacks for voice, clocks, bells and speakers shall be off white in color.
- Workstation outlet assemblies shall include Panduit CFPE2IW and CFPE42IW faceplates and CBX2IW-A and CBX4IW-A surface mount boxes
- Stenciled lettering for voice and data circuits shall be provided using thermal ink transfer process.

UTP Patch Cables UTP patch cables for unshielded twisted pair cable shall be Category 6a rated for Category 6a horizontal cable installations. Such cables shall be equipped with

factory-attached connectors to interconnect equipment mounted on the racks of the distribution frame and to connect computer stations to outlet locations. UTP patch cables shall be available in 3', 5', 7', 10' and 14' lengths for MDF, IDF, SMALL IDF and workstation locations. UTP patch cables may also be used for patching applications, not to exceed 20 feet. Quantities required shall provide for 100% port population with 10% spares. (*Example: If a MDF/IDF has 100 installed drops, there should be a minimum of 10 additional unused patch panel/switch ports to allow for future expansion*)

UTP patch cables shall be manufactured by Panduit or Technology Services approved equal.

Miscellaneous Equipment

- Conduit Sealer Kit - Semco #PR-851
- Aluminum Threaded Innerduct Couplings - Pyramid Products Part#FO9006
- Corrugated Fiber Optic 1" Innerduct - Carlon Products Part# CID100-T (Orange & Yellow, and Blue)
- Fiber Optic Innerduct Labels - Panduit or Wiremold #PVL 200 BY
- 900 Micron Buffered Fiber Label - Panduit or Wiremold #PMDR-0-9 GMM polyester film marker tape as a "flag"
- Fiber Optic Caution Tag - Osburn #FO4002 1-3/4" x 3-1/2"

Unspecified Equipment & Material Any item of equipment or material not specifically addressed on the drawings or in this document and required to provide a complete and functional installation shall be provided in a level of quantity and quality consistent with other specified items.

1.6 PATHWAYS INSTALLATION

Cable Pathway In suspended ceiling areas where duct, cable trays or conduit are not available, the Contractor shall bundle, in bundles of 48 or less, utilize cable hooks above suspended ceilings and in all ceiling spaces station wiring with cable ties snug, but not deforming the cable geometry. Cable bundles shall be supported via "J" hooks. Install cabling above suspended ceilings 6 to 12 inches above ceiling T-bar attached to the existing building structure and framework at a maximum of 48 inch intervals. Properly rated cable ties will be used in all appropriate areas. The Contractor shall adhere to the manufacturers' requirements for bending radius and pulling tension of all data and voice cables. Cables shall not be attached to lift out ceiling grid supports or laid directly on the ceiling grid. Cables shall not be attached to or supported by fire sprinkler lines, HVAC ducting, electrical EMT, lighting fixture or any environmental sensing device located in the ceiling air space. All cable shall be run in transverse or longitudinal paths. Comply with TIA/EIA-568-B.1, B.2, TIA/EIA-569, NEC, CEC, and Technology Services. Do not exceed cable pull tensions recommended by the manufacturer.

Use of existing signal and other conduit must be approved in advance by Technology Services. The contractor shall be responsible for all replacement cost for damage to cables currently occupying existing conduits.

New Construction Conceal interior conduit under floor slabs and within finished walls, ceilings, and floors where possible. Surface mounted raceway is however permitted in classroom and office situations only. All concealed interior conduit shall be a minimum of 1-1/4" to the j-box. Run conduits in crawl spaces and under floor slabs as if exposed. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit is visible after completion of project. Keep conduit minimum 6 inches away from parallel runs of electrical power equipment, flues, steam, and

hot water pipes. Install no more than two 90-degree bends for a single horizontal cable run. Run raceway as determined by site survey.

Existing Construction Use existing conduit, raceways, cable trays, wiremold, etc where possible. If existing pathways are unavailable, surface mounted wiremold is acceptable within habitable interior spaces. Wiremold is to be used in the most efficient manner to minimize the impact to the site. Wiremold is not to be placed in front of any door, window, opening, etc. For non-habitable spaces such as above ceilings and under floor crawl spaces follow rules for New Construction above. Prior to installation of any new wiremold, raceway, conduit, cable tray, etc. a site survey is required and a new pathway is to be approved by Technology Services.

Any transitions between buildings or structures shall include an appropriate liquid tight flex joint with a drip loop. Provide pull boxes with liquid tight flex conduit only where flexible connections are required. OUSD approval required prior to all liquid tight flex conduit installations.

New underground conduit shall be 2", 4" or 6" PVC schedule 40. New underground conduit that will be run under driveways, access roads, buildings, etc shall be 2", 4" or 6" PVC schedule 80. All sections shall be permanently glued together. Transition from underground PVC to above ground stub up shall be via rigid conduit.

All conduits shall be properly reamed and bushed with pull ropes installed.

Based upon the NEC 2017 edition conduit fill capacity shall be as follows:

- Number of Cables at Maximum Recommended Conduit Fill (1 Cable @ 53% Maximum, 2 Cables @ 31% Maximum, 3 or More Cables @ 40% Maximum)
- Conduits terminating inside of building through floor shall be installed so that the conduit extends a minimum of 4" above finished floor. Conduits terminating inside of building through wall shall terminate in appropriately sized junction box.
- Empty conduits shall be plugged with mechanical type seals to ensure that foreign matter does not enter the building. All empty conduits shall be equipped with mechanical type seal plugs in all pull boxes, junction boxes and within all buildings.
- All conduits, sleeves and other penetrations will be firestopped by the Contractor prior to acceptance. Such firestopping shall conform per District Standards and shall be implemented in accordance with UL design guidelines for fire-rated assemblies.
- Provide all coring, patching and painting as needed for Intra-Building and Inter-Building pathways. Caulking is not an acceptable patching method for conduit penetrations into exterior walls. Refer to District Standards for acceptable patching methods.

Underground Pull Boxes and Junction Boxes Underground pull boxes shall be made of concrete and the minimum size shall be 35 ½" x 17 ½" x 12". Underground pull box covers shall be rated for traffic (type T.05) and shall be marked communications. Metal covers shall be used in all location subject to vehicle traffic.

Underground pull boxes and junction boxes shall not be placed in areas subject to flooding. Gravel shall be installed below all Underground pull boxes for drainage. Establish drainage to meet Public Works Construction Standards (Green Book).

Unless otherwise noted, exterior junction boxes shall have minimum dimensions of 24" x 24" x 6". Interior junction boxes shall consist of 16 gauge steel minimum, unless otherwise noted on plans. Indoor enclosures shall conform to NEMA Type 4, unless otherwise noted. Size junction boxes to not less than minimum Code requirements. Increase size above Code requirements where necessary to provide space for pulling, racking or splicing enclosed conductors, or where specified or indicated dimensions exceed Code requirements.

Exterior metal junction boxes exposed to weather (and not installed in or below grade) shall be equipped with rain-tight or weatherproof-hinged doors. Exterior junction boxes shall have 16 gauge steel bodies and 14 gauge steel doors. Exterior pull boxes shall be equipped with stainless steel door clamps on three sides, a removable stainless steel continuous hinge pin, a hasp and staple for padlocking, and external mounting feet.

Enclosures installed on vertical exterior walls shall conform to NEMA Type 3R. Enclosures installed on exterior horizontal surfaces such as rooftops or breezeways shall conform to NEMA Type 4 unless otherwise noted. Raintight or weatherproof boxes shall use threaded watertight hubs for top or side entry and may use knockout for bottom entry only.

Exterior pull boxes shall conform to these industry standards:

- UL 508 Type 4
- NEMA/EEMAC Type 3, Type 4, Type 12, Type 13
- JIC standard EGP-1-1967
- CSA Type 4
- IEC 529, IP66 Junction Boxes shall be labeled "Communications" with screw on 1/8" engraved, black plate, white letters.

Tamper resistant screws shall be used on all exterior aboveground junction boxes that are exposed to public/student areas.

Exterior pull boxes shall be manufactured by Hoffman or OUSD approved equal.

Communication Duct-Banks and Conduits Use of existing signal and other conduit must be approved in advance by Technology Services.

Trenches All underground trenches shall be 24" wide by a minimum of 30" deep. Trenches shall be back-filled at 95% compaction. Contractor shall contact Dig Alert a minimum of 48 hours prior to excavation to verify the location of existing underground utilities. Modifications to pathway design may be dictated by field conditions subject to approval by Technology Services. Conduits must be inspected by OUSD's facilities inspector prior to backfill. Contractor shall restore surface to same or better condition. Compaction testing notification must be provided to OUSD 48 hours prior to testing so that an OUSD inspector may be present.

Slurry fill trenches to within three inches (3") of finished grade whenever crossing paved areas. "Two Sack" slurry shall be used. Pavement removal and patching shall conform to specifications and standards listed in the Public Works Standards (Green Book 2000).

Underground Conduit All communications conduits shall be placed in a uniform manner between ground boxes and pull boxes. Conduit in position #1 at one ground box or pull box shall maintain its position within the duct run and terminate in the #1 position at the next box. The position of all conduits between ground boxes and pull boxes shall be maintained.

Long radius bends (over 30 feet) shall be used whenever possible to make changes in direction. If it is found to be necessary to place a 90-degree bend in the conduit run, a factory-made sweep of no less than 60-inch radius shall be used. No conduit run shall exceed a total of 180 degrees of bend between any two points (such as manholes or buildings) considering both vertical and horizontal sweeps. Cold-formed trench bends shall have a radius of not less than 60 inches and shall pass mandrel integrity. Bend radius criterion is 2" or less 6 times the diameter of the conduit and any conduit larger than 2" is 10 times the diameter of the conduit.

Where communications and power conduits occupy the same trench, all conduit structures shall be built with the telecommunications conduits placed above the power conduits and separated by a minimum of 12" of compact earth or 3" of concrete encasement, unless otherwise

called out and approved by OUSD. If this type of construction is required, it shall receive the prior approval of the contractor and OUSD.

Conduit shall have a factory formed bell on one end for interconnecting segments. All conduits shall be equipped with mechanical seal plugs in all ground boxes and expansion rubber seal plugs within all buildings.

Conduit located under heavy use highways or railroad rights-of-ways shall be encased in steel casing consistent with the AASHTO or AREA specifications. The thickness of the steel casing shall be engineered for each specific application. This may vary based on campus codes.

High impact spacers shall be used in all multi-duct systems, for both solely owned and joint telecommunications/power construction. A horizontal and vertical separation of 1 inch between the ducts shall be maintained by installing high impact spacers with horizontal and vertical locking intervals of ten feet. Spacers shall conform to NEMA TC-2, TC-6, TC-8, and ASTM F 512 dimensions.

Utility marking tape shall be buried 18 inches above the conduits.

The length and destination of all conduits shall be identified in each ground box, pull box and building. Embossed metal or heavy plastic tags strapped to each conduit shall be used.

After installation of communications conduits, the contractor shall prove all conduits by pulling a mandrel with a diameter $\frac{1}{4}$ inch smaller than the conduit and 6 inches long through each conduit end-to-end. An inspector designated by the contractor and OUSD shall be notified 24 hours before this procedure. Each conduit shall be cleaned with a bristle brush to remove any debris.

All conduits shall be equipped with seal plugs in all pull boxes and expansion rubber seal plugs within all junction boxes and building entrances.

Contractor shall install new $\frac{1}{4}$ " pull rope in all conduits placed.

Overhead Conduit OUSD prohibits the installation and use of overhead conduit extending between buildings.

Communications Entrance Conduit To prevent shear, all inter-building conduit transitions (either underground or aerial) shall transition from PVC or metal to Sealtight conduit when attaching between permanent structures. The contractor and OUSD shall determine the placement of all entrance conduits. All applicable standards (i.e., OUSD, NEC, BICSI or G.O. 128) shall be adhered to.

Transition from underground PVC to above ground stub up shall be via rigid conduit. Sealtight flex conduit drip loop lengths shall not exceed 24", unless approved by OUSD, Refer to District Standards.

Conduits terminating inside of building through floor shall be installed so that the conduit extends a minimum of 4" above finished floor. Conduits terminating inside of building through wall shall terminate in appropriately sized junction box.

Provide all coring, patching and painting as needed for Intra-Building and Inter-Building pathways. Caulking is not an acceptable patching method for conduit penetrations into exterior walls. Refer to District Standards for acceptable patching methods.

All conduits shall be properly reamed and bushed. Contractor shall install new $\frac{1}{4}$ " pull rope in all conduits placed. Empty conduits shall be plugged with mechanical type seals to ensure that foreign matter does not enter the building.

Ductbank Locating Cable (e.g., electronically detectable warning tape) Warning tape shall be a minimum of 3" wide, orange in color, and shall have a non-degradable imprint as follows:

Caution Fiber Optic Cable Buried Below

The tape shall be electronically detectable.

Pull Rope Pull rope shall be new ¼" polypropylene over polyester rope with a minimum 1700 lb. Tensile strength. Pull rope shall be new material that is free of knots, kinks, and abrasions and shall be placed as a single continuous length in every new conduit. Pull rope shall be secured at each end.

1.7 BONDING AND GROUNDING

MDF/IDF Grounding All MDF Racks shall be provided with a Telecommunications Grounding Busbar (TGB), installed in accordance with TIA/EIA-607. The TGB shall be grounded to the nearest access to the building ground with a #6 AWG insulated conductor. Building ground is identified as building structural steel, or ground rod; gas pipes and electrical conduits are not acceptable ground attachment points.

Ground conductors are not to exceed 40'. If building ground connection is beyond 40', Contractor is to install a new ground round at the nearest outside location. The ground rod location shall be approved by Technology Services prior to installation.

The Contractor shall provide ohms testing for ground. Ground connections shall not exceed 5 ohms. MDF ground rods shall consist of:

- Fargo clamp
Shall be cast from copper, silver-plated, and furnished with copper bolt. Ground rod: shall be manufactured of high strength high carbon steel, with electrolytically bonded jacket of copper on surface, and meet UL spec. 467 and ANSI C-33.8-1072.

1.8 INSTALLATION

General Installation Practices The Structured Communication Cable System and pathway, including the horizontal and backbone cable, pathway systems, telecommunications outlet/connector assemblies, and associated hardware shall be installed in accordance with TIA/EIA-568-B.1 and B.2, TIA/EIA-569, NFPA 70, and UL standards as applicable.

Cabling shall be connected in a star topology network. Installation methodologies shall adhere to manufacturer installation procedures so as to not violate certifications (i.e. UL). All work shall be performed in a good workmanship-like manner leaving each location in the same or better condition as at the start of each project.

Install horizontal and fiber optic cabling and pathway as determined at site surveys, between MDF and/or IDF and telecommunications outlet assemblies at workstations, in accordance with TIA/EIA-568-B.1 and B.2 and TIA/EIA-569.

- **Architect's Note**

"Contractor shall provide all necessary tools and materials not specified, (tie wraps, "d" rings, screws, consumables, hardware, etc.) and equipment, (ladders, hydraulic lifts, storage containers, etc.) necessary to provide a complete and operating system.

The OUSD-designated representative shall be provided with weekly progress reports and a 3 week look ahead schedule. A pre-pull meeting shall be had prior to the installation of any cabling to ensure agreement between IT cabling contractor and general contractor

with what cabling is to be pulled. Periodic on-site inspections will be done during the course of installation. OUSD reserves the right of "local jurisdiction" for final approval."

Copper Cable Installation Practices Install Category 6a cabling and pathway system in accordance with TIA/EIA-568-B.1, B.2, B.3 and TIA/EIA-569. The cabling installation shall comply with EIA TSB40-A and EIA TSB-36.

Where additional conduit sleeves are required, but not provided by others, the Contractor shall be responsible to provide and install such conduit sleeves.

Applicable practices include, but are not limited to, the following:

- Screw terminals shall not be used except where specifically indicated on plans.
- Do not untwist Category 6a UTP cables more than 1/4 inch from the point of termination to maintain cable geometry.
- Do not exceed manufacturers' cable pull tensions for copper cables. Provide a device to monitor cable pull tensions. Do not exceed 25 pounds pull tension for four pair copper cables.
- Do not chafe or damage outer jacket materials.
- Use only lubricants approved by the cable manufacturer.
- Do not over cinch cables, or crush cables with staples.
- For UTP cable bend radii shall not be less than four (4) times the cable diameter.
- OSP rated cable to be used in all underground conduits and or as specified by the manufacturer.

All cables shall be identified at both ends; underground pull boxes and junction boxes to include cable I.D., type, and size, destination fiber or pair count and any other pertinent information in accordance with Technology Services established labeling procedures. Identification shall be easily visible, firmly attached and impervious to moisture and other elements.

Open Cable. Use only where specifically designated by Technology Services or determined during site surveys and only when approved by Technology Services.

Plenum cable shall be used where required by industry standards, building and safety codes and OUSD rules and regulations; plenum cables shall comply with flammability plenum requirements of NFPA 70 and shall comply with UL 910.

Avoid routing copper cable in areas where there may be high levels of electromagnetic interference (EMI). EMI is caused by AC power lines, broadcast signals, X-ray equipment, motors, generators, and fluorescent lights. UTP cables shall be routed at least 5 inches away from fluorescent lighting fixtures.

- ***Architect's Note (Also to be included in drawings)***

Cables shall be placed in the support device, J-Hooks located every 4 feet, as long as they are separately bundled and tie-wrapped using Velcro ties. Cabling shall be organized and identified so as to facilitate locating and handling individual sheaths for maintenance functions. Each bundle shall be neatly tied without over cinching or stressing cable. Bundles shall be clearly marked identifying the IDF and room to which routed, the station numbers served by the bundle, and any other information that may assist in administration.

Great care shall be taken to protect all cabling from physical damage. An industry standard service loop shall be installed on each cable installation where possible.

Fiber Optic Backbone Cable Contractor shall be responsible for determination of actual segment lengths; actual quantities will be determined by the routing established by Technology Services. Do not exceed manufacturer's recommended bending radii and pull tension.

All fibers shall be terminated into fiber optic SC-type connectors. Contractor to allow minimum 15 feet of armored cable slack. Slack storage to be affixed to the wall adjacent to the enclosures.

- **Architect's Note (Also to be included in drawings)**

Each fiber optic backbone cable segment shall be labeled at each end with its respective IDF identifier. At each location where fiber optic cable is exposed to human intrusion, it shall be marked with warning tags. A warning tag shall be permanently affixed to each exposed cable or bundle of cables, at intervals of not less than five (5) feet. Any section of exposed cable, which is less than five (5) feet in length, shall have at least one (1) warning tag affixed to it.

Telephone Backbone Cabling Install properly sized Category 6a, outdoor and underground rated cable in pathways. The Contractor shall be responsible for determination of actual segment lengths; actual quantities will be determined by the routing established by Technology Services where needed for analog phone lines.

Horizontal Cabling The following is a list of typical/default outlets to be installed; however, Technology Services may elect to specify different requirements within any particular RFP/RFB. Unless specifically noted otherwise, all cabling shall be EIA/TIA Category 6a, installed to industry standards and, unless otherwise specified, at 18" AFF. All MDF/IDF terminations shall be on patch panels. In all cases, one duplex electrical outlet (NEMA 5-15R) is required for each cable drop, and, to the extent possible, electrical receptacles shall be within 12" of the communications outlet.

NOTE: For purposes herein, the word "drop" shall denote one communication cable (as opposed to an outlet location). All drops are installed in even numbers unless specified otherwise, Refer to section *1.5 Products and Minimum Provisions; Communications Cabling, Horizontal Cabling* of this document for Cable & Keystone Jack color designations. All Wireless Access Point (WAP) drops and devices are to be located minimum 5 feet from an alarm device.

NOTE: Electrical Outlets are to be installed adjacent to data drops. One duplex outlet for every 2 data drops.

K-12 School Locations

- Classroom Drops (Includes CDC)
11 Drops per classroom, Install 3 drops to clock area (2 WAP drops, 1 clock/bell/speaker drop) and 8 more on separate walls in pairs (student, teacher, and phone) 1 Drop specifically needs to be located at or near the door for a wall mounted phone.
- Science Classroom
13 Drops per science classroom, Install 3 drops to clock area (2 WAP drops, 1 clock/bell/speaker drop), 2 drops at the end of the teacher workstation, and 8 more on separate walls in pairs (student and phone) 1 Drop specifically needs to be located at or near the door for a wall mounted phone.
- Science Lab
2 drops per lab station located at the end of the station, Install 3 drops to clock area (2 WAP drops, 1 clock/bell/speaker drop) coordinate with OUSD Tech Services for determination if WAP & clock/bell are necessary depending on location of Science Lab to Science Classroom.
- Computer Lab Drops
38 Drops per computer lab (typically 30-34 student drops, plus 2 teacher, 2 phone, 2 WAP drops, 1 clock/bell/speaker drop). No more than 1 single jack every 30 inches or 2 dual jacks every 60 inches, except for teacher station. 1 Drop specifically needs to be located at or near the door for a wall mounted phone.

- Auditorium/Multipurpose
11 Drops (typically 4 WAP drops , 1 clock/bell/speaker drop, 6 general & phone) Install 4 drops to clock/bell area for both the clock/bell & WAP. 1 Drop specifically needs to be located at or near the door for a wall mounted phone.
- Gym/Cafeteria Drops
11 Drops (typically 4 WAP drops , 1 clock/bell/speaker drop, 6 general & phone) 1 Drop specifically needs to be located at or near the door for a wall mounted phone.
- Library
Consult OUSD Technology Services Department to determine drop count as this will vary depending on room layout and staff assigned to the space (must have 2 WAP drops, 1 clock/bell/speaker drop and 1 Drop specifically located at or near the door for a wall mounted phone).
- Regular Office
5 drops (typically 2 WAP drops, 1 clock/bell/speaker drop, 2 general & desk phone)
- Storeroom
5 drops (typically 2 WAP drops, 1 clock/bell/speaker drop, 2 general & phone) 1 Drop specifically needs to be located at or near the door for a wall mounted phone.
- Principal Office
7 drops per Principal office (typically 2 WAP drops, 1 clock/bell/speaker drop, 4 general & desk phone)
- Open Office Work Area or Cubicle Areas
Consult OUSD Technology Services Department to determine drop count as this will vary depending on room layout and staff assigned to the space (must have 2 WAP drops, 1 clock/bell/speaker drop and 1 Drop specifically located at or near the door for a wall mounted phone).
- Outdoor Wireless Access Points
Minimum 2 drops. Consult OUSD Technology Services for placement of outdoor access points to ensure complete coverage.
- Hallways
Minimum 3 drops. 2 drops at either end of the hallway for security cameras, located in the optimal location to eliminate blind spots, plus 1 drop placed roughly equidistant from both ends of the hallway for WAP.

Requirements for AP Installation

- 8 foot high ceiling: 7.5 feet from the ground.
- More than 8 foot high ceiling: 8.5 feet from the ground.
- Wall mounted (not ceiling)
- Installation approval and configuration and licensing by OUSD Technology Department

Administrative Sites Every work area receives a Wireless Access Point and a Clock/Bell/Speaker:

- Two drops for Wireless Access Point
- One drop for Clock/Bell/Speaker
- Workstations
3 drops per workstation, (1 computer, 1 printer, 1 phone)
- Printer, Copier and Other Needs
2 drops per location with a 2 drop minimum

Conference Rooms

- Small Conference rooms (10 or less seats)
10 drops (typically 2 WAP drops, 1 Clock drop and 8 placed around the room 2 drops per wall unless specified otherwise)

- Large Conference rooms(more than 10 seats)
Minimum of 10 drops (typically 2 WAP drops, 1 Clock drop and 8 placed around the room 2 drops per wall. For every 5 seats over 10 (rounded up to the nearest 5) add an additional 4 drops to a maximum of 16 drops for the room)

Offices

- Small Offices
4 drops with an added 2 drops every other office for WAP (consult with Technology Services for the location of the additional 2 drops for WAP).
- Large Offices with a private conference table
6 drops with an added 2 drops for WAP(consult with Technology Services for the location of the additional 2 drops for WAP).
- Storage rooms
Storage rooms/spaces should be set up for future office conversion. Depending on the size of storage rooms or space refer to either Small Offices or Large Offices for drop count. Please refer to “Storerooms” above for minimum drop counts.
- AV Closet or Room
4 drops minimum (consult with AV Department to determine the quantity needed to support each AV rack in the closet or room).

The Contractor will coordinate with Technology Services for placement information of each outlet to be completed. Basic outlet configurations will be designated by Technology Services. The contractor will coordinate with Technology Services for outlet configuration details.

In general, horizontal station cables will: originate at the outlet location; extend through the ceiling plenum via wire hanger, cable tray, conduits/sleeves and/or other cable pathways, enter the MDF or IDF as applicable, and transition to the appropriate rack, cabinet or panel for termination.

Contractor shall provide and install to workstation outlet locations, with suitable infrastructure for routing, cables from the outlet location to and into the appropriate rack or panel in the MDF or IDF. Blank Inserts are to match the faceplate color.

MDF and IDF terminations of data cables shall be in rack-mounted patch panels. In a retrofit project or situation and in new construction, new patch panels shall be installed and sized to allow a minimum of twelve (12) spare ports for future requirements.

The Contractor is responsible for replacement and reinstallation of any installed cable that does not meet the latest TIA/EIA performance parameters, without cost to OUSD.

Terminate UTP cable in accordance with TIA/EIA-568-B.1, B.2 and wiring configuration T568B.

Contractor shall provide and install to workstation outlet locations with suitable infrastructure for routing cables from the outlet location to and into the appropriate rack or panel in the MDF or IDF.

1.9 TESTING

Pre-Installation Cable Testing The Contractor shall test all optical cables prior to the installation of the cable. The Contractor shall assume all liability for the replacement of the cable should it be found defective at a later date.

- Fiber optic testing shall adhere to the Fiber Optic Association guidelines for calculating the minimum and maximum loss. www.thefoa.org

- Any links, not meeting the requirement of the standard, shall be brought into compliance by the Contractor, at no charge, to OUSD.
- Documentation shall be provided in both hardcopy and flash drive to the point of contact.

Inspection Visually inspect UTP and OFN jacket materials for UL or third party certification markings. Inspect cabling terminations in telecommunications rooms and at workstations to confirm color code for tip and ring pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1, B.2 and TIA/EIA-570. Visually confirm Category 6a marking of cables, jacks, patch panels and patch cables.

Final Verification Tests

- Perform verification tests for UTP and OFN systems after the complete telecommunications cabling and workstation jacks are installed.
- All fiber testing shall be performed on all fibers in the completed end-to-end system. Testing shall consist of a bi-directional end to end OTDR trace performed per EIA/TIA 455-61 and bi-directional end to end power meter test performed per EIA/TIA 455-53A. Perform OFN end-to-end attenuation tests using an optical time domain reflectometer (OTDR) and manufacturer's recommended test procedures. Perform tests in accordance with TIA/EIA-526-14-A, Method B for horizontal, Singlemode OFN. Perform verification acceptance tests and factory reel tests. The system loss measurements shall be provided between 1260 and 1620 nanometers for singlemode fibers. All testing shall adhere to the Fiber Optic Association guidelines. On the web at: www.thefoa.org.
- Provide OUSD representative with written final tests verification within 1 week of completion of installation. Final test results shall include summary pages for each MDF/IDF as required. Test results shall be provided in both hard and soft copy.

1.10 WARRANTY

A minimum twenty five (25) year Extended Product and Application Assurance Warranty for this wiring system by the manufacturer shall be provided as follows:

- Minimum 25-Year Extended Product Warranty. The 25-Year Extended Product Warranty shall ensure against product defects; all approved cabling components shall exceed the specifications of TIA/EIA 568A and ISO/IEC IS 11801 and exceed the attenuation and NEXT requirements of TIA/EIA TSB 67 and ISO/IEC IS 11801 for data cabling links/channels. The cable installation will exceed the loss and bandwidth requirements of TIA/EIA TSB 67 and ISO/IEC IS 11801 for fiber links/channels, for a minimum fifteen (15) year period. The warranty shall apply to all passive data components.
- The 25-Year Extended Product Warranty shall cover the replacement or repair of defective product(s).
- Labor for the replacement or repair of such defective product(s) for a one (1) year period.
- Minimum 25-Year Application Assurance and Channel Performance Warranty.
- System Certification. Upon successful completion of the installation and subsequent inspection, the customer shall be provided with a numbered certificate, from the manufacturing company(s), registering the installation.

Additional Warranty Contractor shall state any additional Contractor supplied warranty.

1.11 VOICE AND DATA LABELING

The labeling shall be in accordance with the TIA/EIA-606 standards for data and voice. The labeling shall be computer software generated and printed with readable fonts and black ink.

The ink and label shall be water and smear-proof for both indoor and outdoor use. Samples of each type of media showing label type, labeling format, font size and ink shall be submitted for Technology Services approval.

Voice and Data Systems Labeling The voice and data systems labeling shall include all related equipment, cables, racks and RJ-45 outlets. Label all cables at each end of the cable designating the rack and port number. The labeling shall be delineated on any riser diagrams, floor plans and test reports. The labeling shall be computer software generated and printed with readable fonts and black ink. Each and every cable termination must be labeled, with each and every cable labeled within two (2) inches of each end. Termination labels and cable tags identifying two ends of the same cable must be the same color. All labeling must be securely fastened, either using heat shrink or self-laminating labels and must be machine generated; handwritten labels are not acceptable. Approval of OUSD's Representative for sample labels of each type must be secured prior to commencing application.

Patch Panel Labeling Patch panels shall be provided with factory-installed label fields. Contractor installed labels shall identify workstation outlet location and its room number and related patch panel port number with machine generated labels.

Outlet Labeling Outlets faceplates will be provided with factory installed label field labels. Contractor installed labels shall identify the appropriate MDF/IDF as well as the related patch panel and port number with machine generated labels.

1.12 AS-BUILT DOCUMENTATION

The Contractor shall provide complete documentation of as-built conditions within ten business days of each installation completion; late delivery of all submittals (including, but not limited to, as-built documentation) will cause delay of Acceptance by Technology Services. CAD backgrounds shall be provided in electronic form to OUSD via USB Flash Drive or electronic file.

The Contractor shall provide updated AutoCAD drawings utilizing release 2013 or higher; such drawings will indicate site plans, floor plans, as-built conditions of all outlet locations (including outlet numbering), MDF and IDF areas, as well as main cable runs within the ceiling (including cable pathway apparatus such as cable trays, conduits, sleeves, and trapeze systems).

The Contractor shall provide as part of their as-built documentation for each installation two (2) "E" size hardcopy plots of each drawing installation drawing set as well as in a digital format such as PDF. Copies shall be delivered to OUSD's Technology Services Department.

All other as-Built documentation shall be provided to OUSD's Technology Services Department in PDF format.

Within the required digital documentation, the contractor is also to include documentation that illustrates how all ports are mapped from room to respective IDF and from each IDF to the MDF. Contractor also to include documentation on how the architecture of the network was created and all respective facets there of.

1.13 MISCELLANEOUS SPECIFICATIONS

Ordering of Equipment and Materials The Contractor shall be responsible for placing orders for all required materials, components, and supplies, securing and forwarding to OUSD's Representative written confirmations (including orders and shipping dates) direct from each manufacturer/supplier unless specifically directed to order through OUSD vendors (owner

ordered/contractor purchased) or for owner purchased/contractor installed instances. The Contractor shall expedite shipment of all materials, components and supplies as necessary to ensure the successful completion of each installation by the date required.

Implementation Planning and Execution The Contractor shall work with Technology Services and OUSD's Representatives to plan implementation schedules and methodologies, which minimizes impacts to students/staff or other trades during installation and cutover processes. All costs for planning and coordination as well as for after normal business hours labor shall be included within the Contractor's pricing as provided. Please note that, due to academic and administrative activities, implementation may generally be effected after normal business hours; overtime will be incurred by Contractor (without additional cost to OUSD) only as necessary to ensure compliance with mutually agreed installation milestones.

Training Requirements Respondent's project price shall include (2) two orientation sessions with OUSD's technical/facility support personnel. These sessions, which for planning purposes may last up to four hours each with a minimum of 2 hours, shall: provide an overview of the architecture and its functionality; discuss cross-connect and/or patch cord implementation; review as-built documentation; and establish recommendations for effective management and maintenance of the installed CCS. The first training session will commence within (10) days after final completion and the second will occur within 1 year after final completion.

2.0 NETWORK SYSTEM INFRASTRUCTURE

2.1 OVERVIEW

OUSD's data communications network should be able to support a combination of LAN electronics and transports including: Gigabit switches aggregated back to a switch installed in a centralized location on each campus.

The gigabit network design will utilize a star topology with fiber links back to the core switch at each campus. This network design will allow all multiple access points to be aggregated into a 10-gig distribution switch located in each MDF/IDF.

The 10-Gigabit Ethernet solution must provide scalability, complete compatibility, and be easily integrated into OUSD's future wide area networks fabric. This upgrade must be seamless in its migration to higher bandwidth requirements and comply fully with current 802.3ae standards. With the implementation of the 10-Gigabit backbone Technology Services expects a significant increase in performance over its existing networks.

2.2 CABLING AND NETWORK INFRASTRUCTURE

Technology Services requires a star network topology design. The backbone cabling shall extend from the Main Distribution Frame (MDF), to each of the MDF/IDF/SMALL IDF. All singlemode fiber optic terminations will be home runs back to the MDF.

2.3 ENTERPRISE NETWORK ARCHITECTURE

Technology Services requires enterprise network equipment to implement a Layer 2 & 3 IP network service over an Ethernet switching fabric, which will encompass the core, distribution, and local access components of OUSD's network architecture.

To the maximum extent that market offerings make it feasible, Technology Services shall acquire network products adhering to industry supported standards and specifications from recognized standards-making bodies, such as the IEEE Project 802 and the IETF. The standards

specified below are those deemed appropriate by Technology Services to meet its requirements.

The bandwidth of switched segments, in the OUSD network; 10 Gb/s segments will be deployed, as Technology Services requirements dictate, which will constitute the entire backbone, core network, and some special user distribution and local access segments. Switched segments to network end-stations, switches, and routers will be full duplex.

OUSD will run various Internet transport protocols, including Transmission Control Protocol (TCP), User Datagram Protocol (UDP), and others as robust implementations become available and requirements warrant.

Although Technology Services expects to continue to run IPv4 for the near to intermediate future, it is expected that a transition to IPv6 will be implemented at an appropriate point, perhaps motivated by such features as authentication, Quality of Service (QoS) priorities, and L3 address space expansion.

Endpoints will be organized logically into VLANs. Inter-VLAN communication will be provided by L3 routing functions.

It is Technology Services' objective to provide an Integrated Services IP packet network to support both traditional loss-sensitive/delay-tolerant flows (e.g. DNS queries) and loss-tolerant/delay-sensitive real-time flows (e.g. playback video streaming applications).

Each edge switch shall be fully layer 3 compliant.

Edge switches may be stackable or chassis based. All edge switches shall be connected via home run fiber to the Main Distribution Frame.

2.4 SWITCHED ARCHITECTURE CHARACTERISTICS

Technology Services requires a network with Ethernet MAC-frame-switched architecture, with the exception of L3 packet switching for inter-VLAN operations and routing to external destinations. Contractors shall:

- Provide conceptual drawings of the configurations called for.
- Provide a description of how end-to-end connectivity is provided for all required protocols, and include all switches and router protocols used to provide connectivity (i.e. Spanning Tree, OSPF, EIGRP, etc.).
- Describe what differentiates your product from your competition.
- Network & Component Characteristics. Technology Services desire the following characteristics for the network and its components:

Click to expand

- Gigabit Technical Specifications:
 - All Gigabit Ethernet switches must support Layer 3 switching for IP.
 - All Gigabit Ethernet switches must have redundant switching fabrics.
 - All Core Gigabit Ethernet switches must have at least a 40G switching fabric.
 - All switches must support Policy and Port based VLANs.
 - All Layer 3 implementations should be standards-based. No proprietary protocols or pre-standard protocols should be used to implement routing.
 - Gigabit Ethernet switches must be able to use and understand OSPF, EIGRP, PIM, DVMRP or RIP II for routing purposes.
 - Gigabit Ethernet switches should support at least 20,000 MAC and routing table entries.
 - Gigabit Ethernet switches must support 802.1d Spanning Tree as well as multiple spanning tree groups.
 - Gigabit Ethernet switches must support 802.1Q VLAN tagging.

- Gigabit Ethernet switches must support conversation steering/port mirroring to allow packet monitoring.
- All devices should support management via local console access as well as remote network protocols such as Telnet, SSH or SNMP.
- All switch ports used to terminate drops for telephone handsets, clocks, bells and speakers must support Power-Over-Ethernet (POE).
- Virtual LAN Architecture (L3 Inter-VLAN Operations)
- Client utilizes VLAN functionally to segment video/audio applications (i.e., teleconferencing) traffic from the rest of the network. Technology Services requires standards-based VLANs for the logical organization of all end-stations within its enterprise network.

VLANs should be defined by network equipment in accordance with IEEE P802.1Q/D10. L2 switching operations should conform to specifications in IEEE P802.1Q/D10 and IEEE 802.1D/D16.

Technology Services requires high-speed, highly efficient L2 switches and L3 routers to implement an enterprise-wide configuration of Ethernet switching fabrics and an L3 switching hierarchy.

Technology Services requires an IP network service supporting real-time flow (e.g. video-streaming) applications in both unicast and multicast configurations.

Technology Services requires an IP network service providing QoS assurances for both traditional data and multimedia network service applications. This requirement has two distinct parts: Classes of Service (CoS) and end-to-end Quality of Service (QoS) provision by resource reservation.

CURRENT STANDARDS Equivalents must match the specifications of our current standards

- Juniper EX3400*, 48-port POE IP BASE Switch with dual power supplies - MDF and IDF with 5-year 8x5xNBD support, 10 GB LR SPF+ transceivers in minimum of 2 slots plus an Advanced Feature License (stacking cables must be provided as needed for installation)
- Juniper EX4600* switch - MDF only with 5-year 8x5xNBD support 10 GB LR SPF+ modules in all slots plus an Advanced Feature License
- Meraki AP MR56 (Wifi 6) with 7 years subscription for indoor workspaces and classrooms. Use Meraki AP MR84* (Wifi 6) for outdoor and industrial locations, such as kitchens and warehouses.
- Cisco 8851 IP phones for office spaces, Cisco 7841 IP phones for classroom spaces with wall mount option and a minimum of a 5-year CUWL license.
- Cisco ISR 4431 for VOIP routing (for specific line items consult Technology Services).
- B40-MB50 Multi-Band Antenna, The B40-MB50 Multi-Band Antenna shall be routed in a dedicated ½" minimum EMT conduit. The antenna shall be exterior wall mounted at roof level.

*Substitution to newer models will likely be required. Consult with the OUSD Technology Services Department for current models.

2.5 POWER PROTECTION

Technology Services requires suitable Uninterruptable Power Supply (UPS) systems in all MDF data closets to insure continuous operation of all routers, POE switches and backbone switches in the event of a power failure. UPS in each closet with capacity to run all network equipment for 4 hours

Technology Services requires line conditioners in all IDF data closets to provide regulated voltage to networking equipment greater than or equal to a 3840 joules (TrippLite ISOBAR12ULTRA).

UPS systems shall be, APC Smart-UPS X 3000VA Rack/Tower LCD 100-127V, product number SMX3000LVNC with network card or updated APC model with equivalent specifications

2.6 NETWORK SECURITY

Technology Services requires one integrated scheme of network service user authentication and authorization for access to specific applications and data resources. This scheme should be based upon appropriate (see below) standards, as initial product implementations become available.

VLAN Authentication and Authorization requires an authentication facility, which must be provided and authenticates an end-user by personal identification or a device by MAC address or receiving L2 switch port address for operation within one or more specific VLANs. In addition, authorization controls must be provided to determine which applications and data resources an end-user or her workstation will be able to access. Specify how the Equipment will make that possible.

2.7 SYSTEMS TESTING AND ACCEPTANCE

The vendor is asked to submit an acceptance plan as part of their response. A minimum acceptable plan will include testing of LAN and Wide Area Network access to the targeted applications for each device.

3.0 SECURITY CAMERA EQUIPMENT & SOFTWARE

3.1 OVERVIEW

The Security Equipment and Software is designed to be integrated into the District network with security services originating from a server at the Main Distribution Frame (MDF). From the MDF, cables shall extend to various Intermediate Distribution Frame (IDF) locations distributed throughout the campus. An extensive conduit system extends throughout most of the larger campuses and provides cable pathways to each of the buildings.

The purpose of this solution is to provide an IP Based Video Surveillance Solution for the Oakland Unified School District including but not limited to all Electrical requirements, Pathways, Cabling, Cameras and all other equipment necessary for a complete functional District wide video safety system

The system will offer remote observation capabilities locally as well as at Police Services and Facilities Project Manager using fixed position or omniview cameras to capture the exterior and interior of each campus. Cameras shall be locally recorded on network video recorders. These recorders shall be connected to the security LAN data network. This connection shall enable authorized personnel utilizing client computers to access these network recorders and monitor live or recorded video remotely via the GUI interface on the client computers. **PTZ cameras cannot be used or installed.**

3.2 GENERAL ABBREVIATIONS, ACRONYMS AND STANDARDS

Click to expand

- JPEG: Joint Photographic Experts Group (image format)
- LAN: Local Area Network

- Lux: A standard unit of illumination measurement
- MPEG: Moving Picture Experts Group
- Multicast: Communication between a single sender and multiple receivers on a network
- NTP: Network Time Protocol
- NTSC: National Television System Committee – a color encoding system based on 60Hz
- ONVIF: Global standard for the interface of IP-based physical security products
- PoE: Power over Ethernet (IEEE 802.3af/at) standard for providing power over network cable
- Progressive scan: An image scanning technology which scans the entire picture
- SDK: Software Development Kit
- ACC: Video Codec “Active Content Compression
- ADDS: Active Directory Domain Services
- AGC: Automatic gain control
- API: Application Programming Interface
- Bit Rate: The number of bits/time unit sent over a network
- Bonjour: Enables automatic discovery of computers, devices, and services on IP networks.
- DHCP: Dynamic Host Configuration Protocol
- DVR: Digital Video Recorder
- DNS: Domain Name System
- FPS: Frames per Second
- FTP: File Transfer Protocol
- GbE: Gigabit Ethernet (1000Mbps)
- H.264/5 (Video Compression Format)
- IEEE 802.1x: Authentication framework for network devices
- IP: Internet Protocol
- RAID: Redundant Array of Independent Disks
- SMTP: Simple Mail Transfer Protocol
- SNMP: Simple Network Management Protocol
- SSL: Secure Sockets Layer
- TCP: Transmission Control Protocol
- TLS: Transport Layer Security
- Unicast: Communication between a single sender and single receiver on a network
- UPnP: Universal Plug and Play
- VMS: Video Management System

3.3 BASIC CONTRACTOR RESPONSIBILITIES

The Contractor shall, at a minimum, possess the following attributes:

- Shall be a licensed security Contractor with a minimum of five (5) years’ experience installing and servicing systems of similar scope and complexity.
- All software and camera installations, configuration, setup, program and related work shall be performed by software/electronic technicians thoroughly trained by the manufacturer in the installation and service of the equipment provided.
- Shall submit certifications from the manufacturer of the equipment from the last two years of the highest level of training provided.
- Shall have 24/7/365 service technicians and be a stocking contractor of the manufacturers equipment. The Integrator shall be able to respond to a service call on site and have trained resources within 60 miles of the owner’s location.
- The Integrator’s main resources within the project shall carry proper certification issued by the manufacturer and provide recent certifications to confirm sufficient product and technology knowledge.
- The Integrator shall follow the installation instructions provided by the manufacturer to ensure the system is designed, calculated and installed per the manufacturer recommen-

datations.

- The database shall be reviewed by the Owner and approved before the Integrator enters it into the system.
- All equipment shall be tested and configured in accordance with instructions provided by the manufacturer prior to testing and training of the owner.
- All firmware in products shall be the latest and most up-to-date provided by the manufacturer, or of a version as specified by the provider of the Video Management System to ensure approved integration compatibility.
- F. A proper installation shall meet NEC (National Electrical Code - US only) per the guidelines of that year's revision and the local authority having jurisdiction. When properly installed equipment meets Low Voltage, Class 2 classification of the NEC.

3.4 SOFTWARE

Video Management System Unless otherwise noted the VMS will be Xprotect Professional+ as manufactured by Milestone Systems and supplied by a Certified Factory representative. This will allow Police Services and Facilities Project Manager to be able to access and manage all of the video recorders remotely for each site as well as locally by authorized personnel. Only authorized personnel will have access to the software which includes the Facilities Project Manager, Maintenance Vendor, and Technology Services for the purposes of configuring the recorders using the VMS. The Video Management System shall be manufactured by a corporation utilizing quality best practices meeting the specified features.

The VMS shall utilize an (SDK) which enables seamless integration of video analytics algorithms and other third-party applications in XProtect Smart Client and Management Client. The integration option shall support Milestone ONVIF Bridge that enables full video interoperability in multivendor installations using a standardized ONVIF compliant video-out interface. Generic event integration shall enable easy and fast integration of third-party applications and systems via a simple message-based socket communication interface. The system configuration API shall enable external applications to make changes to the system's configuration.

VMS Software Installation Locations VMS software will be installed locally on a desktop computer in a location as determined by the site administrator. VMS software **will not** be installed on any portable computing device (e.g. laptop, tablet, smartphone). Local desktop installation shall be at the following locations;

High School

1. Principal's office
2. Each Vice Principal's office
3. Lead Site Security Officer office

Middle School

1. Principal's office
2. Each Vice Principal's office
3. Lead Site Security Officer office

Elementary School

1. Principal's office
2. Vice Principal's office
3. Lead Site Security Officer office

Recorded camera footage is to be kept for a minimum of 30 days.

Video Management System Accessibility, Authorization, & Authentication For the purposes of safety and due to the nature of the use of security surveillance systems, local accessibility to the video management software is to be limited to authorized personnel only. Police Services and Facilities Project Manager will provide a list of authorized site personnel that will be given access to the VMS.

Typical authorized personnel is as follows:

1. Principal
2. Vice Principal (may be more than one if located at a middle school or high school)
3. Lead Site Security Officer

For any additional authorized personnel consult with the Police Services and Facilities Project Manager.

Authentication

- System log-in shall use Microsoft Active Directory, local Windows or basic user account. Hereby, current windows logon shall be used for authentication.
- Dual authorization shall offer an optional additional level of system security, where Management Client users are granted access to the system only when a second user or supervisor has confirmed the log-in with a successful authorization of the second user.

Management Server & Management Client The Management Server & Client shall be configured as stated below:

- The Management server shall enable user authentication logon, system configuration and logging.
- The Management Client shall enable administration of the system such as recording servers, devices, security, rules and logging.
- The Management Client shall be compatible with XProtect Professional+ 18 and newer.
- All configuration and logs from the entire system shall be stored in a Microsoft SQL database and accessible by the management server only.
- The Failover solution for the management server shall provide a resilient system solution based on Windows Server Clustering, ensuring high system availability.
- The Management server manager shall be available in the local console notification area (icon tray) for status messages and to start/stop the service.
- The management server shall run as a Windows service under local system account or optional local Windows user or Microsoft active directory account with run-as-a-service privileges.
- The management client's graphical user interface shall be available in a minimum of 12 languages including: American English, Chinese (Simplified), Chinese (Traditional), Danish, German, French, Italian, Japanese, Korean, Portuguese (Brazil), Russian and Spanish.
- The management client's built-in help shall be available in a minimum of 6 languages including: American English, Chinese (Simplified), French, Japanese, Korean and Portuguese (Brazil).
- To register and validate your licenses, the system shall offer easy-to-use automatic or manual online activation via the Internet and alternatively, offline activation via email and web for closed surveillance networks.
- XProtect Professional+ shall support both IPv4 and IPv6 addressing. XProtect Professional+ shall also be backwards compatible with XProtect 2018 and newer versions.
- Logs of system, audit and rule entries shall consolidate from all recording servers and clients. Each log file shall have adjustable size and time limitations.

Milestone Interconnect Remote Site

- The System concept shall interconnect all Milestone XProtect video management software (VMS), Milestone Arcus and Milestone Husky units to gain operation and cost-effective management of geographically dispersed surveillance sites.
- Intelligent video storage management shall make optimal use of remote video storage and available network bandwidth with a choice to store video recordings remotely, or combined with flexible revival of the remotely stored video.
- XProtect Professional+ includes the possibility that shall define time interval and bandwidth cap for upload of video from a remote interconnected site.
- XProtect Professional+ shall enable the proactive detection of errors and cost-efficient management of connected sites by propagation of system status events and embedded remote management of connected system.
- XProtect Professional+ has the ability that shall detect system problems and remotely manage interconnected sites reducing operational costs and the need for on-site visits.

Storage

- Allows the definition of one or more storage containers with individual archiving schemes and retention times. The recording capacity shall be limited only by disk space. All recordings are to be kept for a minimum of 30 days.
- Each storage container shall be defined as a live database and one or more optional archives, where the video data is moved from the live database to secondary disk systems or network drives. The archived data shall be still online and available for clients.
- Archiving schemes shall define when video is archived to the next archiving stage in the storage container and how long the video data is retained before deletion.
- The storage functionality shall enable the ability to allocate individual devices to different storage containers.
- XProtect Professional+ shall allow to move a device or a group of devices between two storage containers.
- Storage overview shall give instant indication of used vs. available storage in total and for individual cameras.
- The VMS shall manage maximum recording time for manual recordings.

Devices

- The Hardware wizard shall add devices; automatically using Universal Plug and Play (UPnP) discovery, via IP network range scanning, or using manual device detection. All methods support automatic or manual model detection.
- The Wizard shall enable swift replacement of malfunctioning devices with preserved configuration settings and recordings.
- The Wizard shall enable easy moving of hardware devices (with attached cameras, microphones, speakers, inputs, outputs and metadata devices) between recording servers in runtime without losing settings, recordings, rules, permissions etc. It shall enable and disable devices if they are not used or are down for maintenance.
- It shall allow to adjust settings such as brightness, color level, compression, maximum bit rate, resolution and rotation per camera or camera group; select and configure video format, frames per second (FPS), resolution and quality for the video streams used per camera; select and configure one, or more, video streams per camera to be used for live viewing. Each stream can be in different video format, FPS, resolution and quality.
- XProtect Professional+ shall enable adjustable group of pictures (GOP) length for MPEG4 H.264 and H.265 encoded video. It also shall enable assigning camera shortcut number for easy operation by clients and shall provide optional preview window for immediate verification of video settings per camera or for a group of cameras.

- The VMS shall allow to run multiple patrolling schedules per camera per day, for example, run different schedules for day/night/weekend.
- Privacy mask shall consistently hide certain areas in the camera view in live and playback video and in exported material.
- It shall allow to configure device events like motion detection with pre- and post-buffers, or input signal behavior options and allow to fine-tune motion detection sensitivity per camera manually or automatically.
- The VMS shall allow to apply one or multiple exclusion zones for where motion detection is to be disabled to avoid unwanted detection.

Rules, time profiles and notifications

- The Powerful Microsoft Outlook®-style rule system shall support an unlimited number of rules.
- Time profiles with recurring time selection and expire condition shall support an unlimited number of time profiles.
- Start actions: The triggering events may initiate a wide set of actions in the VMS system,
- The VMS shall enable multi-recipient customizable email notification with image and/or AVI attachment of incidents.

User Rights Management

- User rights management shall enable common management of all user rights across all user and programmatic (MIP SDK) interfaces.
- Overall system security definition shall make it possible to globally allow or deny permission to devices and functions (such as manage, read, edit and delete).
- Device-specific security definition shall make it possible to allow or deny permission to individual devices and functions (such as manage, read, edit and delete).
- User rights management shall control roles, user and administrator access to:
 1. Inputs and outputs: visibility, administrate, status, activation
 2. manual control, activate fixed position or omniview camera priority, manage fixed position or omniview camera and patrolling, reserve and release fixed position or omniview camera session
 3. Remote recordings: retrieve remote recordings
 4. External events: visibility, administrate.
 5. Alarms: visibility of alarms and ability to manage alarms
 6. MIP: Plug-in permissions
 7. Application: manager, XProtect Smart Client/XProtect Web Client/Milestone Mobile, live/ playback/setup, status API and service registration API

Management Client Profiles

- Management Client profiles shall enable the ability to tailor the availability of main/sub functions in the Management Client for different user roles.

X-Protect Smart Client Profiles

- Smart Client profiles shall enable the ability to enforce or recommend optional XProtect Smart Client application options for a user or group of users, using up to 3 XProtect Smart Client profiles.
- Profiles shall enable defining general XProtect Smart Client application options, including (listing not exhaustive): visibility of time, visibility of camera live indicators, default image quality, default frame rate, keyboard and joystick setup, startup mode and deinterlacing filters.

- XProtect Smart Client profiles also shall:
 1. provide access to live mode and the availability of individual control panes and overlay buttons
 2. Shall provide access to playback mode and the availability of individual control panes, overlay buttons and settings for specific functions, such as default export path
 3. provide access to setup mode and the availability of individual control panes and setup functions
 4. provide access to Sequence Explorer, Alarm Manager, System Monitor
 5. provide access to setup mode and the availability of individual control panes and setup functions
 6. define available view layouts

System Administration

- System administration shall include built-in backup and restore support for manual system backup of all configuration data, including (listing not exhaustive): system configuration data, maps alarm settings and definitions and client views.
- System administration shall enable historic performance and usage investigation and reports of; storage usage, network use, server and camera performance.
- Configuration Reporting shall enable complete or partial documentation of system configuration. Custom and site-specific free-text information, integrator's notes and logo can be added to the printer-friendly reports.

License Administration

- License overview shall include add-on products, Milestone Care coverage and renewal date. The License owner information shall synchronize with the software registration page on the Milestone website.
- License administration shall provide expanded license information for multi-site installations where both the total used licenses for the common SLC is presented and the license use in the specific system. It shall provide license overview that presents the license use of all the individual sites running on the same SLC.
- The "Changes without activation" function shall allow additions and replacements of limited number of devices without requiring license activation.

Event Server

- The alarm manager shall manage single-point alarm management of all internal system alarms and external security alarms. It shall provide alarm descriptions and work instructions to make alarms actionable for operators.
- An alarm location map shall be linked to each alarm providing instant situational awareness to the operator dealing with the alarm.
- Customizable alarm priorities shall allow operators to focus on the most critical alarms and shall enable logical grouping of alarms dependent on their type and nature.
- Customizable alarm statuses shall enable alignment of the alarm handling workflow with existing workflows and security systems.
- The alarm handling result code shall enable tracking of the outcome of the alarms.
- The alarm manager shall enable automatic allocation to alarm owners with escalation and alarm forwarding possibilities.
- The alarm manager shall enable time profiles for definition of active alarms. It shall provide the possibility to associate one or more cameras to an alarm (maximum 15 cameras can be displayed simultaneously in the alarm preview window).
- A set of alarm handling reports shall give valuable information about alarm inflow and alarm handling performance.

- The alarm manager shall enable extensive logging of alarms.
- Microsoft Clustering shall support the event server enables secure and redundant alarm handling.

Milestone Mobile Server

- The Milestone Mobile server shall run as a dedicated service, allowing it to be installed either on the same server as other system components or on dedicated hardware in more demanding installations.
- The Milestone Mobile server shall transcode video so streams are robust and can adapt to changing connection bandwidth. The server also optimizes the use of available bandwidth to get the best possible stream quality.
- Adjustable transcoding logic shall enable capping of video resolution and frame rate for video streams provided to XProtect Web Clients and Milestone Mobile clients.
- The server shall provide an option to bypass the transcoding logic and send direct streams to XProtect Web Clients.
- Installing the Milestone Mobile server plugin in the Management Client shall give access to Milestone Mobile server management in order to change settings, read out miscellaneous status information, configure codecs used for exports as well as manage ongoing and completed exports.
- Milestone Mobile servers shall be installed in parallel, offering redundancy and/or allowing more simultaneous users.
- Milestone Mobile servers shall be configured through the tray controller to easily adjust or update settings Shall provide option to either a default-generated certificate for HTTPS encrypting the connection to the Milestone Mobile server or provide your own custom certificate.
- Video Push configuration shall be done from the server, so users can download and use Milestone Mobile without having to do any configuration.
- Milestone Mobile server shall support creating server-side export through XProtect Web Client and Milestone Mobile.
- XProtect Web Client, including optional browser plug-ins, shall be included with the Milestone Mobile server. No additional setup is needed
- Smart Connect shall enable easy configuration of internet access to the Mobile Server by automatic configuration of firewalls and internet routers via UPnP. Smart Connect shall also verify the configuration and operation of the internet connection, and can be used to email connection details to Mobile Client users.

XProtect Smart Client

General

1. XProtect Smart Client shall provide dedicated task-oriented tabs for the Sequence Explorer, Alarm Manager and System Monitor, in addition to the traditional Live and Playback tabs.
2. The client shall provide application theme support with choice of dark or light themes.
3. XProtect Smart Client shall provide true multi-window support where secondary windows have full functionality and can be operated in independent mode or synchronized mode where they follow the control of the main window.
4. It shall enable shortcuts to select a specific window or specific camera in a window.
5. The client shall provide a camera search function that promptly finds cameras, types of cameras and views in the system with the ability to create temporary views to display all or a subset of cameras matching the search criteria.
6. XProtect Smart Client shall display metadata bounding boxes from supported devices in live views and playback.

Customization

1. The application options shall enable customization of the general behavior and look of the XProtect Smart Client. The customization shall be able to either be made as individual personalization managed by each operator.
2. The application shall offer a simplified user interface with the possibility to toggle between “Simple” and “Advanced” modes, where Advanced mode is default.
3. The XProtect Smart Client shall enable control of general look & feel and navigation properties, such as color mode, camera title bar, grid sizes etc.
4. The client shall provide the availability of control panes and functions in live and playback tabs, and in setup mode, as well as the behavior and availability of the Professional+ function.
5. The application shall allow to include information in timeline in the playback tab, setup keyboard shortcuts and joystick controls, as well as specific behavior of alarms and access control notifications.

Live View

1. XProtect Smart Client shall enable to view live video from 1-100 cameras per computer monitor/view. Multiple computer monitor support shall provide a main window and any number of either floating windows or full screen views.
2. Live view digital zoom shall allow a full view of recordings while the operator can digitally zoom in to see details.
3. Live view shall support multiple view layouts optimized for 4:3 and 16:9 display settings in both landscape and portrait.
4. Independent playback capability shall allow for instant playback of recorded video for one or more cameras, while in live mode.
5. Live view provides the possibility to instantly re-arrange cameras in views for optimized monitoring of incidents, with single click restore of original view.
6. It shall provide seamless access to cameras in remote interconnected systems.
7. Live view shall enable instant camera placement in live view allows for instant replacement of cameras in a view, where new cameras can be placed in a particular view and positioned through a simple drag-and drop operation.
8. Live view shall update on “motion only” optimizes CPU use by allowing motion detection to control whether or not the image should be decoded and displayed.
9. Global hotspot function shall allow users to work in detail with any camera selected from any view. Local hotspot function shall allow users to work in detail with a camera selected from the same view.
10. Carousel function shall allow a specific view item to rotate between pre-defined cameras that are not necessarily present in the view at the same time. Operators shall select default or custom display times for each camera, and they are able to manually switch to the next or previous camera in the carousel list.
11. Matrix function shall show live video from multiple cameras in any view layout with customizable rotation paths, remotely controlled by computers sending matrix remote commands.
12. Live view shall import static or active HTML maps for fast navigation to cameras and to provide a good overview of premises.
13. It shall hide the HTML page toolbar in HTML page views.
14. Live view shall activate matrix via graphical maps of premises using JavaScript or integrate with centralized access control systems.
15. It shall allow the operator can assign outputs and views as actions to joystick buttons and as keyboard shortcuts.
16. Two-way audio support shall enable XProtect Smart Client to record and play live audio from camera- connected microphones and outgoing audio from the operator’s microphone to one or multiple camera speakers.

17. Live view shall enable adaptive deinterlacing option secures high video quality, based on the actual video content received. XProtect Smart Client shall optionally apply a filter to areas of the image where jagged edges would otherwise show up.
18. Operators shall start/stop manual recording on individual cameras, where the recording status is propagated to all XProtect Smart Client users active in the system.

I/O and Events

1. Overlay buttons shall provide intuitive control of cameras, camera-integrated devices and other integrated systems directly from the camera view.
2. I/O and events shall enable to manually trigger output port relay operation, for example when controlling gates.
3. I/O and events shall enable to manually trigger events by activating a server-defined event from a list.

Bookmarking

1. Bookmarking shall enable users to manually add bookmarks with the bookmark function.
2. Bookmarks shall be shown in timeline with instant preview.
3. The function shall enable users to listen and preview bookmarks in recording search.
4. Bookmark reports shall enable effortless incident documentation.
5. Direct video export of a bookmark shall reduce the time needed to prepare forensic video material.

Playback

1. Playback shall provide playback video from 1-100 cameras per computer monitor/view.
2. Advanced video navigation shall include fast/slow playback, jump to date/time, single step and video motion search.
3. Playback shall include integrated video timeline with time navigation and playback controls, including an integrated function to select a time interval for export, video retrieval from Edge Storage devices and remote interconnected systems.
4. Playback shall allow to toggle between simple and advanced timeline mode.
5. Playback shall allow to toggle between simple and advanced timeline mode.
6. Independent playback capability shall allow the independent playback of recorded video from one or more cameras.
7. Instant camera placement in playback view shall allow users to instantly replace cameras in a view, where a new camera can be placed in a particular view and position with a simple drag-and drop operation.
8. Digital zoom shall allow the operator to see magnified details in the recorded video.

Export & Print

1. The snapshot function shall enable operators to produce instant visual documentation of a camera by saving the camera image to a file, or sending it directly to a printer.
2. The storyboarding function shall make it possible to include video sequences from different or overlapping time intervals from different cameras in the one and the same export.
3. The export and print function shall provide export in XProtect format; including the standalone XProtect Smart Client - Player application for instant and easy viewing by authorities.
4. The function shall allow export preview with looped playback.
5. Export and print shall enable encryption and password protection of exported video material with a choice of following strong encryption algorithms: 56-bit DES 128, 192 and 256-bit AES.

6. Export and print shall allow to create evidence material in media player format (AVI files), MKV format, or still image format (JPEG images).
7. The function shall allow to disable the re-export option to prevent undesirable distribution of sensitive evidence material.
8. Export and print shall allow bulk camera export in multiple formats to multiple destinations, including direct export to optical media, results in more efficient video exports and more secure handling of evidence material.
9. Export comment function shall enable users to add general and/or camera-specific comments to a video export when exporting to XProtect format.
10. In media player format comments shall be added as pre/post slides.
11. The VMS shall allow to print incident reports including image, surveillance details and free-text user comments.

Sequence Explorer

1. The smart client shall include a dedicated tab for the Sequence Explorer.
2. The search options shall be: Manual Search.
3. The sequence explorer shall include smooth navigation with sliding preview and “drag-and-throw” function for video thumbnails.
4. The VMS shall include preview of selected sequence with auto play and direct export support.

Map Function

1. Built-in map function in XProtect Smart Client shall provide an intuitive overview of the system and offers integrated access to all system components.
2. Map images shall be in standard graphic file formats including JPG, GIF, PNG and TIF.
3. Map function shall include any number of layered maps such as city, street, building and room.
4. The function shall enable instant camera preview on “mouse over” and one-click shows all cameras on map.
5. The function shall allow depiction of camera view zones on map with clickable fixed position or omniview camera zones for instant fixed position or omniview camera control.
6. Map function shall allow easy drag-and-drop and point-and-click definition of: cameras, servers, microphones, speakers, I/O devices, hot-zones for map hierarchies, camera view zones.
7. The function shall provide integrated control of speakers, microphones, and events and output I/O control, including: doors, gates, light and access control systems.
8. Map function shall also:
 - provide real-time status monitoring indication from all system components including cameras, I/O devices and system servers
 - provide graphical visualization of the system status through color coding
 - provide hierarchical propagation of status indications to higher ordered maps
 - make different levels of status indications available (alarm, warning and errors)
 - provide system performance data for cameras and servers including camera resolution, FPS, network use and disk space
 - be able to suppress status indications (such as error and warning) for a given device
 - provide the possibility to edit device names in a map and assign map-specific names and references to devices in a map
 - Map editing subject to user rights

Camera Navigator

1. The camera navigator shall provide consistent and comprehensive visual verification, ensuring easier tracking of moving objects in geographically complex environments.
2. The navigator shall automatically display thumbnail views of nearby cameras.
3. The camera navigator shall provide add-on to the map application with no special configuration needed.

Alarm Manager

1. The Smart Client shall provide a dedicated dockable tab for the Alarm Manager.
2. The alarm manager shall include an alarm list with extensive filtering capabilities and an alarm preview in both live and playback mode.
3. The alarm manager shall enable extensive alarm sort and filtering functions allow operators to focus on most critical alarms.
4. Instant preview of primary and related cameras shall reduce the number of false alarms.
5. Tight integration with the map function shall allow operators to indicate and acknowledge active alarms in the map.
6. Alarm descriptions and work instructions shall make alarms actionable for operators.
7. Alarm escalation and alarm forwarding possibilities shall allow operators with appropriate skills to handle different alarms.
8. Alarm reports shall enable incident documentation.
9. Alarm location map shall present the alarm operator with a map showing the alarm area when an alarm is selected.
10. The alarm manager shall provide alarm notification to a single or a group of Milestone Mobile client users using Push Notifications.
11. The manager shall provide optional sound notifications for different alarm priorities for notification of new incoming alarms.
12. Alarm disabling option shall enable users to suppress alarms from a given device in a certain time period.
13. The alarm manager shall enable instant access to both live and recorded video from the cameras that are related to the alarm.
14. Alarm handling reports shall give valuable information about alarm inflow and alarm handling performance.
15. The manager shall provide a common alarm list for all interconnected sites.

System Monitor

1. The system monitor shall provide a dedicated dockable tab with system performance and use information.
2. The system monitor shall provide historic performance and usage investigation and reports of; storage usage, network use, server and camera performance.

Set-up & Management

1. Download and install XProtect Smart Client from a web page on the management server. It shall enable notification about new updates at log-in.
2. Application options shall allow users to adapt the layout and personalize the application to their particular preferences.

Authentication

1. System log-in shall use Microsoft Active Directory, local Windows or a basic user account. Furthermore, it shall use current Windows log-on for authentication, and use Auto-log-in and auto-restore views.

2. Dual authorization shall offer an optional additional level of system security, where XProtect Smart Client users are granted access to the system only when a second user or supervisor has confirmed the log-in with a successful authorization of the second user.

System

1. The system shall support IPv4 and IPv6 addressing.
2. The 64-bit Windows® operating system support shall enable better performance when viewing and operating many cameras.
3. It shall support hardware accelerated decoding using Intel Quick Sync video.

XProtect Smart Client Player

1. XProtect Smart Client - Player shall be able to play back recorded or archived video and audio evidence, including edited storyboard exports.
2. The player shall include the same user-friendly interface and most functions as XProtect Smart Client.
3. The player shall offer a simplified user interface with the possibility option to toggle between “Simple” and “Advanced” modes.
4. It shall provide instant one-click playback for easy viewing of exported video evidence.
5. Advanced second-level investigation tools shall make it easy to refine exported video and re-export the most essential evidence.
6. Metadata bounding boxes included in exports shall be displayed time synchronized in XProtect Smart Client - Player.
7. The project tool shall allow users to merge video exports or archives from two different locations or XProtect systems together into one new export.
8. Xprotect Smart Client Player shall also:
 - provide view up to 100 cameras time-synced during playback
 - provide camera search function promptly finds cameras, types of cameras and camera views in the system
 - provide scrollable activity timeline with magnifying feature
 - provide instant search on recordings based on date/time and activity/alarm (video motion detection)
 - Shall allow to view, modify or add general and/or camera-specific comments for a given video export
 - Shall allow de-interlacing of video from analog cameras
 - Shall support 360° ImmerVision Enables® panomorph lens technology
9. Evidence shall be generated as a printed report, a JPEG image, an AVI or MKV film or in XProtect format Shall include export audio recordings in WAV, MKV or AVI format.
10. Exported video shall be digitally zoomed to view an area of interest and minimize export footprint size.
11. The player shall enable re-export evidence containing XProtect format and XProtect Smart Client - Player for instant, easy viewing by authorities.
12. The player shall provide encryption and password protection of exported video material with a choice of the following strong encryption algorithms: 56-bit DES 128, 192 and 256-bit AES.

XProtect Web Client

1. XProtect views shall be accessed through the browser and avoid advanced setup.
2. Camera search function shall promptly find cameras, types of cameras and camera views in the system.
3. The client shall include:

- Easy multi camera video playback including fast/slow playback, single frame step and jump to date/time with frame preview while adjusting time.
 - Investigation function with ability to save exports for later usage or download
 - Option for client-side video decoding via browser plug-ins
 - Control fixed position or omniview camera cameras remotely, including preset positions
 - Dynamic bandwidth optimization when streaming from server to client gives better use of bandwidth
 - Create AVI files or save JPEG images
 - Preview exports on the server without downloading them
 - System log-in using XProtect user name and password
 - System log-in using Microsoft Active Directory user
 - Secure connection through HTTPS
1. The XProtect Web Client shall allow export on the server to avoid moving large video files back and forth. The client shall allow to only download needed files or save them for downloading when on a faster connection.
 2. There shall be no installation needed on the client computer.

Milestone Mobile

- Milestone mobile shall support any mobile device running Android® 2.2, iOS5, and Windows® Phone 8, or newer versions.
- Add log-in credentials for multiple servers in Milestone Mobile shall allow to easily switch between sites or different connection addresses.
- Views shall be inherited from the connected XProtect VMS system. The client shall automatically obtain the user's private and shared views from the system to be used as camera lists in Milestone Mobile.
- A view with all cameras shall be automatically generated, allowing Milestone Mobile to be used when no views are set up. It shall also provide a quick way of searching through cameras.
- Camera search function shall promptly find cameras, types of cameras and camera views in the system.
- Cameras shall be viewed in full screen to take better advantage of the device's screen. It is also possible to search through cameras in a view while in fullscreen by swiping left or right.
- Digital pinch-to-zoom shall enable users to zoom in on a part of the image for closer review and conduct detailed investigation of video when using megapixel or high-definition cameras.
- Milestone Mobile shall allow to play back recordings from the database and select a specific time or recorded sequence to start playback, step through recordings and select a playback speed.
- Milestone Mobile shall allow to view recordings from the database while keeping an eye on what is currently happening. The client shall display a live picture-in-picture frame of the same camera when in playback mode. The picture-in-picture shall be moved by dragging and double-tapping and will return to live view.
- Control over the fixed position or omniview camera cameras shall be given with Milestone Mobile either manually or by selecting predefined presets for quick navigation.
- Video Push shall allow users to use their mobile devices' cameras as cameras in the XProtect VMS. It is easy to use and requires no setup in the mobile device.
- Milestone Mobile shall include the option to include location metadata in Video Push.

Licensing Structure

Server Base License

1. An XProtect Professional+ server base license is mandatory for installing the product.
2. The base server license permits the following deployments within the legal entity purchasing the base server license:
 - Unlimited number of Management Servers
 - Unlimited number of Recording Servers
 - Unlimited number of XProtect Smart Clients, XProtect Web Clients and Milestone Mobile applications

Hardware Device License

1. To connect cameras, audio devices, video encoders and other devices to XProtect Professional+, one license per physical hardware devices required.
2. In total, for all copies of the product installed under this license, the product may only be used with hardware devices as you have purchased hardware device licenses for.
3. An unlimited number of hardware device licenses can be purchased. To extend an installation with additional hardware device licenses, the base server license number (SLC) is required when ordering.

Licensing of Milestone remote Interconnect

1. One Milestone Interconnect device license is required per device (camera) in an inter-connected site that is enabled in the XProtect Professional+ system.

3.5 SECURITY CAMERA DESIGN & INTENT

Camera Locations Site walk is to be conducted prior to installation to determine mounting height and exact location of cameras. Prior to installation, Camera locations are to be approved by Police Services, District Facilities Project Manager and Site Administrator. Location of the camera is determined by line of sight and what the camera is trying to capture. Locations are to eliminate “dead spots” within the site both interior and exterior and playfields. Playfields may require wireless cameras and equipment. Camera placement for elementary schools will be exterior only whereas for high schools and middle schools cameras will be placed in both interior and exterior spaces. Cameras are not to be placed in restrooms, locker rooms, showers, drama dressing rooms, etc or any other locations where a person’s body will be exposed on camera. Cameras are to be tied to Milestone and/or AiPhone IP addressable intercom systems.

Camera height Camera heights vary per site. Camera height should be determined by building height, roof line, and whether it is interior or exterior location.

- Minimum height for an exterior location is 12’-0”
- Minimum height for an interior location is 8’-0” (dependent upon ceiling height within the space)
- Cameras are not to be installed on swing arm mounting poles.

Analog to Digital Migration For sites where analog cameras are present, they are required to be tied into the digital server. An encoder is to be provided by the contractor for the translation from an analog signal to a digital signal. Due to the power requirements of the encoder and per the requirements stated in the *Technology Services Data & Communications Specifications* under Distribution Frame Room, Electrical for MDF a 30 amp outlet needs to be provided.

Analog to Digital Encoder IKVISION DS-6716QHIS-SATA with the following key features:

1. Connects to HD-TVI and Analog Cameras
2. Connects to Turbo/HD Camera/Dome with long with long transmission distance
3. Redundant recording and holiday recording
4. Manual video quality diagnostics
5. VCA detection alarm (line crossing detection and intrusion detection)
6. Locks and unlocks video files
7. HDD quota and group management; different capacities can be assigned to different cameras under quota mode
8. 2 SATA interfaces
9. 1 self adaptive 10m/100m/1000m network interface
10. HIKVISION DDNS (Dynamic Domain Name System)
11. NETWORK DETECTION

3.6 SECURITY CAMERAS & LOCAL SECURITY CAMERA RECORDING SERVER

All camera cabling shall be routed to the nearest IDF. Consult with Technology Services as to the route and the nearest IDF location prior to installation.

Security Cameras AXIS P3225-LV Mk Network Camera - Option 1 with the following key features:

1. Variable Lens
2. LLDP
3. Tailgate Detector
4. Analytics
5. Milestone Preferred
6. Light finder and WDR - Forensic Capture

LTS Platinum 4.0 Network Matrix IR Dome Camera CMIP7342V-28-Option 2 with the following key features:

1. Fixed Focus Camera
2. Analytics
3. High Performance Matrix IR LED
4. 4.0MP High Definition
5. Milestone Compatible

Vivotek FD9389 Series-Option 3 with the following key features:

1. 30 fps @ 2560x1920, 60 fps @ 1920x1080 (WDR Pro on)
2. H.265 Compression Technology
3. Smart Stream III to Optimize Bandwidth Efficiency
4. WDR Pro (120 dB) for Unparalleled Visibility in Extremely Bright and Dark Environments
5. 5MP minimum
6. SNV (Supreme Night Visibility) for Low Light Conditions
7. Built-in IR Illuminators, effective up to 30 Meters
8. Smart IR Technology to Avoid Overexposure
9. Trend Micro IoT Security within Standard Warranty Period
10. Weather-proof IP66-rated and Vandal-proof IK10-rated Housing
11. Milestone Compatible

Vivotek MA8391-ETV Multi-Sensor Adjustable Dome Network Camera, 12MP Total Resolution, Multi-Directional, Adjustable Views, Remote Focus, SNV, IP66, IK10 with the following key features:

1. 12-Megapixel total resolution
2. 4 Independent sensors, adjustable views
3. Remote focus
4. 7 FPS(2048x1536) per sensor
5. Removable IR-Cut filter for Day & Night Function
6. Smart Stream II to Optimize Bandwidth Efficiency
7. SNV (Supreme Night Visibility)
8. 3D Noise reduction for low-light conditions
9. Weather proof IP66 rated and vandal proof IK10 rated housing
10. -40C ~ -50C Wide temperature range for extreme weather conditions
11. Built-in microphone
12. Built-in MicroSD/SDHC/SDXC card slot

Installation Installation of cameras will be per the manufacturer recommended installation.

Central server is virtualized

Local Security Camera Recording Server Requirements

- The system shall facilitate simultaneous digital multi-channel MJPEG, MPEG4, MPEG-4 ASP, MxPEG, and H.265 video recording of IP cameras and IP video encoders without any software limitations on number of cameras per server.
- The two-way audio shall allow users to transmit and record audio from connected microphones and audio from the operator's microphone to attached speakers.
- The generic framework shall receive and store metadata from compatible devices and clients.
- Route traffic between multiple connected cameras and multiple clients shall be able to request live view, playback and export.
- A dedicated recording stream shall enable optimization stream properties (resolutions, encodings and frame rate) for video storage and forensic usage.
- The system shall secure a high speed recording database holding JPEG images or MPEG4, MPEG-4 ASP, MxPEG, H.264 or H.265 streams.
- Flexible control of recording characteristics for MPEG4/H.264/H.265 streams, shall make it possible to toggle between recording keyframes only or the full stream.
- The system shall record more than 30 frames per second per camera, limited only by hardware. Recording quality shall depend entirely on camera and video encoder capabilities with no software limitations.
- Pre-recording buffer (used for event/motion based recording) in RAM shall minimize the disk read/write operations when no video is recorded.
- Edge Storage with flexible retrieval shall enable video retrieval from camera storage. This shall enable users to effectively retrieve video recordings across low-bandwidth connections.
- Scalable Video Quality Recording™ (SVQR) shall enable seamless merging of video stored in the recording server, and video retrieved from a camera associated edge storage, or interconnected system.
- The system shall enable the possibility to import pre-event images recorded locally in camera or video encoder.
- Built-in, real-time, camera-independent motion detection with the ability to generate motion metadata for Smart Search.
- The recording server shall run as a Windows service under local system account or optional local Windows user or Microsoft Active Directory account with run-as-a-service privileges

- Port forwarding shall enable clients to access the recording servers from outside a network address translation (NAT) firewall.
 - The system shall support both IPv4 and IPv6 addressing.
 - The 64-bit recording servers shall allow more cameras to be run on a single server unit
 - The secure HTTPS camera connection on devices shall support HTTPS.
 - Remote Connect Services shall enable you to securely connect remote cameras across different types of private and public networks.
 - I/O and events
1. XProtect Professional+shall support devices with one or more input and output ports.
 2. The Powerful rule processing engine shall execute start and stop actions triggered by events or time profiles.
 - Setup and management
 1. Download and install the recording server from a web page on the management server. The recording server shall be completely managed via the Management Client and configuration changes shall be applied instantly while recording is in operation.
 2. Local recording server configuration data shall be available during periods where the management server is inaccessible.
 3. Recording server manager shall be available in the local console notification area (icon tray) for status messages, start/stop of the service and change of network settings.
 - Clients shall be authenticated and authorized at the management server and shall use a session-limited access token to access the recording server.
 - Shall enable logging of system, audit and rule entries to the management server with local caching during offline scenarios.

Local Security Camera Server for fewer than 30 cameras Unless otherwise noted, the server that is to be used shall be based upon the Dell PowerEdge R230 Server and shall consist of the following requirements:

Click to expand

- Chassis: Chassis with up to 4, 3.5 Hot Plug Hard Drives (321-BBUO)
- Misc.: PowerEdge R230 Shipping (340-AQDE)
- Processor: Intel Xeon E3-1240 v5 3.5GHz, 8M cache, 4C/8T, turbo (80W) (338-BHTX)
- Heat Sink: Standard Heat Sink for PE R230/R330 (412-AAGT)
- Riser: PCIe Riser with Fan (330-BBFB)
- Misc.: 2400MT/s UDIMMs (370-ADRB)
- Misc.: Performance Optimized (370-AAIP)
- RAID: RAID 5, H330/H730 for SAS/SATA (780-BBYO)
- Controller: PERC H330 Integrated RAID Controller (405-AAGI)
- Misc.: On-Board LOM 1GbE Dual Port (BCM5720 GbE LOM) (542-BBCQ)
- Misc.: DVD ROM SATA Internal (429-AAQM)
- Cable: Optical Drive SATA cable for PowerEdge R230 (470-ABLM)
- Cable: Optical Drive power cable for PowerEdge R230 (470-ABLN)
- Bezel: Dell EMC 1U Standard Bezel (325-BCJU)
- Rails: 1U/2U Static Rails for 2-Post and 4-Post Racks (770-BBHI)
- Misc.: Performance BIOS Settings (384-BBBL)
- Power Supply: Single, Cabled Power Supply, 250W (450-AEUX)
- Misc.: No Systems Documentation, No OpenManage DVD Kit (631-AACK)
- Misc.: No Operating System (619-ABVR)
- Misc.: No Media Required (421-5736)
- Misc.: UEFI BIOS Boot Mode with GPT Partition (800-BBDM)
- Misc.: US Order (332-1286)
- Warranty: ProSupport: 7x24 HW / SW Tech Support and Assistance, 3 Year (806-0205)

- Warranty: Dell Hardware Limited Warranty Plus On Site Service (806-0209)
- Warranty: ProSupport: Next Business Day Onsite Service After Problem Diagnosis, 3 Year (806-0369)
- Base Unit: PowerEdge R230 Server (210-AEXB)
- Misc.: PowerEdge R230 Motherboard MLK (329-BDLB)
- Misc.: No Trusted Platform Module (461-AADZ)
- Memory: 8GB UDIMM, 2400MT/s, Single Rank, x8 Data Width (Qty 2) (370-ADPU)
- Hard Drive: 6TB 7.2K RPM SATA6 6Gbps 512e 3.5in Hot-plug Hard Drive,13G (Qty 3) (400-AGMM)*
- Misc.: iDRAC Port Card (330-BBFM)
- Misc.: iDRAC8 Enterprise, integrated Dell Remote Access Controller, Enterprise (385-BBHO)
- Power Cord: NEMA 5-15P to C13 Wall Plug, 125 Volt, 15 AMP, 10 Feet (3m),
- Power Cord, North America (450-AALV)
- Hard Drive: 200GB SSD SATA Mix Use 6Gbps 512n 2.5in Hot-plug Drive,3.5
- HYB CARR, Hawk-M4R, CusKit (400-ARRY)

Local Security Camera Server for more than 30 cameras

- Contact Technology Services for current model.

Intercoms & Emergency Stations AiPhone IX Series IP Addressable Intercoms & Emergency Stations

1. Master Station
Architect to consult with District Project Manager for Specific model
2. Sub Master Station
Architect to consult with District Project Manager for Specific model
3. Video Stations
Architect to consult with District Project Manager for Specific model
4. Audio Stations
Architect to consult with District Project Manager for Specific model
5. Adapters
Architect to consult with District Project Manager for Specific model

Warranty The contractor shall warrant their work to be free of defects for a period of twelve (12) months from the date of issuance of the Notice of Completion. The manufacturer's warranty period for video recording equipment shall be a minimum of thirty-six (36) months from the manufacture date code under normal use and service. The warranty period for cameras shall be a minimum of twelve (12) months from date of manufacture.

All equipment and workmanship of entire system shall be under warranty for 1 year from date of system final acceptance by the Facilities Project Manager, Police Services, and Technology Services. NEW Component warranties shall be honored for the term established by the manufacturer, if greater than 1 year. The Contractor shall include in the warranty one site visit at the end of the warranty period to check and adjust all equipment and restore all systems to original performance standards.

During the Warranty period Contractor shall respond to Service Calls for equipment failures resulting in complete or partial network outages. Contractor shall respond to such calls within 4 hours and be on-site within 24 hours with replacement components as required to restore the network to original performance standards

Activate all manufacturers' equipment warranties on NEW product in Owner's name to commence on the date of acceptance. In the case of Contractor- modified equipment, the manufacturer's warranty is normally voided. In such cases, the Contractor shall provide the Owner with a warranty equivalent to that of the original manufacturer.

Warranty Documentation All warranty documentation shall consist of the following:

- Warranty shall be a twenty (20) year manufacturer supported extended warranty issued to the customer upon completion of the project.
- Documentation from the manufacturer that the contractor has authority to provide the warranty on behalf of the manufacturer.
- Complete documentation regarding the manufacturer's warranty shall be submitted as part of the proposal. This shall include, but is not limited to: a sample of the warranty that would be provided to the customer when the installation is complete and documentation of the support procedure for warranty issues.
- A systems application assurance manual documenting the vendor supported applications and application guidelines shall be provided as part of the submittals.

Training Requirements Respondent's project price shall include (2) two orientation sessions with OUSD's Police Services, Technology Services and facility support personnel. These sessions, which for planning purposes may last up to four (4) hours each at a minimum of two (2) hours, shall:

- Provide an overview of the architecture and its functionality
- Provide on-the-job training to designated personnel, to instruct them in the operation and maintenance of the systems.
- Review as-built documentation
- Establish recommendations for effective management and maintenance of the installed VMS.
- Arrange with the equipment manufacturer for such instruction, at no additional cost, in the event qualified instructors are not available on staff for certain sophisticated equipment.
- Provide training on the use of the Service Ticketing Email System if the security system or a camera malfunctions or breaks.

The first training session will commence within (10) days after final completion and the second will occur within 1 year after final completion.

3.7 SYSTEMS TESTING AND ACCEPTANCE

Pre-Test & Final Testing Facilities Project Manager and Technology Services shall be notified 72 hours prior to any and all acceptance testing of security camera systems, so monitoring of the security camera system can be initiated, and OUSD project team shall be scheduled to attend the testing.

Facilities Project Manager and Technology services shall always be present and participate in all testing on a project whether it is a pre-test or final acceptance test. Verification of cameras, labels and device addresses shall be made via Service Ticketing Email System and confirmed with the vendor, Facilities Project Manager or Technology Services during the testing.

Prior to the final acceptance test, the vendor shall perform a complete pre-test with the Facilities Project Manager and Technology Services. The pre-test shall be for all security camera equipment and testing records of the pre-test shall be provided to ensure a successful final acceptance test. As part of the completion of work on the security camera systems, a full documented test of all the components on the security camera system shall be performed.

A representative from the OUSD project team shall be present for the test. Any deficiencies reported by the district representatives and/or district consultant shall be corrected and retested prior to calling for the final inspection. As part of the testing, the vendor shall provide the OUSD project team with a points list of all the devices to be tested. A record set of approved plans shall also be available on site during the testing for reference.

If the pre-test is successful, at the discretion of the Facilities Project Manager and Technology Services, the pre-test may be considered the final acceptance test.

Prior to any final acceptance test, the Facilities Project Manager and Technology Services must be sent an email listing the total number of new cameras installed, and the number of existing cameras prior to the start of the final acceptance test. For any final acceptance test that is scheduled after working hours or weekends, the vendor must perform a pre-test of the system during a time when the Facilities Project Manager and Technology Services are able to verify the receipt of the camera signals at the time of pre-testing.

System acceptance tests shall not be performed until the initial system commissioning has been completed. The system acceptance tests shall be supervised by the Facilities Project Manager, Technology Services, and the vendor and shall consist of the following:

- Take a physical inventory of all equipment and materials on site and compare to equipment lists in the contract documents.
- Demonstrate the operation of all system equipment.
- Application tests will be required to determine compliance and interoperability with core network based applications.
- In the event further adjustment is required, or defective equipment must be repaired or replaced, tests may be suspended or continued at the option of the vendor.
- If acceptance of the system is delayed because of defective equipment or because the equipment does not fulfill this specification, reimburse the Owner for all time and expenses of the vendor for these tests during any extensions of the acceptance-testing period.

If the security camera installation or modification is in “phased” stages or if there are substantial corrections and additions to the scope of the project, then the Contractor shall assume responsibility for subsequent testing and retesting of the security camera system installation. After the last phase of the security camera system has been completed and tested totally, ten percent of the previously completed phases are to be tested with the final test phase.

Punch list items are only allowed on issues that do not create safety issues, such as hardware or software failures, any trouble conditions, equipment failures, or for items that do not affect a fully operation security camera system with complete coverage in order to conduct a final acceptance test. Non-critical items such as painting and patching, demolition, access issues are examples of what may be considered as “Punch List” items.

Once a security camera installation has been tested, and subsequent changes are made after the final test that affect the configuration of the original installation and scope of the project’s security camera system, a new final security camera test shall be performed due to the changes of the originally installed system. Label changes do not require a new final security camera test. Only changes, such as device additions, deletions or changes to functional programming shall require a new final security camera test.

Acceptance & Sign-off Spare parts are required and noted within these Standards shall be delivered to the Facilities Project Manager prior to scheduling a final test. No FINAL test date will be accepted until the spare parts indicated in the project specifications and these Standards have been received by the Facilities Project Manager.

No system troubles or equipment failures shall be present at the final acceptance testing. If there are troubles, the test shall not occur.

Facilities Project Manager, Police Services, and Technology Services as the End User/Owner of these systems reserves the right to not accept any installation that does not adhere to these Standards. The vendor shall correct all issues to the Facilities Project Manager's, Police Services', and Technology Services' satisfaction before the Facilities Project Manager, Police Services, and Technology Services will accept the system handover.

4.0 AUDIO VISUAL DESIGN STANDARDS & GUIDELINES

4.1 PURPOSE, CONTENT AND ORGANIZATION

OUSD implements educational technology and communications systems on its campuses to support education and to serve the campus community including the students, staff and administration. In broad terms the areas of focus of this document are design standards for Audio-visual systems, including Instructional Presentation Systems.

The purpose of this implementation standards document is intended to communicate and document the goals, issues, objectives and approaches to be used by persons with an interest in the implementation of Technology Programs for Oakland Unified School District including:

- District Facilities Staff, including Program Managers
- District IT staff
- Site administration, operations and instructional personnel
- District Facilities project managers
- District Maintenance & Operations staff
- Architectural Teams working on the design of new and modernization projects.

As such, the intent of this document addresses several audiences with differing interests.

4.2 TIMELINE FOR STANDARD

While the interior conduit and outside plant infrastructure as described in sections 1.0 & 2.0 of this document have intrinsically long useful lifespans, the communications cabling and equipment does not. AV hardware may be obsolete in as little as 5-7 years, and certainly in need of replacement due to incremental failure in a 10-12 year span. It is therefore expected that this document will need to be reviewed and updated at least biannually to ensure its continuing relevance to ongoing District construction.

4.3 GOALS

The principal goal of this document is to promote consistency in the implementation of technology based systems across the District's sites. The reasons to do so are reviewed in the following summary sections.

4.4 PROMOTE STANDARDIZATION

A standardized implementation across all sites will yield several positive benefits:

Common capabilities

If all sites have a common core infrastructure, it becomes possible to easily roll out District wide programs or upgrades to the communications facilities, despite the infrastructure having been constructed by differing subcontractors. It is further possible to easily replicate successful programs in use at one site to other sites knowing that their physical facilities are similar.

Increased staff familiarity

A standard implementation will be easier for District level staff to maintain and troubleshoot.

Instructional staff can also expect to transfer between sites and find similar capabilities available.

Reduced costs

By standardizing on common components, maintenance personnel and outside contractors serving the District will need to inventory fewer parts and pieces, thereby reducing their cost in responding. This is particularly important to Districtwide infrastructure systems that touch each campus and will need to be adjusted and updated by a common pool of District and outside systems (hardware) contractors.

Equity

Use of identical components at all sites promotes equity between sites. The purpose of the standard is to permit implementation of both best current practice today, but also to permit ready adaptation of the current implementation to new practices when and if the District chooses to do so.

This document will therefore seek to achieve the benefits outlined above by presenting the District's staff and designers with a standard for implementing Audio-visual Systems and related aspects of implementation in a manner that is standardized across the District.

4.5 AUDIO-VISUAL IMPLEMENTATION

This section describes design standards related to design of audio-visual facilities for all campuses across the District including but not limited to; Auditoriums, Multi-Purpose rooms, classrooms, and conference rooms.

OUSD supports diverse spaces where formal and informal presentation facilities are required. Among these are:

- Auditoriums and Theaters
- Multi-Purpose Rooms (seat 50 to 120)
- Standard classrooms (seat 21 to 49)
- Small classrooms and conference rooms (seat 20 or fewer)

This section defines instructional presentation facility requirements for each of these spaces

4.6 INTEGRATED AUDIO-VIDEO SYSTEMS AND EQUIPMENT FOR SMALL VENUES

This section covers the requirements for a contractor to design, provide equipment for, and install a standard audio-visual system for classrooms, conference rooms, and other small venues. This is intended to supply a complete instructional technology classroom that can be arranged in multiple configurations. There will be a laser projector and screen or 82" monitor for the primary display. Screen size may vary depending on room size and should be approved prior to purchase and installation. All audio and image sources should be capable of being shown on the screen and heard in the classroom.

The work covered in this document consists of furnishing all labor, material and services necessary to install a complete audiovisual system as indicated on the project drawings and in these specifications.

Deliverables: Prior to ordering materials or commencing any construction activities, the contractor shall provide the owner with a complete bill of materials, including all quantities of components, devices, equipment, and wiring required to complete this work. Submit product data, including manufacturer's data sheets for all proposed system components. Submit three copies with all specific items that will be provided clearly indicated and any options highlighted.

SYSTEMS DESCRIPTION Provide a complete Audio-Visual System for small to medium sized classrooms and conference rooms. The system switching and audio amplification equipment shall be securely mounted and concealed in a ceiling mounted enclosure located in close proximity to the display. Audio and image source equipment can be connected to the system and displayed via active interface panels located in the area of the teacher's station. The audio and image signals from source devices shall be transmitted from the active interface panels over XTP shielded twisted pair cabling architecture.

Classroom Definition

A classroom that has fixed instructional media video projection capabilities, Internet connectivity at the teacher's station, student networking (usually wireless), a document camera, other multimedia input devices, current laptop interface, multimedia control system that is connected to the network and capabilities for additional add-on modular features.

Technology Enhanced Classrooms (TECs)

Use standardized control/interface systems and employ a standardized operational protocol. The principles of this recommendation are to establish desirable goals with respect to classroom design and installed technology. The TEC classroom standard includes control systems that comply with ADA, Section 508 through buttons that are discernible without activation and easily reached control panel locations. In addition, provisions shall be included for compliance with Section 504 of the Rehabilitation Act relating to closed captioning and hearing assistance. These combined with a user-friendly operator protocol are among the features that are consistent with universal design principles.

All new construction general purpose classrooms will meet this minimum standard. The standard will be met in major renovations wherever possible. The standard will be retrofitted in existing general-purpose classrooms according to an established upgrade plan.

GENERAL EQUIPMENT REQUIREMENTS The room shall be equipped with an integrated audio video system. System control shall be provided by an easy to operate control panel located near the instructor area. The audio system may be monaural or stereo for voice and program sound. System parameters shall be capable of being monitored, administered and controlled over the data network.

Acceptable functionality requirements are listed below categorized by type of equipment. Quantities are listed for movable, portable or loose equipment, and other selected entries. Where quantities are not listed, refer to the system drawings.

- The System components shall all be correctly listed and labeled by Underwriters Laboratories Incorporated (UL) for their intended use.
- All products shall be new and under warranty at the time of installation. B-stock, previously installed, refurbished or used equipment shall not be provided on this project.
- Where the specification lists several manufacturers for a major item, or group of items, the AV contractor shall provide that entire item from one manufacturer only.
- The contractor shall provide all options, accessories and hardware necessary to meet the function of the design even if they are not specifically listed (i.e. mounting kits, separate or additional power supplies, input modules, transformers, etc).

FIXED EQUIPMENT

STANDARD CLASSROOM AND CONFERENCE ROOM Provide the following Audio Video System as an all-inclusive system as described below, one system for each room:

DISPLAY As indicated on the drawings, either a laser projector or 82" monitor will be located in the front of each classroom and be the primary display for instruction. Depending on the architecture of the room, the laser projector will either be an ultra-short-throw (UST) wall mounted projector, or a standard throw ceiling mounted projector. District standard models are indicated as follows in order of preference.

Substitutions of equal or better specified products must be pre-approved by the District:

Device	Better or Equal
Monitor	Samsung QE82R
*Wall-Mounted UST Laser Projector	Epson PowerLite 700U WUXGA 4000 Lumens
*Ceiling-Mounted Laser Projector	Epson PowerLite L400U WUXGA 4000 Lumens

* Projectors have filters in them that need to be cleaned regularly to preserve the life and image of these devices.

Mounting System The display device will be securely mounted to the wall or ceiling with seismic bracing where required. Mounting details will be provided in the construction drawings. District standard models are indicated as follows. Substitutions of equal or better specified products must be pre-approved by the District:

- UST Projector Wall-Mount: Extron USFM 100
- T-Bar Ceiling Projector Mount: Extron PCM340 & UPB125
- Hard Lid Ceiling Projector Mount: Chief CMA105, CMSxxx & RPAU
- Monitor Tilt Wall-Mount: Chief XTM1U

A-V Enclosure An enclosure will be provided that houses the A/V switch, power supply and accessories. District standard models are indicated as follows. Substitutions of equal or better specified products must be pre-approved by the District:

Device	Better or Equal
UST Projector Enclosure	Extron USFM 100
Projector (T-Bar) Enclosure	Extron PMK 560
Projector (Hard Lid) Enclosure	Extron WMK 160
Monitor (T-Bar) Enclosure	Extron PVM 220
Monitor (Hard Lid) Enclosure	Extron WMK 160

System Source Selection, Switching, and Amplification Each room will have one device, located in the A-V enclosure, that capable of A-V switching and amplification. District standard model is indicated as follows. Substitutions of equal or better specified products must be pre-approved by the District:

- Extron PVS 407 D
 - The switcher shall have two inputs that each support connection to a dual input switching wallplate via one female RJ-45 connector.
 - Audio for switched video sources shall be carried on the same RJ-45 connections.
 - The switcher shall have a switched auxiliary audio input to support audio from video sources that are directly connected to the display or sources that only offer audio content.
 - The switcher shall provide two local HDMI inputs for sources that can be located in close proximity to the switcher.

- The switcher shall have one HDMI video output
- Connection from the switcher to the display device shall be provided with one HDMI to HDMI video cable.
- An onboard audio amplifier shall provide gain / volume adjustment from -10db to +10db, adjustable in 1 db steps. The speaker amplifier shall have two channels, one stereo (default) or dual mono channels via one 5.0 mm 4 pole captive screw connector. The output of the amplifier shall be 25 watts (rms) per channel at 4/8 ohms.
- In addition to the stereo / mono speaker output, an additional audio output that will produce line level output shall also be available. This line level audio output must be capable for being set for either fixed or variable level and balanced or unbalanced signal settings.

Media Source Interfaces Each room will have either 2 or 4 HDMI source plates, as indicated on the construction drawings. The media source equipment shall be connected to the audiovisual system via one or two dual input, switching wall plates or the two local inputs of the switcher. These inputs shall enable the system to display video, graphic data and audio from laptop computers, tablets, Blu-ray players, document cameras, streaming devices, tuners, etc. District standard model is indicated as follows. Substitutions of equal or better specified products must be pre-approved by the District:

- Extron PVT HDMI
 - The transmitters shall be placed in convenient locations throughout the classroom to facilitate easy connection of sources.
 - One PVT HDMI shall be used to connect up to two HDMI devices to the system.
 - Twisted pair transmitter shall transmit high resolution digital video and audio to the PVS AV Switches
 - Wallplate shall offer two female HDMI connectors for interfacing with video source devices.
 - Wall plate shall fit in a standard, 2-gang electrical box and feature Decorator-style type faceplates.
 - One stereo audio input on 3.5mm mini stereo jack shall be available for each video input
 - The output of the interface shall be via one female RJ-45 connector.
 - Connection to the PVS AV Switcher shall be via one UL plenum rated CAT 6 shielded twisted pair cable
 - To ensure correct grounding throughout the transmission cable, the braid shield must make contact with the shielded RJ-45 connector on both ends of the cable.

Media Source Control Each room will have a single point of control for display power, system volume, and HDMI source selection. District standard model is indicated as follows. Substitutions of equal or better specified products must be pre-approved by the District:

Extron MLC Plus 100

Classroom media sources shall be controlled with a MediaLink Controller.

- The MediaLink Controller shall contain six tri-color, multi-status LEDs push-buttons for device selection, display on / off control, and special functions. A rotary volume control knob with five LED volume indicators shall permit system volume level control.
- The controller shall provide a LAN (IP) connector. This Ethernet connection shall be used for configuration of the controller and installation of device drivers for the equipment to be controlled.
- The MLC Controller shall feature Extron IP Link Ethernet for monitoring, scheduling and control. This IP technology shall enable the device to be controlled, scheduled and

monitored over a LAN, WAN or the Internet using Extron GlobalViewer software.

- The Controller shall also feature two bi-directional serial ports to provide device control. These two ports shall control the display device and PVS AV Switcher respectively.
- The MLC Controller shall also have two configurable (via software) digital input / outputs for devices such as sensors, switches, LEDs and relays.
- Connection from the MLC Controller to the display shall be provided by one 50' display control cable.
- Connection from the MLC Controller to the PVS AV Switcher shall be provided by one 50' Switcher Control cable.

Speakers Each room will have one pair of speakers, either recessed in t-bar or wall mounted on each side of the display screen.

- Rooms with T-Bar Ceiling: Extron FF 120
- Rooms with Hard Lid Ceiling: Extron SM 3

In suspended ceiling applications, one pair of Extron FF120 speakers shall be used.

- These speakers feature a low profile, 3.25" deep, aluminized composite enclosure, rectangular shape with a metal grille.
- The coverage angle of the speaker offers an extraordinarily wide dispersion area of 170 degrees, providing a very wide room coverage pattern.
- Meets the regulatory compliance safety specifications of NFPA90A, NFPA70; UL Listed for use in plenum airspaces: meets UL 2043 for heat and smoke release, meets UL 1480 for commercial and professional audio
- The speakers feature a frequency response of 68 Hz to 18 kHz - 10db, half space.
- The power capacity is 16 watts of continuous pink noise or 32 watts of continuous program media.
- The nominal impedance is 8 ohms.
- The input connector uses (1) 5mm captive screw for 1 input
- Connection from the PVS AV switcher to the FF120 speaker is provided by Plenum rated 18 Gauge Speaker Cable Extron SPK-18.

In hard lid ceiling applications, one pair of Extron SM3 speakers shall be used.

- Provide a compact, full-range 8 ohm surface mount speaker that shall accommodate division-of-labor installations. Compact, full-range surface mount speaker with a single-ported enclosure, grille, 8 ohm nominal impedance, and a concealed mounting system
- Shall consist of a 3" full-range driver with a tuned bass reflex port
- Shall provide a frequency range of 75 Hz to 18 kHz, -10 dB below average SPL, measured on-axis in full space
- Shall provide a power capacity of 15 watts (rms) continuous pink noise per IEC 60268-5 and 30 watts (rms) continuous program
- Shall provide a nominal sensitivity of 83 dB SPL (1 W, 1 m) measured in full space
- Shall provide a nominal impedance of 8 ohms
- Shall support 8 ohm direct connection from power amplifiers
- Enclosure Requirements

Speech Reinforcement An optional Speech Reinforcement system shall be included when indicated on the construction drawings. The wireless RF microphone system shall be used in conjunction with the audiovisual system to amplify the teachers voice and ensure it is heard clearly throughout the room. District standard model is indicated as follows. Substitutions of equal or better specified products must be pre-approved by the District:

Extron VLM 3001 (Optional based on needs, all items required)

VoiceLift Pendant Microphone:

- The wireless pendant microphone is lightweight and designed to be worn around the neck with a lanyard or clipped on a lapel or belt. The instructor's voice is picked up by the microphone and transmitted wirelessly to a receiver. The receiver passes microphone audio to the PVS AV switcher and speakers which evenly distribute sound throughout the room.
- Each pendant microphone shall have volume control, a power switch, an auxiliary mic input, and a function button.
- The microphone will have an instant alert feature that may be configured to allow the instructor to request assistance in the classroom.
- The microphone shall be based on an industry standard radio frequency technology operating in a spectrum reserved exclusively for voice communications. This technology should not be affected by environmental factors, such as windows, sunlight, and fluorescent lighting, that create problems for infrared systems.
- VoiceLift Wireless Receiver
 - The receiver shall wirelessly connect with pendant and handheld microphones and pass their audio signals to the dedicated VoiceLift Receiver input of a PVS AV Switcher.
 - The receiver shall support pairing with up to two microphones.
 - The receiver shall be based on an industry standard radio frequency technology operating in a spectrum reserved exclusively for voice communications. This technology should not be affected by environmental factors, such as windows, sunlight, and fluorescent lighting, that create problems for infrared systems.
 - VoiceLift Wireless Microphone Charging Station
 - This device is constructed of high impact ABS plastic and acts as a holding and charging station for up to two VoiceLift pendant or handheld wireless microphones.
 - Assistive Listening Interface: Legrand OR-KS35STST (or equal)

All classrooms shall have supplementary wiring necessary to support portable assistive listening devices for complying with applicable provisions of Section 504 of the Rehabilitation Act.

- Provide an audio cable pathway for an Assisted Listening Device (ASD) by using a 20-gauge audio cable to make a connection from the audio out of the PVS 407D Switcher to a wall plate featuring a 3.5mm audio connection.
- Adjustment of the output audio levels will be in completed in accordance of the ALD manufactures recommendations
- 3.5mm keystone interface shall be located in the same wall plate as the USB keystone.
- Data Connectivity

The audio video system shall incorporate features that expand access and connectivity to an existing data network

1. The PVS Switcher shall incorporate a four port network switch, allowing the switcher to be configured over the over the network as well as data access for three additional devices over a single network drop
 2. The audio video system shall include a IP Link enabled MediaLink controller, also connected to the network switch in the PVS Switcher, allowing remote monitoring, scheduling and control of the system over a network.
- Energy Efficiency

The audio video system shall incorporate energy conservation features to reduce consumption and lower operating costs.

1. The system shall incorporate an Auto Power Save Mode with fast power-up that automatically deactivates the audio amplifier after 25 minutes of inactivity. It quickly returns to full power status in less than one second upon signal detection
2. The system shall incorporate a Network Standby Power Save Mode that allows the amplifier, wallplates, VoiceLift receiver, and network switch to be deactivated when not in use.
3. The system shall incorporate monitoring and scheduling of system peripherals, such as sources and displays, in order to deactivate them when not in use or alert to unauthorized use.

4.7 INTEGRATED AUDIO-VISUAL SYSTEM FOR LARGE VENUES

This section covers the requirements for an Integrator to provide equipment and install instructional audio/visual technology large school venues such as Libraries, Multi-Use Rooms, Gyms, and Theaters. There will typically be a large venue projector as the primary display device. Some locations will include additional monitors. All audio and image sources should be capable of being shown on the screen and audio heard throughout the room. The work covered in this document consists of furnishing all labor, material and services necessary to install a complete audiovisual system as indicated on the project drawings and in these specifications.

Deliverables

: Prior to ordering materials or commencing any construction activities, the Integrator shall provide the Owner with a complete bill of materials, including all quantities of components, devices, equipment, and wiring required to complete this work. Submit product data, including manufacturer's data sheets for all proposed system components.

SYSTEMS DESCRIPTION Provide a complete Audio/Visual System for a large venue. The system switching and audio amplification equipment shall be securely mounted and concealed in a standard audio rack in an adjacent room. Audio and image source equipment can be connected to the system and displayed via numerous HDMI interface ports located at various locations as indicated on the construction drawings. An amplifier with multiple speakers will be sized appropriately to provide adequate sound throughout the venue. The audio and image signals from source devices shall be transmitted from the interface panels over high performance shielded twisted-pair (XTP) and HDMI cabling architecture. A front projection system with at least 7000 ANSI laser 4k capable projector with appropriate throw lens will be mounted from the ceiling. A 16:10 ratio electric projection screen will be installed size appropriately for the room.

GENERAL EQUIPMENT REQUIREMENTS The room will be equipped with a customized easy to operate 7" touchscreen interface customized for the source inputs and display outputs. System parameters can be monitored, administered and controlled over the data network.

Acceptable functionality requirements are listed below categorized by type of equipment. Quantities are listed for movable, portable or loose equipment, and other selected entries. Where quantities are not listed, refer to the system drawings.

Deviations from this specification must be documented in writing to the Architect and Owner at least ten business days prior to the submittal date.

The System components shall all be correctly listed and labeled by Underwriters Laboratories Incorporated (UL) for their intended use.

All products shall be new and under warranty at the time of installation. B-stock, previously installed, refurbished or used equipment shall not be provided on this project.

Where the specification lists several manufacturers for a major item, or group of items, the AV Integrator shall provide that entire item from one manufacturer only.

The Integrator shall provide all options, accessories and hardware necessary to meet the function of the design even if they are not specifically listed (i.e. mounting kits, separate or additional power supplies, input modules, transformers, etc.).

FIXED EQUIPMENT Provide the following Audio Video System as an all-inclusive system as described below. District standard models are indicated. Substitutions of equal or better specified products must be pre-approved by the District.

1. Large Venue Digital Projector Epson Pro L1075UNL (p/n: V11H940820)

Projector Specifications

1. Projection System: High-aperture Epson 3-chip, 3LCD technology
2. Projection Method: Front / rear / ceiling mount
3. Driving Method: Epson Poly-silicon TFT Active Matrix
4. Pixel Number: 2,304,000 dots (1920 x 1200) x 3
5. Color Brightness - Color Light Output: 7000 lumens
6. White Brightness - White Light Output: 7000 lumens
7. Aspect Ratio: Supports 4:3, 16:9, 16:10
8. Native Resolution: 1920x1200 WUXGA with 4K Enhancement
9. Resize: 640x480, 800x600, 1280x1024, 1400x1050 1. Brightness Uniformity: 85%
10. Pixel Arrangement: Cross stripe
11. Contrast Ratio: 2,500,000:1 (Dynamic Contrast On)
12. Color Reproduction: Up to 1.07 billion colors

2. Large Venue Projection Screen

- An electrically powered projection screen with low-voltage trigger shall be provided with each projector. Screens for rooms with T-bar ceilings shall be recessed into the ceiling with appropriate matching trim. Screens for rooms with hard lid or open ceilings shall be wall mounted. All electrical and control wiring shall be concealed in conduit and brought directly into the power/control box on the appropriate side of the screen. Screen will have a 16:10 ratio. The specific size of the screen will be indicated on the construction drawings.
- Custom "Black Drops" shall be included where indicated so the screen display area is at the appropriate height as indicated in the construction drawings. In some cases, a reverse fabric roll (Fabric Roll B) will be required when the screen is mounted in reverse of the display image, such as when it is mounted on the rear side of the Proscenium wall. A standard white case will be provided unless otherwise indicated (e.g. black case for backstage)
 1. Recessed T-Bar Screen
Da-Lite Contour Tensioned Electrol with 1.1 HD Progressive Surface (e.g Da-Lite p/n: 21864LSI - exact screen size will be indicated in construction drawings)
 2. Surface Mount Screen
Da-Lite Cosmopolitan Tensioned Electrol with 1.1 Progressive Surface (e.g. Da-Lite p/n: 21878L - exact screen size will be indicated in construction drawings).

3. Wall-Mount Audio-Visual Cabinet TrippLite SRW15US

Wall-mount cabinet secures and organizes 15U of 19-inch rack. Houses audio-visual equipment up to 20.5 inches deep. Maximum load capacity of 200 lb. Swings away from wall on hinge for easy back-door access. Locking steel cabinet vented at sides, front, top and bottom. Flow-through ventilation keeps equipment cool. Secures 15U of 19 in. rack equipment up to 20.5 in. deep. 5-year limited warranty.

4. **Cabinet Shelf** TrippLite SRSHELF2P

Provide one shelf per A-V cabinet for holding assisted listening system docking stations and other peripherals.

5. **Structural Projector Mount**

A projector mount with seismic bracing will be provided for each projector and attached to the building structure. An additional custom 5/8" steel bracket may be required for mounting around a glulam or joist. A mounting detail will be provided in the construction drawings with the required parts and installation method. Typical parts are as follows:

- I-Beam or Glulam: Chief p/n: CMA 360
- Hard Lid or T-bar: Chief CMA 345

6. **Projector Mount** Legrand Chief Heavy Duty Projector Mount (p/n: VCMUW)

The projector mount shall have Independent roll, pitch and yaw adjustments for quick and precise projector registration. Quick connect/disconnect for convenient lamp and filter access on most projectors. Cable management through top of the mount without additional accessories. The projector bracket shall also use a 1.5" NPT (National Tapered Pipe) threaded pipe adapter for mounting a projector pole Weight Capacity: 250lbs.

7. **Projector Extension Column** Legrand Chief Speed Connect Fixed Extension Column (p/n: CMS###)

- A 1.5" NPT column threaded on both sides will be used to connect the projector mount with the structural adapter. Color shall be white unless otherwise indicated. Length as needed so the projection lens is level with the top of the projection area.

8. **Eight-Input Scaling Presentation Switcher with DTP**

For rooms with only one or two screens intended to show the same source image, a dual-output Presentation Switcher will be provided.

Extron IN1608xi IPCP SA p/n: 60-1238-85

1. System source selection and switching shall be provided by an Extron IN1608xi Eight Input HDCP-Compliant Scaling Presentation Switcher with DTP Extension
2. Integrated DTP inputs and output support transmission of video, control, and analog audio up to 330 feet (100 meters) over a shielded CATx cable
3. Inputs: Four HDMI; two universal 15-pin HD inputs for RGB, component video, S-video, or composite video; two DTP twisted pair inputs on RJ-45; six stereo balanced/unbalanced audio inputs on captive screw; two mic/line audio inputs on captive screw.
4. Outputs: Three simultaneous video outputs - two HDMI outputs, one DTP® output on RJ-45; one variable stereo audio output on captive screw. One DTP output is compatible with HDBaseT-enabled devices.
5. RS-232 insertion from the Ethernet control ports — System level device control to all remote locations via the switcher's Ethernet ports, providing comprehensive control of endpoints and attached devices without needing additional equipment.

9. **8x4 4K Scaling Presentation Matrix Switcher**

For rooms specified with multiple displays intended to show different image sources simultaneously an 8-input 4-output matrix switcher with DTP extension will be provided.

Extron DTP CrossPoint 84 4K IPCP SA p/n: 60-1515-22

1. System source selection and switching shall be provided by an Extron CrossPoint 84 4K Eight-Input, Four-Output HDCP-Compliant Scaling Presentation Matrix Switcher with DTP Extension and integrated control processor.

2. Integrated DTP inputs and output support transmission of video, control, and analog audio up to 330 feet (100 meters) over a shielded CATx cable
 3. Inputs: Six HDMI; two universal 15-pin HD inputs for RGB, component video, S-video, or composite video; two DTP twisted pair inputs on RJ-45; six stereo balanced/unbalanced audio inputs on captive screw; two mic/line audio inputs on captive screw.
 4. Scaled Outputs: Four video outputs - two HDMI outputs, two DTP® output on RJ-45; one variable stereo audio output on captive screw. The two DTP outputs are compatible with HDBaseT-enabled devices.
 5. RS-232 insertion from the Ethernet control ports — System level device control to all remote locations via the switcher’s Ethernet ports, providing comprehensive control of endpoints and attached devices without needing additional equipment.
10. **Media Source Control** Extron TLP 725M TouchLink Pro p/n: 60-1563-03 or Extron TPL 725T TouchLink Pro for tabletop installations p/n: 60-1562-03
1. Provide a 7” capacitive touchscreen interface for switching and control of AV equipment. **
 2. Device shall feature scratch and smudge-resitant Corning® Gorilla Glass®
 3. Device shall support Extron IP Link Pro Control Processors
 4. Device shall include a built-in down firing speaker which can be configured to provide audio and button feedback
 5. Device shall have a female RJ-45 jack located on the back of the enclosure that supports 10/100/1000Base-T, half/full duplex with auto-detect for connection to a LAN or WAN and includes link and activity LED indicators located on the left and right of the jack for troubleshooting network issues as well as supports PoE- Power over Ethernet, 802.3af
 6. Device shall include a single high-speed micro USB 2.0 type B receptacle located on the back of the enclosure.
 7. Provide two red/green LEDs along the left and right sides of the display to indicate room status, six rear-facing, red/green LEDs located on the back of the enclosure to provide ambient light to the mounted area and radiates a soft glow behind the panel to enhance visibility from distant locations, all of which can be configured or programmed as a group
 8. Provide a built-in motion sensor located on the top bezel of the touch surface allowing the panel to be woken from a sleep state or set up via software to trigger any number of actions.
 9. Provide a light sensor located on the top bezel of the touch surface that automatically adjusts the LCD screen’s backlight based on available ambient light.
 10. Provide a front panel status LED that blinks red if the touch panel loses network connectivity with the control processor.
 11. Device shall have a menu button located on the back setup of items such as IP address and sound volume at minimum.
 12. Device shall support the following protocols: DHCP, DNS, HTTP, HTTPS, ICMP, SFTP, SSH, TCP/IP, UDP/IP.
 13. Device shall have the following memory available, at minimum: SDRAM: 2 GB, Flash: 4 GB

14. Connection from the MLC Controller to the IP Control Processor (IPCP) shall be provided by a data network PoE switch.

11. **Audio-Video Interfaces** Two or more DTP HDMI interfaces shall be located at various locations in the room, as shown on the construction drawings and shall be no further than 300 cable feet away from the Presentation Switcher. Interfaces connect to the A/V Presentation Switcher via Extron DTP/XTP Cables (e.g. p/n: 22-236-03).

Passive HDMI interfaces located on the AV enclosure or within 15 cable feet for the switcher will connect directly via HDMI Ultra 4K cable. Interface shall be Extron WPD 110 A (p/n: 70-726-63). Interfaces connect to the A/V Presentation Switcher via Extron HDMI Ultra Cable (p/n: 26-663-## where ## equals length not to exceed 15 feet).

12. **Microphone System** Shure BLX24R/SM58-H10

Provide and configure at least 2 handheld wireless microphones with rack-mount receivers. Microphone receivers will connect directly to the Presentation switcher. Drawings will indicate if more than two wireless microphone systems are required per venue.

13. **Amplifier**

Venues, such as Libraries and Large Classrooms will utilize the built in 50W stereo amplifier of the Presentation Switcher. Two channel audio (stereo) will be provided by way of parallel speaker cabling on each side of the room. Larger venues such as Multi-Use Rooms, Gyms, and Theaters will have a separate multi-channel amplifier appropriately sized for the venue.

Where a separate amplifier is specified, depending on the size of the venue, the amplifier will be one of the following QSC CXD series amplifier as follows. The 700W x 4 Channel will be provided unless a larger amplifier is indicated on the construction drawings.

Model	Characteristics
CXD4.2	700W x 4 Channels
CXD4.3	1400W x 4 Channels
CXD4.5	2000W x 4 Channels

14. **Speakers**

Venues utilizing the 50W amplifier integrated into the Presentation Switcher will use Extron standard 2-way speakers. Venues utilizing a separate amplifier will use QSC speakers appropriately sized for the room. Speaker quantities will be indicated on the construction drawings.

Speaker Type	Make/Model	Part No.
T-Bar Speaker	Extron FF220T	42-141-03
Hard Lid Speaker	Extron SF 26CT	60-1310-03
Wall-Mount Speaker	Extron SM 26T	60-1308-13
Pendant-Mount Speaker	Extron SF 26PT	60-1752-03
Large Venue Main Speaker	QSC E112 w/E112YM	
Large Venue Secondary Speaker	QSC E110 w/E110YM	

4.8 ASSISTIVE LISTENING SYSTEMS

Furnish portable assistive listening system (ALS) as required to meet or exceed all applicable Federal, State, and Local ADA requirements. Dedicated ALS system shall be provided for

rooms with a seating capacity greater than 50. Portable ALS systems may be provided for rooms with a seating capacity of less than or equal to 50.

Portable ALS will be stored in the Front Office for checkout as required.

1. Conference Room
2. Multi-Use Room
3. Library
4. Classrooms

Include all materials specified herein. It is the intent that complete operating portable systems be provided to the Owner, stored in the school's front office, and checked out when required. Each room containing an Integrated Audio-Visual System will include a 3.5mm audio jack from the teacher's workstation area to the A-V switcher in the ceiling. This will enable the user to connect the ALS transmitter to the line out of the A-V switcher so all classroom presentation audio, including wireless voice enhancement, can be transmitted to the ALS receivers.

For rooms without integrated Audio-Visual Systems, the portable kit includes a lavalier microphone that can be connected directly to the ALS transmitter.

EQUIPMENT

1. Portable Assistive Listening System

Type	Description	Model
Transmitter	ListenTALK Transciever	LK-1-A0
Receivers	ListenTALK Receiver Pro	LKR-11-A0
Neck Loops	Neck Loop	LA-166
Input/Output Cable	Audio Cable	LA-436
Microphone	Lavalier Microphone	LA-261
Charging Unit	4-Port USB Charger	LA-423-01
Carrying Case	Soft Shell Case 4	LA-483

2. Fixed Assistive Listening System

Description	Manufactuer	Model
Stationary RF Transmitter (72Mhz)	Listen Technologies	LT-800-072-01
Universal Rack Mounting Kit	Listen Technologies	LA-326
Coaxial Diple Remote Antenna (72Mhz)	Listen Technologies	LA-116
Intelligent DSP RF Receiver (72MHz)*	Listen Technologies	LR-4200-072
Universal Ear Speaker*	Listen Technologies	LA-401
Intelligent Earphone/Neck Loop Lanyard	Listen Technologies	LA-430
Intelligent 12-Unit Charging Tray**	Listen Technologies	LA-381-01
ALS Notification Signage Kit	Listen Technologies	LA-304

* Provide sufficient quantity of receivers to meet ADA Requirements

** Provide sufficient quantity of Charging Trays to accommodate all receivers

4.9 GLOSSARY

Audio/Visual

In this document, the term is used collectively to describe a wide variety of sound and video systems and subsystems, including sound reinforcement, audio playback, public address, foreground and background music, television (satellite, CATV, MATV}, baseband video (composite), HDMI, HD Analog), computer graphics (VGA and higher speed) and production intercommunications systems.

Audio Playback

The reproduction, through use of processing hardware, amplifiers and loudspeakers, of either pre-corded program material (e.g. a CD, a tape, a digital audio track, the audio portion of a television feed, a videotape or DVD) or the playback of live sound originating from a physically different space or property (overflow seating, Webcast, simulcast, etc.).

Audio-Teleconferencing

At a small scale, what is done with a speakerphone (e.g. Polycomm). At a larger scale, a dedicated system that relays audio between two points over telephone lines, while preventing the emergence of echo or audio feedback. Other audio issues involve control of background noise (HVAC Noise Control, sound isolation) and control of reflections within the room (Room Acoustic treatment).

Background Music

Generally, music that is played so softly and innocuously in a space as to fade into the "background"; forming more of a subliminal stimulus or masking of other sounds than a focal point itself. Using inexpensive loudspeakers, the sound is usually further shaped to remove the bass/beat (lows) and syllables (highs) to prevent the sound from drawing attention to itself. Contrast with Foreground Music.

Composite Video

A legacy analog video format video most commonly associated with consumer VCR's. In the U.S., this is technically NTSC standard video. Not suitable a medium for transmitting computer graphics. By comparison with Computer Graphics, a simplistic evaluation of Composite Video would assign it a maximum resolution of 440x330 pixels.

Computer Graphics

The type of video created by a computer and displayed by a computer monitor. Beginning with lower resolution standards, such as VGA (640Hx480Wx60 frames/sec), an almost limitless and increasingly high resolution number of standards are supported. Commodity computer monitors and video projectors support WUXGA resolution (1920x1200) at 76+ frames/second), however yet higher standards are supported on engineering workstations, high-end PC's and premium priced Projectors.

Contrast Ratio

The difference between the brightest and darkest perceived object within the field of view. The typical design ratio for computer screen environments is 4:1 with a maximum ratio of 10:1. A Comparison of Contrast Ratio Limits

- 100,000:1 Human eye.
- 10,000:1 Still photography, large format, museum quality silver gelatin print.
- 1,000:1 Cinema photography, 35mm Panavision camera with Panavision prime lens, Kodak wide latitude stock, custom negative processing, positive print struck directly from camera negative, observed in a laboratory quality control screening room conforming to SMPTE standards.
- 150:1 Typical 35mm cinema viewing conditions in a first-run venue.
- 100:1 Professional (i.e. Hollywood production house) video photography. Digital processing camera, digital recorder, monitor with SMPTE type C phosphor, adjusted per

SMPTE recommended practices. Viewing room meeting SMPTE standards.

- 20:1 Typical limitation on over-the-air NTSC broadcasting.
- 10:1 VHS tape, typical.
- 4:1 Compressed video for Web distribution.

Device

Generic term for any computer or peripheral with a network address.

Display Device

Generic term for any item of equipment that produces a visible image.

Facility Panel

In essence, a plate placed in the wall or floor that contains specialized inputs and outputs associated with Audio-Visual uses. Whereas the plates commonly used for structured cabling systems are small, standardized, high-density and inexpensive (see Glossary entry above), those associated with AN are larger, custom, less dense, and use specialized connectors.

Feedback

The unpleasant condition of “howling” caused when a sound system makes a noise that is picked up by its own microphones which causes the system to make the same noise, only louder, in an ever increasing spiral. Proper selection, separation and orientation of microphones and loudspeakers and acoustic treatment can alleviate this condition, as can use of modern “feedback suppression” audio processing hardware.

Foreground Music

The next step in the continuum from background music. Foreground music is music played loud enough to interfere with normal conversation and to become a focal element of the space it is in. In addition to simply increasing the level the spectral shape of the sound is generally boosted at either the “treble” (high) end, or the “bass” (low) end in order to give it prominence. Better loudspeakers are required than with background music in order to retain fidelity.

Front Projection

An image display produced by projecting light on to a reflective surface (front projection screen). The method used in a motion picture theater. Scatter (ambient) light in the room is also reflected off the image surface, reducing contrast ratio. Functions best only in spaces with minimum ambient light, as for example, theater darkness.

Pixel

In a display device, the smallest element of the device that may be individually addressed to assemble the entire image. For example, a laptop computer with an XGA display provides an image made up of an array of pixels 1024 wide by 768 high.

Production Intercom

A system of “backstage” communications used by technical staff in producing live events. Typically, participants wear headphone/ microphones and beltpacks and connect by wired or wireless means to a system providing one or more discrete channels of communications.

Sharpness

A relative metric of human perception of detail when viewing an image on a display system. A function of both pixel size and contrast ratio.

SMPTE

Society of Motion Picture and Television Engineers. Professional society that sets standards used in television and cinema presentation.

Sound Reinforcement

The use of a system of microphones, processing hardware, amplifiers and loudspeakers to make a live talker/presenter/singer sound louder and more intelligible to the listener. The use of open microphones creates the possibility of audio “feedback”: The presence of a physical source of sound (the talker) places constraints on the location of the loudspeakers to ensure that the “suspension-of-disbelief” is maintained by making the audio image match the visual one. By contrast, audio playback is much simpler.

Video Conferencing

As the name implies, two way audio and video communications between two groups of people over telephone lines (or the Internet, or similar links). Passing the video images between parties requires considerable bandwidth in the link between the sites. Other video issues relate to how the cameras on the two ends are controlled (requiring operators and multiple cameras whenever more than a 6-8 people are involved at one end), how the audio is switched to follow changes in the video, how the faces are lit to present a useable camera image, and control of the sources of stray light and reflection in the room. All of the challenges in audio-conferencing noted above are also present in the Video Conferencing application.

Videowall

A large scale display surface made stacking together an array of individual smaller display devices. A videowall processor is used to assign pixels of an incoming signal to pixels of an individual display device. Mullions may be a distraction. Matching the individual display devices to one another is required. Can be reasonably bright. Requires 3 to 5 feet of depth. Usually maintenance intensive to own and operate.

Viewing Distance

Distance of the viewer from the visual display device, usually expressed in terms of image height (H). Controlled by visual acuity, contrast ratio, and image content. Comparison to viewing distance for typical conditions:

- Reading this document, 1.5H
- Desktop computer, 1.5H to 2.0H.
- Direct view television set in typical home living room, 4H to 9H typical, 12H maximum.
- Motion picture theater, SMPTE recommended practice, 2H to 6H.
- Multiplex theater, seats 1 H to 4H, preferred seating at about 3H.

Visual Acuity

The limit of the human vision system, when corrected to population normal vision, to resolve detail. For text characters, a typical limit is reached when the character is less than 150th of the distance from the observer.

APPENDIX A: QUICK REFERENCE DATA DESIGN GUIDELINES & LABELING STANDARDS

ERATE 14 Rack/Cable
Standard – 12/09/13
Created by Aaron Soo

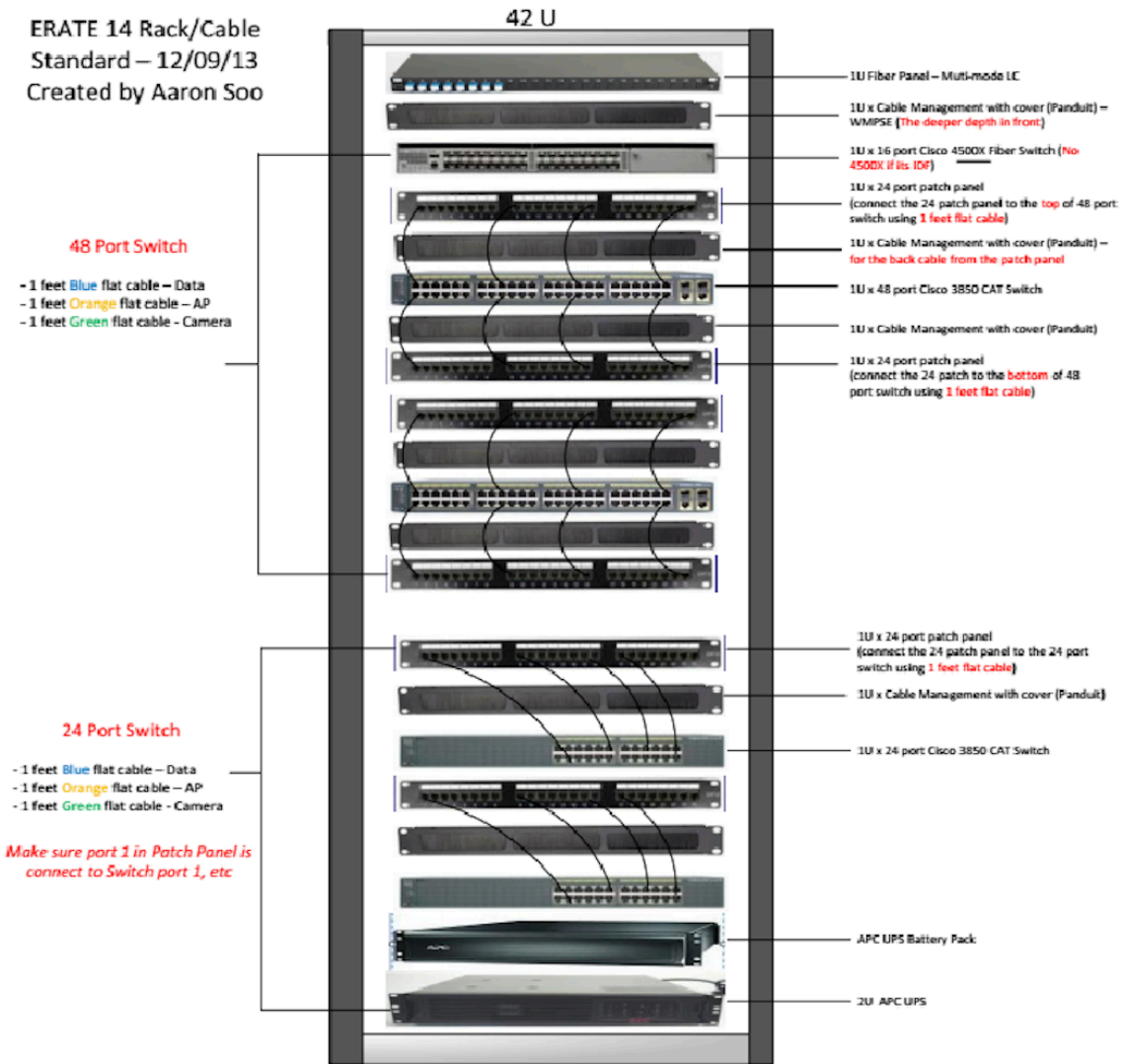


Figure 1: Reference Diagram