



Master Telecommunications Design Standards

Up Valley Support Services JPA

v1.1.0, October 11, 2011

© OneInterface Engineering, LLC (www.oneif.net)



Master Telecommunications Design Standards (MTDS)

TABLE OF CONTENTS

Chapter 1 Introduction	1
Chapter 2 Owner Prescribed Definitions	2
Chapter 3 Telecommunications Administration	14
Chapter 4 Intra-building Telecommunications Pathways	17
Chapter 5 Telecommunications Spaces	26
Chapter 6 Intra-building Grounding and Bonding	33
Chapter 7 Typical Data and Power Outlets	39

Chapter 1– Introduction

1.1 Foreword by Up Valley Support Services JPA

This Master Telecommunications Design Standards (MTDS) is a required reference for technology design consultants (Engineer) on all Up Valley Support Services JPA (UVSSJPA) construction projects containing technology. The MTDS is intended to supplement the applicable codes and standards by clarifying the Owner preferred implementation options allowed within the respective codes or standards. Where technology topics are not mentioned specifically, the Engineer shall use thoughtful application of the applicable codes and standards to complete the design. In these cases, the Engineer shall consult with the Owner for approval on any quantitative or qualitative standards based design options made outside of the MTDS guidelines.

The Engineer and design team shall be responsible for both a fully standards based design and, ultimately, the defensibility of the respective construction documents should contractors question the requirements of the plans during construction. This responsibility requires explicit annotations, detailing, and specifications to ensure the Inspector of Record (IOR) can quickly and decisively enforce the desired implementation on the contractor. The Engineer shall ensure that all necessary coordination is communicated to the design team in writing, via the Architect. The Engineer shall work with the Architect to ensure the technology requirements materialize explicitly, accurately, and without conflict, in the construction documents for all design team disciplines.

On modernization projects, it is likely that many design requirements of the MTDS are not possible or reasonable. The design team shall consider all possible options to implement the MTDS as specified. Where existing conditions make the implementation of the MTDS unreasonable, the design team shall present to the Owner their best subjective design options. All proposed design options shall closely follow the intent of the MTDS, and occur as early in the design process as possible.

It is essential that the design team adhere to the definitions within Chapter 2 of the MTDS. The definitions are intended to ensure clear and accurate communications between the design team and the Owner. If the MTDS definitions conflict with industry standard definitions, the definitions shown within the MTDS shall have highest precedence. The definitions listed in Chapter 2 are meant to facilitate Owner communications to the design team and have broader scope than the typical industry definitions. It is critical that the design team familiarize themselves and utilizes these definitions for all technology projects.

Chapter 2 – Owner Prescribed Definitions

2.1 Overview

2.1.1 Engineering Goals

The following definitions, acronyms and abbreviations are intended to be consistent with contemporary terminology as used in the context of telecommunications design and construction processes. The design team shall strictly adhere to these definitions to ensure clear and concise communications with the Owner and design team and other project officials.

2.1.2 Owner Definitions

Accessible: Capable of being readily reached or entered for operation, renewal, or inspections without causing unnecessary disruption of telecommunications service.

Administration Identifiers: A TIA-606A compliant labeling scheme comprised of a sequential array of alphanumeric characters that links specific elements of the telecommunications infrastructure with corresponding records maintained throughout the life cycle.

Applicable Standards: The telecommunications industry standards listed in each section of this document, their Addenda, Annexes, normative references, and all relevant Codes and Regulations included as part of the cumulative design requirements.

As-Built: Contractor's record of actual infrastructure installation, such as pathway sizes, routes, and cable quantities. All work shall be professionally and clearly annotated on the construction documents and clearly marked as 'As-Built' with the latest as-built document completion date. All as-built documentation shall be turned into over to the Owner in both full size PDF and the latest CAD drawing format used by the design team.

CJUSD: Calistoga Joint Unified School District (see Owner and UVSSJPA)

Code: All applicable National, State, and Local Codes and ordinances.

Construction Documents: All documentation relating to the construction and inspection of facilities, including but not limited to specifications, drawings, requests for information, change orders, supplemental instructions, as-built drawings, and manuals.

Convergence: The integration of all system transmission types utilizing network transport.

Data Outlet: Single or multi-jack outlet assembly typically serving a finite work area or space occupied by one or more end users with horizontal cabling. Includes all installed cabling, horizontal distribution pathways, termination and installation materials and labor, as-built documentation, and passing test certifications. All designs, installation, materials, and testing shall be in conformance to the latest applicable standards.

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

Design: The process led by the Telecommunications Engineer and coordinated with the entire design team, of determining and acquiring the current and foreseeable technology needs of the Owner and applying them through the Construction Documents. The Construction Documents shall be made detailed and explicit to ensure the Contractor has both monetary, qualitative, and quantitative accountability to install to the preferences and applicable codes and standards referenced herein.

Engineer: Engineering/Design Firm responsible for telecommunications design and related construction documents

Fiber: Owner approved fiber optic cabling typically implemented in the form of an optical-fiber backbone system.

Horizontal Distribution Pathways: The portion of a structured wiring system that runs from the cross-connect to the data outlets; commonly comprised of copper twisted-pair cable.

Installed Cabling: Required amount of cables terminated and fully compliant with all applicable standards.

Interbuilding: Pathways and associated cables run between buildings, including up to 50 feet of additional cable length extending inside each building. Interbuilding cabling containing conductive materials of any sort shall be have fused protection and grounding at both building entrances per latest applicable standards.

Intrabuilding: Pathways and associated cables confined within a single building wherein no exterior cable runs are involved.

Location Drop(s): See Data Outlet.

Local Area Network: A computer communications network that spans a limited geographic area.

MTDS: JPA Master Telecommunications Design Standard

Network: Any type of interactive information-carrying system.

Owner: Up Valley Support Services Joint Powers Agency (UVSSJPA) consisting of SHUSD and CJUSD.

Owner's Representative: Owner authorized representative.

Pathway(s): All associated materials and methods used to support, protect, and facilitate the placement and routing of telecommunications cabling infrastructure.

Pathway Access Point: Readily accessible pull-point for horizontal or vertical pathways.

SHUSD: St. Helena Unified School District (see Owner and UVSSJPA)

Structured Cabling: Fully administered and continuous point-to-point Telecommunications Cabling installed per Applicable Standards from associated Telecommunications Room to work area (or remote) outlet location.

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

System(s): A group of interconnected electronic components (known as hardware) and/or software programming that produces a complete and functional service.

Technology: Electronic or digital products and systems considered as a group. A generation of specific systems designed to work together based on specific standards or guidelines.

Workstation: A single-user computer connected to a local area network (LAN).

Work Area: A specific area of a building designated for one or more workstations or a particular area that may accommodate future workstation(s).

2.1.3 TIA/EIA Definitions

Access Floor: A system consisting of completely removable and interchangeable floor panels that are supported on adjustable pedestals or stringers (or both) to allow access to the area beneath.

Access Provider: The operator of any facility that is used to convey Telecommunications signals to and from a customer premises.

Access Unit: A location that allows entry into the pathway system.

Aerial Cable: Telecommunications cable installed on aerial supporting structures such as poles, sides of buildings, and other structures.

Alternate Entrance: A supplementary entrance facility into a building using a different routing to provide diversity of service and for assurance of service continuity.

Backbone: A facility (e.g., pathway, cable or conductors) between any of the following spaces: Telecommunications Rooms, Telecommunications Enclosures, Common Telecommunications Rooms, Floor Serving Terminals, Entrance Facilities, Equipment Rooms, and Common Equipment Rooms.

Backbone Cable: See Backbone.

Backbone Raceway: That portion of the pathway system that permits the placing of main and high-volume cables between the entrance location and all cross-connect points within a building and between buildings.

Blank Cell: The hollow space of a cellular metal or cellular concrete floor unit without factory installed fittings.

Blended Floor System: A combination of cellular floor units with raceway capability and other floor units with raceway capability, systematically arranged in a modular pattern.

Bonding: The permanent joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to conduct safely any current likely to be imposed.

Bonding Conductor: A conductor that interconnects the screened twisted-pair horizontal cabling infrastructure to the telecommunications grounding busbar.

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

Building Automation System: Equipment and telecommunications infrastructure that supports monitoring, control, operation and management of building services.

Building Backbone: Cabling for interconnecting telecommunications spaces from the telecommunications entrance facility to a horizontal cross-connect within a building.

Building Core: A three-dimensional space permeating one or more floors of the building and used for the extension and distribution of utility services (e.g., elevators, washrooms, stairwells, mechanical and electrical systems, and telecommunications) throughout the building.

Building Module: The standard selected as the dimensional coordination for the design of the building, e.g., a multiple of 100 mm (4 in), since the international standards have established a 100 mm (4 in) basic module.

Buried Cable: A cable installed under the surface of the ground in such a manner that it cannot be removed without disturbing the soil.

Cabinet: A container that may enclose connection devices, terminations, apparatus, wiring, and equipment.

Campus: The buildings and grounds having legal contiguous interconnection.

Cell: A single raceway of a cellular or underfloor duct system.

Cellular Floor: A floor distribution method in which cables pass through floor cells, constructed of steel or concrete to provide a ready-made raceway for distribution of power and telecommunications cables.

Cementitious Firestop: A firestopping material that is mixed with water, similar in appearance to mortar. See Firestopping.

Commercial Building: A building or portion thereof that is intended for office use.

Common Equipment Room (Telecommunications): An enclosed space used for equipment and backbone interconnections for more than one tenant in a building or campus.

Common Telecommunications Room: An enclosed space used for backbone interconnections for more than one tenant in a building, which may also house equipment.

Conduit: (1) A raceway of circular cross-section. (2) A structure containing one or more ducts. For this Owner, the term conduit includes electrical metallic tubing (EMT) or electrical non-metallic tubing (ENT)

Conduit System: Any combination of ducts, conduits, maintenance holes, hand holes and vaults joined to form an integrated whole.

Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.

Core Area: See building core.

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

Customer Premises: Building(s), grounds and appurtenances (belongings) under the control of the customer.

Customer Premises Equipment: Telecommunications equipment located on the customer's premises.

Demarcation Point: A point where the operational control or Ownership changes.

Direct-buried Cable: A telecommunications cable designed to be installed under the surface of the earth, in direct contact with the soil.

Distribution Duct: A raceway of rectangular cross-section placed within or just below the finished floor and used to extend the wires or cables to a specific work area.

Duct: (1) A single enclosed raceway for conductors or cables. See also Conduit, Raceway. (2) A single enclosed raceway for wires or cables usually used in soil or concrete. (3) An enclosure in which air is moved. Generally part of the HVAC system of a building.

Earthing: See Grounding.

Elastomeric Firestop: A firestopping material resembling rubber. See also Firestopping.

Electromagnetic Interference: Radiated or conducted electromagnetic energy that has an undesirable effect on electronic equipment or signal transmissions.

Embedded Duct: A duct fully enclosed inside a floor or a wall.

Enclosure (Telecommunications): A case or housing for telecommunications equipment, cable terminations, and cross-connect cabling.

End User: The Owner or user of the premises cabling system.

Entrance Facility (Telecommunications): An entrance to a building for both public and private network service cables (including wireless) including the entrance point of the building and continuing to the entrance room or space.

Entrance Point (Telecommunications): The point of emergence for Telecommunications cabling through an exterior wall, a floor, or from a conduit.

Entrance Room or Space (Telecommunications): A space in which the joining of inter or intra building Telecommunications backbone facilities takes place. An entrance room may also serve as an equipment room.

Equipment Room (Telecommunications): An environmentally controlled centralized space for Telecommunications equipment that usually houses a main or intermediate cross-connect.

False Ceiling: See Suspended Ceiling.

Feeder Duct: See Header Duct.

Firestop: A fire-rated material, device, or assembly of parts installed in a penetration of a fire rated barrier.

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

Firestop Seals: See Firestop system.

Firestop System: A specific construction consisting of the material(s) (firestop penetration seals) that fill the opening in the wall or floor assembly and any items that penetrate the wall or floor, such as cables, cable trays, conduit, ducts, pipes, and any termination devices, such as electrical outlet boxes, along with their means of support.

Firestopping: The process of installing listed, fire-rated materials into penetrations in fire-rated barriers to reestablish the fire-resistance rating of the barrier.

Floor Serving Terminal: See Terminal.

Floor Slab: That part of a reinforced concrete floor, which is carried on beams below.

Flush Duct: A duct accessible by a cover that is even with the surface it is mounted in.

Furniture Cluster: A contiguous group of work areas, typically including space divisions, work surfaces, storage, and seating.

Grounding: The act of creating a ground.

Header Duct (Trench Duct, Feeder Duct): A raceway of rectangular cross-section placed within the floor to tie distribution duct(s) or cell(s) to the Telecommunications Room.

Horizontal Cabling: 1) The cabling between and including the Telecommunications outlet/connector and the horizontal cross-connect. 2) The cabling between and including the building automation system outlet or the first mechanical termination of the horizontal connection point and the horizontal cross-connect. 3) In a data center, horizontal cabling is the cabling from the horizontal cross-connect (in the main distribution area or horizontal distribution area) to the outlet in the equipment distribution area or zone distribution area.

Horizontal Connection Point: A location for connections between horizontal cables that extend from building pathways and horizontal cables that extends to building automation systems devices and equipment.

Infrastructure (Telecommunications): A collection of those Telecommunications components, excluding equipment, that together provides the basic support for the distribution of all information within a building or campus.

Innerduct: A nonmetallic raceway, usually circular, placed within a larger raceway.

Insert: An opening into the distribution duct or cell, from which the wires or cables emerge.

Insert, Afterset: An insert installed after the installation of the concrete floor slab or other flooring material.

Insert, Preset: An insert installed prior to the installation of the concrete floor slab or other flooring material.

Intumescent Firestop: A firestopping material that expands under the influence of heat.

Junction Box: A location in the pathway system that allows transition of pathways and access to cables.

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

Listed: Equipment included in a list published by an organization, acceptable to the authority having jurisdiction, that maintains periodic inspection of production of listed equipment, and whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

Membrane Penetration: An opening through only one surface or side of a barrier.

Monolithic Pour: The single, continuous pouring of a concrete floor or columns of a building structure.

Multi-User Telecommunications Outlet Assembly: A grouping in one location of several telecommunications outlet/connectors.

Outlet Box (Telecommunications): A housing used to hold Telecommunications outlet/connectors.

Pathway(s): All associated materials and methods used to support, protect, and facilitate the placement of Telecommunications cabling.

Penetration: An opening in a fire-rated barrier.

Penetration Seals: See Firestop System.

Plaster Ring: A metal or plastic plate that attaches to wallboard or a wall stud for the purpose of mounting a Telecommunications faceplate.

Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.

Poke-Thru Device: An assembly that allows through-penetration of floor decking with Telecommunication cables, or power, or both, while maintaining the fire-rating integrity of the floor.

Poke-Thru System: A poke-thru device installed in a penetration through a fire-resistant floor structure.

Post-Tensioned Concrete: A type of reinforced concrete construction in which the embedded steel members are first put under tension, the concrete poured and allowed to harden, and the tension of the steel members released causing compression of the concrete.

Pull Box: A housing located in a pathway run used to facilitate the placing of wire or cables.

Raceway: Any enclosed channel designed for holding wires or cables.

Reinforced Concrete: A type of construction in which steel (reinforcement) and concrete are combined, with the steel-resisting tension and the concrete-resisting compression.

Screed Line: The line to which poured concrete is leveled.

Service Entrance: See Entrance Facility (Telecommunications).

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

Service Fitting: An outlet box to house the connections for Telecommunications at the user work area. See also Insert.

Service Provider: The operator of any service that furnishes telecommunications content (transmissions) delivered over access provider facilities.

Sleeve: An opening, usually circular, through the wall, ceiling, or floor to allow the passage of cables.

Slot: An opening, usually rectangular, through a wall, floor, or ceiling to allow the passage of cables.

Space (Telecommunications): An area used for housing the installation and termination of Telecommunications equipment and cable, e.g., Common Equipment Rooms, Equipment Rooms, Common Telecommunications Rooms, Telecommunications Rooms, Work Areas, and maintenance holes/hand-holes.

Splice Box: A box, located in a pathway run, intended to house a cable splice.

Splice Closure: A device used to protect a splice.

Suspended Ceiling: A ceiling that creates an area or space between the ceiling material and the structure above.

Telecommunications: Any transmission, emission, and reception of signs, signals, writings, images, and sounds, that is, information of any nature by cable, radio, optical, or other electromagnetic systems.

Telecommunications Closet: See Telecommunications Room.

Telecommunications Enclosure: See Enclosure (Telecommunications).

Telecommunications Entrance Facility: See Entrance Facility (Telecommunications).

Telecommunications Entrance Point: See Entrance Point (Telecommunications).

Telecommunications Entrance Room or Space: See Entrance Room or Space (Telecommunications).

Telecommunications Equipment Room: See Equipment Room (Telecommunications).

Telecommunications Infrastructure: See Infrastructure (Telecommunications).

Telecommunications Outlet: See Outlet/Connector (Telecommunications).

Telecommunications Room: An enclosed architectural space for housing Telecommunications equipment, cable terminations, and cross-connect cabling.

Telecommunications Service Entrance: See Entrance Facility (Telecommunications).

Telecommunications Space: See Space (Telecommunications).

Through Penetration: A continuous opening that passes through both surfaces of a fire-rated barrier.

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

Trench Duct: See Header Duct.

Two-Level Duct: An underfloor raceway system installed with the header raceways and the distribution raceways on two different planes.

Underfloor Raceway: A pathway placed within the floor and from which wires and cables emerge to a specific floor area.

Uninterruptible Power Supply: A buffer between utility power or other power source and a load that requires continuous precise power.

Usable Floor Space: Floor space, which is capable of being used as a work area.

Wireless: The use of radiated electromagnetic energy (e.g., radio frequency and microwave signals, light) traveling through space to convey information.

Work Area: A building space where the occupants interact with Telecommunications terminal equipment.

Zone Box: An enclosure used to house one or more of the following; a) a consolidation point, b) a horizontal connection point, c) building automation system outlets

2.1.4 Acronyms and Abbreviations

(E):	Existing
(F):	Future
(N):	New
(R):	Existing To Be Removed or Released
A:	Amperes
AC:	Alternating Current
ADA:	Americans with Disabilities Act
AFF:	Above Finish Floor
AHJ:	Authority having jurisdiction
AIA:	American Institute of Architects
AIC:	Amps Interrupting Capacity
AL:	Aluminum Conductor or Bus
ANSI:	American National Standards Institute
AP:	Access Provider
ASHRAE:	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASTM:	American Society for Testing and Materials
ATIS:	Alliance for Telecommunications Industry Solutions
AWG:	American Wire Gauge
BC:	Bare Copper
BET:	Building Entrance Terminal
BICSI:	Building Industry Consulting Service International

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

BOCA:	Building Officials and Code Administrators
BOMA:	Building Owners Managers Association
C:	Conduit
CB:	Circuit Breaker
CBC:	California Building Code
CCITT:	International Telegraph and Telephone Consultative Committee
CCTV:	Closed-Circuit Television
CEC:	California Electrical Code
CER:	Common Equipment Room
CKT:	Circuit
CO:	Conduit Only (Empty Conduit with Pull Cord/Wire)
CSA:	Canadian Standards Association International
CSI:	Construction Specifications Institute
CTR:	Common Telecommunications Room
CU:	Copper
EF:	Entrance Facility
EIA:	Electronics Industry Association
EM:	Emergency
EMI:	Electromagnetic Interference
EMT:	Electrical Metallic Tubing
ENT:	Electrical Nonmetallic Tubing
EP:	Entrance Point
F:	Fuse
FA:	Fire Alarm
FACP:	Fire Alarm Control Panel
FBO:	Furnished By Others
FCC:	Federal Communications Commission
FLA:	Full Load Amps
GFI:	Ground Fault Circuit Interrupter
GFP:	Ground Fault Protection
GND:	Ground
HC:	Horizontal Cross-Connect
HID:	High Intensity Discharge
HP:	Horsepower
HPS:	High Pressure Sodium
HR:	Homerun
HVAC:	Heating, Ventilation and Air Conditioning
IBO:	Installed By Others

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

ICEA:	Insulated Cable Engineers Association (Formerly IPCEA)
ID:	Inside Dimensions
IEC:	International Electrotechnical Commission
IEEE:	The Institute of Electrical and Electronics Engineers
IESNA:	Illuminating Engineering Society of North America
IFMA:	International Facility Management Association
ISO:	International Organization for Standardization
JB:	Junction Box
KV:	Kilovolt
KVA:	Kilovolt Amperes
KW:	Kilowatt
LTG:	Lighting
LV:	Low Voltage
MAC:	Moves, Adds, Changes
MC:	Main Cross-Connect
MCC:	Motor Control Center
MCP:	Motor Circuit Protector
MH:	Manhole
MLO:	Main Lug Only
MMF:	Multimode Fiber
MOSR:	Multi-Outlet Surface Raceway
MPOE:	Minimum Point Of Entry
MSB:	Main Switchboard
MTD:	Mounted
MTG:	Mounting
MUTOA:	Multi-user Telecommunications Outlet Assembly
MV:	Medium Voltage
N:	Neutral
NBC:	National Building Code of Canada
NCTA:	National Cable Television Association
NEC:	National Electrical Code
NEMA:	National Electrical Manufacturers Association
NESC:	National Electrical Safety Code
NFPA:	National Fire Protection Association
NIC:	Not In Contract
NIST:	National Institute for Standards and Technologies
NP:	Nameplate
NRTL:	National Recognized Testing Laboratory

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

NTS:	Not To Scale
OC:	On Center
OL:	Overload Device
OSHA:	Occupational Safety and Health Act
P:	Pole
PB:	Pull Box
PNL:	Panel
PVC:	Polyvinyl Chloride
PVC/RSC:	PVC coated RSC
PWR:	Power
RCPT:	Receptacle
RF:	Radio Frequency
RM:	Room
RSC:	Rigid Steel Conduit
RU:	Rack Unit
SCTE:	Society of Cable Telecommunications Engineers
SMF:	Single-Mode Fiber
SP:	Service Provider
STR:	Strand
SW:	Switch
SWBD:	Switchboard
TE:	Telecommunications Enclosure
TIA:	Telecommunications Industry Association
TMGB:	Telecommunications Main Grounding Busbar
TR:	Telecommunications Room
TS:	Telecommunications Space
TSB:	Telecommunications System Bulletin
TYP:	Typical
UG:	Underground
UL:	Underwriters Laboratories Inc
ULC:	Underwriters Laboratories of Canada
UON:	Unless Otherwise Noted
UPS:	Uninterruptible Power Supply
V:	Volts, Voltage
W:	Watts
WP:	Weatherproof
XFMR:	Transformer
~:	Approximately, As Close As Functionally Possible

Chapter 3 – Telecommunications Administration

3.1 Overview

3.1.1 Engineering Goals

This chapter describes the telecommunications administration methods and labeling schema required as design criteria for the project Engineer. This administration schema, properly implemented, will provide sufficient detail to the Owner and administrators to describe any object within the telecommunications system explicitly and uniformly. The administration schema allows for the ability of the administrators to prepare explicit work orders, map IDs directly to network ports, troubleshoot, and make deterministic plans and future upgrades to the network.

Properly annotated construction documents will work as the administrators' daily reference documents and will be the basis of design and maintenance for the subsequent network electronics and networked systems. Therefore, it is imperative that the Engineer's construction documents denote each administration item on the plans explicitly. The Engineer shall not attempt to implement this administration schema textually or generally.

3.1.2 Applicable Standards

The following standards, their Addenda, Annexes, normative references, and all other relevant Codes and Regulations shall be included as part of the requirements of this MTDS.

TIA-526-7, OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant

TIA-526-14-A OFSTP-14 Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant

TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises

TIA-568-C.1, Commercial Building Telecommunications Cabling Standard

TIA-568-C.2, Balanced Twisted-Pair Telecommunication Cabling and Components Standard

TIA-568-C.3, Optical Fiber Cabling Components Standard

TIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces

TIA-598-B, Optical Fiber Cable Color-coding

TIA-606-A, Administration Standard for Commercial Telecommunications Infrastructure

J-STD-607-A, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

TIA-758-A, Customer-owned Outside Plant Telecommunications Infrastructure Standard

ANSI/ICEA S-80-576-1994, Communications Wire and Cable for Wiring Premises

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

IEEE C2, National Electrical Safety Code

NFPA 70, National Electrical Code

BICSI Telecommunications Distribution Methods Manual

BICSI Cabling Installation Manual

BICSI Customer-owned Outside Plant Methods Manual

3.2 Implementation

3.2.1 Class of Administration

The Engineer shall strictly follow the TIA-606-A using the Class 4 (Multi-Site Enterprise) implementation.

3.2.2 Owner Approved Identifiers

All administration identifiers shall be used in strict accordance with this MTDS and applicable standards.

Due to potential confusion between numeral '1' and the letter 'l' and between the numeral '0' and the letter 'O', Owner preferences forbid usage of 'l' and 'O' in the alpha character set.

TIA-606-A, Annex B, Table 3, Optional Identifiers shall be used where applicable.

3.2.3 Color-Coding Identification

All color coding shall be in accordance with applicable standards except for the following Owner preferences:

- campus backbone fiber optic cabling shall be black.

3.2.4 Labeling Requirements

Owner or Owner's representative shall approve Engineer proposed administration schema prior to completion of construction documents. Engineer is responsible for the administration design with full compliance of applicable standards, unless authorized by Owner in writing. Engineer shall provide all construction requirements within the construction documents to ensure and facilitate enforceability of the contractor by the IOR.

Engineer shall enforce, via the construction documents, that all contractor installed physical labels shall:

- be visible during the installation and normal operation/maintenance of the telecommunications infrastructure.
- be laser printed or machine generated (under no circumstances shall hand written labels be used).

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

- utilize only Owner approved products intended specifically for the purpose.
- utilize only Owner approved colors with maximum label background contrast against the labeled object and maximum label font contrast against label background.
- utilize the largest label possible and/or practical that fits the object to label.
- utilize fonts of maximum size and clarity that fit the chosen label.
- utilize exactly the same schema for every object of the same type and function project-wide.
- be installed per the manufacturer's guidelines in the neatest, most permanent and robust method possible.
- be designed to last as long as the labeled component in the same environmental conditions as the labeled component.
- be installed orthogonally to the object to label and consistently project-wide.
- be installed using a method that produces consistent high-quality results.

3.2.5 As-Built Documentation Requirements

Engineer shall require the contractor to install the administration schema exactly as per plans and annotate any required changes immediately. Engineer shall be required to approve and completely implement all as-built changes in cad and return revised digital files to the IOR upon project completion (see as-built definition). The construction administration fees will be withheld from Engineer until the completed as-built drawings are returned to the IOR.

Engineer shall require the contractor to provide well-formatted electronic documentation (in the latest version of microsoft excel format) in accordance with TIA-606-A, Annex B, Figure 10. Contractor's electronic documentation shall be supplied to the IOR for review upon project completion. IOR shall completely field verify accuracy and completion of contractor provided documentation and labeling prior to final payment to contractor.

Chapter 4 – Intrabuilding Telecommunications Pathways

4.1 Overview

4.1.1 Engineering Goals

This chapter describes the intrabuilding telecommunications pathways design requirements encompassing the telecommunications systems and affected building design and construction. The effective implementation of this MTDS is contingent on the capabilities and diligence of the responsible engineer. The engineer shall be required to coordinate between all design disciplines to ensure that the building systems will accommodate the requirements of this MTDS unless otherwise directed, in writing, by the owner.

The main design objective is to ensure the building has maximum responsiveness to change, be media and topology independent, and avoid technology obsolescence. The engineer shall design all capacity and routing of pathways to be capable of supporting future expansion based on projected or potential growth. All designs of the telecommunications pathways shall conform to all applicable standards and requirements of this MTDS.

The engineer shall explicitly denote all pathway routing, type, quantity, and administration identifiers on the construction documents. All pathways routing design shall be the responsibility of the engineer, not the contractor. The engineer shall not attempt to implement pathway design textually or generally.

4.1.2 Applicable Standards

The following standards, their Addenda, Annexes, Normative References, and all other relevant Codes and Regulations shall be included as part of the requirements of this MTDS.

TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises

TIA-568-C.1, Commercial Building Telecommunications Cabling Standard

TIA-568-C.2, Balanced Twisted-Pair Telecommunication Cabling and Components Standard

TIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces

TIA-606-A, Administration Standard for Commercial Telecommunications Infrastructure

J-STD-607-A, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

TIA-758-A, Customer-owned Outside Plant Telecommunications Infrastructure Standard

ANSI/ICEA S-80-576-1994, Communications Wire and Cable for Wiring Premises

IEEE C2, National Electrical Safety Code

NFPA 70, National Electrical Code

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

BICSI Telecommunications Distribution Methods Manual

BICSI Cabling Installation Manual

BICSI Customer-owned Outside Plant Methods Manual

4.2 Intrabuilding Pathways Requirements

4.2.1 Design Criteria

All intrabuilding pathways shall be designed and explicitly annotated by the Engineer to enforce the final construction to:

- allow the most accessible, direct, safe, flexible, and dry routing possible.
- be completely electrically bonded as per applicable standards or as directed herein.
- be installed orthogonally to structure.
- ensure no pathway segment exceeds 100' length without an explicitly documented pathway access point.
- support the weight of the total possible fill (not the design fill) using individual cable weights of fifty (50) pounds per 1000'.
- conform to the applicable standards and cabling manufacturer's minimum allowable bend radii, whichever is greater, for each respective cabling type for both pulling and final installation requirements.
- have no more than 180 degrees of aggregate bends between pathway access points.
- have no single bend in excess of 90 degrees without a pathway access point.
- not be run within the slab-on-grade unless required, and then, only where required and while using cabling designed for "wet location" installations.
- restore original fire-ratings of all penetrated fire-rated barriers as per applicable standards.
- caulk all non-fire rated penetrations for sound isolation between adjacent spaces.
- provide separation from telecommunications and power cabling as per applicable standards.
- utilize upon installation, and include for future, a pull tape having a minimum test rating of 200lbs or twice the cable manufacturer's pull rating for the largest cable type within the raceway (whichever is larger).

Flexible metallic conduit shall not be used for new construction or anywhere an EMT installation is a reasonable option.

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

The Owner requires the use mechanical firestopping hardware, when penetrating fire rated barriers, to facilitate Owner cabling additions and changes. Engineer shall design and annotate the location of each fire barrier penetration to ensure each constructed penetration conforms to the applicable standards.

All pathways, not specifically designed as riser pathways for interconnecting stacked telecommunications spaces, shall terminate on the same floor from which they service.

Engineer shall denote administration identifiers for each pathway on construction documents as per applicable standards.

Engineer shall require and detail the bonding of all telecommunications pathway types as per applicable standards.

Engineer shall consult a licensed structure Engineer for review and approval of all overhead pathway support systems.

4.2.2 Pathway Sizing Requirements

All horizontal pathways shall be sized to accommodate 150 percent additional capacity from the maximum foreseeable future downstream horizontal cabling quantities. Engineer's fill calculations for maximum foreseeable future growth shall not exceed the design fill percentages listed within the applicable standards.

All pathways sizing calculations shall be based on horizontal cabling outside diameters using 0.32", contrary to applicable standards dictating 0.354", regardless of the outside diameter of the current specified cable.

The minimum faculty work area designs density shall be at least one (1) work area per 100 sq. Ft. Of usable floor space, unless otherwise directed by Owner or described herein.

The minimum building automation system design density shall be a minimum of one (1) ceiling data outlet location, with two (2) data outlets each, per 250 sq. Ft. Of all floor space in addition to the student and faculty work area design requirements.

4.3 General Pathway Access Point Requirements

4.3.1 Design Criteria

in addition to the intrabuilding pathway requirements, all pathway access points shall be designed to:

- be located to provide the most accessible, safe, and dry locations possible.
- transition pathways at right angle transitions/bends where sweeps are not possible due to clearances or other physical interference issues.
- allow cabling to route straight through, from the entrance conduit to the exit conduit, without bends.

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

- have a length minimum of eight (8) times the diameter of the largest conduit and/or as per applicable standards whichever is greater.

Engineer shall denote administration identifiers for each pathway access point on construction documents as per applicable standards.

Engineer shall detail and require the bonding of all pathway access points as per applicable standards.

4.4 General Cabletray Requirements

4.4.1 Design Criteria

In addition to the intrabuilding pathway requirements, all cabletray pathways shall be designed to:

- not exceed a maximum design fill of 25% as per applicable standards.
- support the weight of the maximum foreseeable aggregate cabling densities it will service.
- locate supports where practicable so that connections between sections of the tray fall between the support point and 1/4 the distance of the span.
- support cabletray within 24" of each side of any bend, tee, or cross connection.
- meet at least zone 3, or greater where required by code, seismic bracing standards for horizontal, vertical, and lateral movement.
- be basket tray unless approved by Owner.
- be at least 6" wide.
- minimize the distance of zone conduits and j-hook runs through thoughtful routing design.
- enter a telecommunications space exactly 6" and transitioning to a "waterfall" specifically manufactured for the purpose and for use by the respective cabletray.
- avoid crossing fluorescent light fixtures wherever possible. When cabletray must cross over fluorescent light fixtures, cross fixture perpendicular to fixture width (shortest path) and maintain a minimum clearance of 12" between bottom of cabletray and the top of the light fixture.
- maintain a minimum clearance of 12" at all times above the cabletray.
- be installed within 12' above finished floor at all times.
- utilize "waterfalls", specifically manufactured for the purpose and for use by the cabletray used, when cables enter or exit the tray.

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

- ensure objects (i.e. mechanical ducts, sprinkler systems, etc.) will not block access to the cabletray at any point.
- ensure twisted-pair cabling remains unbundled and randomized within the cabletray to avoid harmonizing with adjacent cables.
- utilize electrically bonded zone conduits, of at least 2" trade-size, to feed any room having communications outlets that are separated by a fire barrier or other obstruction.

Cabletray must transition to a quantity of 4" conduits having the equivalent usable area, at design fill, as the original cabletray when:

- routing over fixed ceiling spaces greater than 30' AFF.
- the cabletray must incline or decline more than 20 degrees.

4.5 General Conduit Requirements

4.5.1 Design Criteria

In addition to the Intrabuilding Pathway Requirements, the Engineer shall design conduit pathways to:

- not exceed a maximum design fill of 40% as per applicable standards.
- accommodate a required capacity reduction of 20% for runs over 50'.
- be EMT unless conditions preclude.
- be no less than 1" trade size.
- ensure that all conduits are properly bushed and sealed.
- increase in diameter (up to 4" trade size) and/or quantity toward the serving telecommunications room calculated to completely support the maximum cumulative capacity of the downstream pathways serviced.
- maintain 8" on center spacing between conduits.
- ensure all conduits entering telecommunications spaces from floor must rise exactly 3" above finished floor measured prior to bushing installation.
- have no more than three (3) bends without a pathway access point from the serving telecommunications room to the outlet locations.
- have a single dedicated conduit to accessible ceiling space serving one, and only one, backbox.
- be offset by at least 12" from outlet locations on the opposite side of a common wall to maintain sound isolation.

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

- utilize innerduct organizers and plugs when containing one (1) or more innerducts.

4.5.2 Sleeve Requirements

In addition to the intrabuilding pathway requirements, all conduit sleeves shall be designed to:

- be 2" trade size minimum.
- mount at least 12" above ceilings.
- extend past soffits and hard lid ceilings into accessible ceiling space.
- be filed clean and properly bushed to protect cabling.
- shall be prepped and painted, with products specifically designed for galvanized surfaces, to match wall finishes prior to bushing installation when exposed.

4.6 General J-Hook Requirements

4.6.1 Design Criteria

In addition to the intrabuilding pathway requirements, j-hook pathways shall be designed to:

- allow the most accessible, direct, safe, flexible, and dry routing possible.
- be installed orthogonally to structure.
- not exceed a maximum j-hook separation distance of 4' on center.
- have a minimum of 4" and a maximum of 6" of cable bundle sag between j-hooks.
- maintain a minimum clearance from the top of light fixtures of 18" from the bottom of j-hooks, and 12" from the bottom of lowest point of cable bundle sag.
- not exceed a maximum cable capacity of thirty (30) cables without utilizing a cabletray or, if necessary, a zone conduit system.
- never be attached to ceiling wires supporting false ceiling grid, lighting, or mechanical fixtures.
- maintain a minimum clearance of 12" at all times above the j-hooks.
- be installed within 12' above finished floor at all times.
- ensure cable bundles are wrapped with 1" width black velcro loop-strap ties at intervals of every 24" on center.
- ensure that neither nylon nor plastic ties shall be used at any time on the telecommunications cabling.
- not exceed j-hook static load limits of one-hundred (100) pounds.

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

- utilize wheel attachments to minimize cable stress and friction during installation.
- use mechanical firestopping hardware, when penetrating fire barriers, to facilitate Owner cabling additions and changes.
- provide separation from telecommunications and power cabling as per applicable standards.
- provide 50% extra j-hook capacity for future cabling additions.

J-hook assemblies shall be secured by one or more of the following methods:

- a minimum of one (1) #12 ceiling wire to ceiling structure.
- two (2) 1/8" screws with a minimum of 1" stud penetration into attic wall surfaces.
- threaded rods.
- beam clamps.

Engineer shall denote administration identifiers for each pathway on construction documents as per applicable standards.

4.7 Intrabuilding Backbone Pathways

4.7.1 Entrance Facility Pathways

Owner requires that the conduit configuration between the entrance facility and the equipment room be identical in quantity and configuration as the service entrance pathway with the following additions:

- provide one (1) additional spare conduit for buildings less than 10,000 sq. ft.
- provide two (2) additional spare conduits for buildings greater than 10,000 sq. ft.

4.7.2 Service Entrance Pathways

Owner requires exactly two (2) 4" conduit as Service Entrance Pathway for buildings less than 10,000 sq. ft.

Owner requires exactly three (3) 4" conduit as Service Entrance Pathway for buildings greater than 10,000 sq. ft.

Owner requires all interbuilding conduits to contain four (4) 1" innerducts colored blue, orange, green and brown.

4.7.3 Riser Pathways

Sleeves shall be used as Riser Pathways if Telecommunications Spaces are stacked.

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

Riser pathways for a multi-story structure of 10,000 asf or less shall utilize three (3) 4" riser sleeves between each floor. Multi-story structures over 10,000 asf shall have four (4) 4" riser sleeves per floor.

Where conditions require more than one (1) row of sleeves, Engineer shall not allow more than two (2) rows of sleeves unless unavoidable.

One (1) 4" riser sleeves shall be added from lowest floor to the top floor, in addition to the prescribed riser pathways, for future roof mounted systems (i.e. Wireless or satellite systems).

One (1) 4" conduit shall be installed from a top floor telecommunications space (that is in closest vertical alignment to the equipment room) to a NEMA 4 enclosure on the roof for use as an antenna access point. To ground the enclosure, a dedicated earth ground shall be installed in the most direct path possible. Design of enclosure grounding and bonding system shall be compliant with applicable standards. Provide one (1) 1-1/4" conduit and weatherproof junction box from the antenna enclosure location to the telecommunications space electrical panel below.

If telecommunications spaces are not stacked or are offset in any way, provide one (1) additional sleeves/conduits per floor to final riser sleeve counts.

All riser sleeves originating from a telecommunications space below must rise to exactly 3" above finished floor, measured prior to bushing installation, and be 1-1/2" from the wall (pre-plywood) to the sleeve nearest edge. Review sleeve locations with the design team's structural Engineer and adjust if necessary.

All riser sleeves originating from a telecommunications space above must extend to exactly 8" above the perimeter ladder runway, measured prior to bushing installation, and be 1-1/2" from the wall (pre-plywood) to the sleeve nearest edge.

Maintain 8" on-center spacing between riser sleeves.

Provide appropriate support for sleeves as per applicable standards.

Riser sleeves shall be prepped and painted to match wall finishes prior to bushing installation.

Firestop and seal as all sleeves and conduits as per applicable standards.

Engineer shall denote administration identifiers for each sleeve on construction documents as per applicable standards.

4.8 Outlet Location Pathways

4.8.1 Design Criteria

The minimum outlet location pathway shall be one (1) 4-11/16" sq. Backbox served by one (1) 1-1/4" conduit. Consult a structural engineer and the AHJ when routing conduit larger than 3/4" within block wall construction.

Outlet location shall be served by a dedicated conduit to accessible ceiling space and shall not be looped or "daisy-chained".

In addition to the intrabuilding pathway requirements, all outlet location pathways shall be designed to:

- extend to the nearest pathway access point, accessible ceiling space, j-hook pathway, zone conduit, or cabletray using the most accessible, direct, safe, and dry routing possible.
- be emt unless conditions preclude.
- utilize bend radii that exceed the minimum outlet location pathway bend radius of 7".
- have a single dedicated conduit serving one, and only one, backbox.
- be offset at least 12", if possible, from outlet locations on the opposite side of a common wall to maintain sound isolation.
- not use surface perimeter raceway unless required and with written owner approval.

Rooms with ceiling-mounted projection systems shall have a 1-1/4" conduit in a quad size ceiling junction box extended from the projector location to the instructor's teaching position. Provide a 6"x6" minimum pullbox between the instructor's teaching location and the ceiling mounted projection system to minimize cable bends.

4.9 As-Built Documentation Requirements

Engineer shall require the Contractor to install the telecommunications pathways exactly as per plans and annotate any required changes immediately. Engineer shall be required to approve and completely implement all as-built changes in CAD and return revised full size PDF and CAD drawings upon project completion. The construction administration fees will be withheld from Engineer until the completed as-built drawings are returned to the IOR.

Chapter 5 – Telecommunications Spaces

5.1 Overview

5.1.1 Engineering Goals

This chapter describes the design requirements for several types of telecommunications spaces and the related impact on building design and construction. The effective implementation of this MTDS is contingent on the capabilities and diligence of the responsible Engineer. The Engineer shall be required to coordinate between all design disciplines to ensure that the building systems will accommodate the requirements of this MTDS unless otherwise directed, in writing, by the Owner.

The main design objective is to ensure the building has maximum responsiveness to change, be media and topology independent, and avoid technology obsolescence. In addition, the various types of spaces incorporated into the design shall conform to the applicable requirements of this MTDS. All spaces shall accommodate future expansion based on projected maximum growth.

The Engineer shall explicitly denote all relevant entities associated with telecommunications spaces on the construction documents. All pertinent aspects of telecommunication spaces design shall be the responsibility of the Engineer, not the Contractor. The Engineer shall not attempt to implement design of telecommunications spaces textually or generally.

5.1.2 Applicable Standards

The following standards, their addenda, annexes, normative references, and all other relevant codes and regulations shall be included as part of the requirements of this MTDS.

TIA-526-7, OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant

TIA-526-14-A OFSTP-14 Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant

TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises

TIA-568-C.1, Commercial Building Telecommunications Cabling Standard

TIA-568-C.2, Balanced Twisted-Pair Telecommunication Cabling and Components Standard

TIA-568-C.3, Optical Fiber Cabling Components Standard

TIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces

TIA-598-B, Optical Fiber Cable Color-coding

TIA-606-A, Administration Standard for Commercial Telecommunications Infrastructure

J-STD-607-A, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

TIA-758-A, Customer-owned Outside Plant Telecommunications Infrastructure Standard

ANSI/ICEA S-80-576-1994, Communications Wire and Cable for Wiring Premises

IEEE C2, National Electrical Safety Code

NFPA 70, National Electrical Code

BICSI Telecommunications Distribution Methods Manual

BICSI Cabling Installation Manual

BICSI Customer-owned Outside Plant Methods Manual

5.2 Telecommunications Rooms (TRs)

5.2.1 Locations

Telecommunications Room's shall be located as centrally to the respective area served as possible. The Telecommunications Room housing the Main Cross-connect shall be located as close to the buildings first level core area as possible.

In multilevel buildings, the Telecommunication Rooms shall be stacked.

There shall be a minimum of one (1) Telecommunications Space per floor.

Additional rooms are required when:

- the floor area served exceeds 10,000 sq. ft.
- any cable run will exceed 90 meters in total installed cable length.
- potential future Station Cabling densities served from any one (1) room may exceed 480.

5.2.2 Access Requirements

Telecommunications Rooms shall be directly and readily accessible (e.g. a common hallway).

5.2.3 Sizing and Architectural Requirements

To serve up to 5,000 square feet of usable floor space, the minimum allowable size for Telecommunication Rooms is 8' by 10'. All telecommunications spaces not capable these parameters shall be approved in writing by the Owner or Owner's Representative prior to

To serve 5,000 to 10,000 square feet of usable floor space, the minimum allowable size for Telecommunication Rooms is 10' by 10'.

All Telecommunications Rooms shall be designed to maintain a minimum clearance of 3.28' (1m) of clear, unobstructed space, after final equipment installation. All clearances shall be

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

measured from the outermost surfaces of the largest foreseeable installed equipment, rather than the mounting surface of the rack.

All walls within the Telecommunications Rooms shall be covered with 3/4" grade A-C void free non-fire-rated plywood backboards installed with the A-grade side exposed. All backboards shall be kiln-dried to maximum moisture content of 15%. All backboards shall be painted with two coats of fire-retardant matte paint, with a minimum coefficient of reflectance of 80%. Only non-fire-rated plywood shall be used to prevent the fire-rated paint from bubbling and flaking over time from the fire treatment.

All plywood shall be mounted vertically with vertical edge aligned on stud centerlines. The backboard lowest edge shall be between 6" and 12" above the finished floor, and extending to 1" below finished ceiling. Mounting screws shall be countersunk and shall penetrate into wall stud a minimum of 1" at intervals of 10" on center. Adjacent plywood sheets shall mate to form a gapless seam on the stud centerline. Vertically offset mounting screws of adjacent plywood by 1/2".

The ceiling shall have a gypsum board ceiling with a minimum height of 8'-0" above finished floor. Ceiling should be 10'-0" above finished floor if possible. Suspended ceilings shall not be used.

The flooring shall be non-static vinyl composition tile or raised access flooring with minimum coefficient of reflectance at 90%. The Architect shall select flooring color and design, meeting these criteria.

The access door to each Telecommunications Room shall be solid core construction and be a minimum of 36" wide and 84" high. Door shall be hinged to open outward (without exceptions for new installations) unless approved by Owner. Existing installations not allowing outward opening doors, due to Code issues, must have the room depth increased by 24" opposite the door. The door shall be fitted with commercial grade locks and keyed the same as all campus telecom rooms. All campus telecom rooms shall be keyed independently of other campus keys.

All architectural surfaces shall be treated to eliminate dust.

All doors shall have permanent and complete weather stripping or gasketing to eliminate dust and heat from entering the room.

5.2.4 Equipment Rack Design Requirements

New installations, and where possible in modernizations and retrofits, each equipment rack shall be dedicated to the following applications:

- horizontal & backbone cabling
- equipment & systems (servers, sound reinforcement, surveillance, etc.)
- network electronics

Horizontal cabling shall not exceed 240 terminated cables per equipment rack.

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

All equipment racks shall be designed to maintain a minimum clearance of 42" (1m) of clear, unobstructed space, after final equipment installation. All clearances shall be measured from the outermost surfaces of the largest foreseeable installed equipment, rather than the mounting surface of the rack.

All equipment racks, cable runways, and cable management shall be colored black.

All Equipment Racks shall be 19"x7'-0", fully TIA compliant, and factory painted black in color unless directed otherwise in writing by Owner.

All copper patch panels shall be 48-port and separated with a 2RU, double-sided, horizontal cable manager.

All fiber patch panels shall be 4RU and separated with a 2RU, double-sided, horizontal cable manager.

All equipment racks shall have two (2) 2RU, double-sided, horizontal cable managers mounted at the top 4RU, and one (1) 2RU, double-sided, horizontal cable managers in the bottom 2RU.

Allow for at least 200% cabling growth when determining quantity of equipment racks for horizontal cabling.

The quantity of equipment racks for Network Electronics shall equal the quantity of equipment racks for the horizontal cabling.

Equipment racks for Network Electronics and other Telecommunications Systems shall be in an individual row opposing equipment racks for horizontal cabling and backbone cabling where possible.

Equipment racks shall be installed perpendicular to the non-door wall representing the width of the Telecom Room. A clearance distance of 24" shall be maintained between the center point of the first Equipment Rack and the adjacent perpendicular wall.

All Equipment Racks shall have a two-sided vertical cable manager on both sides. All vertical cable managers shall be a minimum of 8" in width. Sizes shall be increased as determined by fill capacity requirements at maximum foreseeable future capacity.

All cable runways shall be a minimum of 12" in width. Sizes shall be increased as determined by fill capacity requirements at maximum foreseeable future capacity.

The cable runway shall encircle the perimeter of the Telecommunications Room and run parallel over the center of each equipment rack row. Paths of cable runway shall also run perpendicular to each side of each equipment rack row, centered over each vertical wire manager.

Cable runway and installation accessories shall be of the same manufacturer as the equipment racks and be secured to adjacent racks to manufacturers installation guidelines.

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

5.2.5 Environmental Requirements

The Telecommunications Room shall maintain temperatures between 65 and 75 degrees Fahrenheit. Relative humidity shall be maintained between 30 and 55 percent.

Heat loads shall be calculated based using standard calculations in addition to the minimum equipment only heat output of 10KW. Where a dedicated load center is defined, the equipment heat load calculations shall match the maximum rated load center output power, de-rated by 80% for continuous use devices (per NEC), and assuming 40% equipment electrical efficiency.

A positive air pressure shall be maintained with a minimum of one (1) air change per hour.

Environmental requirements shall be on a 24-hour, 365 days a year basis and shall not be swept off at any time via the EMS system.

All Telecommunications Rooms shall each have dedicated cooling units. If emergency power is available, the Engineer shall incorporate into the design the connection of the dedicated cooling system.

A particulate filtration system shall be installed in each Telecommunications Room to eliminate contamination of equipment and fiber optic connectors. Filtration maintenance shall be designed to easily accessible to Owner maintenance personnel.

All Telecommunications Rooms require the installation of a TCP/IP based environmental monitoring appliance with email alert functionality and web-based monitoring capability. Each environmental monitoring appliance shall be configured to produce SMTP email notifications to all Owner directed personnel and ultimately send an SNMP trap to the rack mounted IP managed power distribution units for automated equipment shutdown.

5.2.6 Electrical Power Requirements

An appropriately sized dedicated power distribution panel shall be installed within each campus Main Telecommunications Room.

All dedicated power panels shall have a dedicated isolated ground and a minimum ampacity of 100-Amps with feeder cabling sized to potentially support 250-Amps.

Where the addition of an emergency power system is required to provide backup power for critical loads associated with telecommunications, the system shall be capable of automatic switchover in the event of a commercial power outage.

All power distribution panels serving Telecommunications Rooms shall have an integrated Transient Voltage Surge Suppression System.

Quad receptacles shall be placed at 6' on center intervals around the perimeter walls at a height of 18" above the finished floor. Each two perimeter quad receptacles shall be served by a dedicated 20A/1P circuit.

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

The configuration and type of power receptacles at Equipment Racks shall be coordinated with the Owner during the initial design. The minimum rack power configuration shall include at least one dedicated 20A/1P circuit in an outlet box at the base of each rack and an additional 30A/1P circuit for the rack serving the network electronics.

All power receptacles within the Telecommunications Room shall use a minimum of #10 AWG wiring, isolated ground, and oversized neutral. Each outlet box shall be a 4" square box minimum.

Branch circuits originating from a power distribution panel dedicated to telecommunications shall not serve any load outside of the Telecommunications Room.

Coordinate all UPS requirements and rack location receptacle(s) outlet NEMA configuration with Owner.

5.2.7 Lighting Requirements

Telecommunications Room Lighting shall:

- be a minimum of 50 candela measured at 30" above finished floor from the middle of each aisle.
- be controlled by switches located near the entrance to the room.
- not be powered by the same electrical distribution panel as the telecommunications equipment.
- be located and orientated to provide maximum vertical foot-candelas to the faces of both sides of all racks.

5.2.8 Structural Requirements

Telecommunications Rooms shall be located on floor areas designed with a minimum uniform floor loading capacity of at least 100 lbs. per square foot.

Engineer shall obtain approval from the Structural Engineer prior to specifying any alterations to structural members (eg. to facilitate entrance of Telecommunications Pathways).

Equipment racks shall be anchored to the floor, using all available floor anchor holes, and tightened to manufacturers torque specifications with anchor assembly selection and installation depths as calculated by a licensed structural Engineer.

Equipment racks mounted on raised access flooring shall be anchored to sub-floor and utilize a minimum of Seismic Zone 3 for transverse and longitudinal bracing. Pre-Approve all configurations with a licensed structural Engineer.

Cable runway wall support hardware shall be anchored to walls using purpose designed hardware by the cable runway manufacturer. Anchors shall penetrate the perimeter plywood backboard into studs with fastener hardware and locations as directed by a licensed Structural Engineer.

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

Seismic calculations for the each Telecom Room complete equipment rack and cable runway system shall accompany the construction documents DSA submission for DSA review and approval.

5.3 As-Built Documentation Requirements

Engineer shall require the Contractor to install the Telecommunications Spaces exactly as per plans and annotate any required changes immediately. Engineer shall be required to approve and completely implement all As-Built changes in CAD and return full-sized PDF and CAD files to the IOR. The Construction Administration fees will be withheld from Engineer until the completed As-Built drawings are returned to the IOR.

Chapter 6 – Intrabuilding Grounding and Bonding

6.1 Overview

6.1.1 Engineering Goals

This chapter describes the intrabuilding grounding and bonding design requirements encompassing the telecommunications systems and affected building design and construction. The effective implementation of this MTDS is contingent on the capabilities and diligence of the responsible Engineer. Engineer shall be required to coordinate between all design disciplines to ensure that the building systems will accommodate the requirements of this MTDS unless otherwise agreed upon in writing with the Owner.

The main design objective is to ensure the building has maximum responsiveness to change, be media and topology independent, and avoid technology obsolescence. In addition to providing support for a multi-vendor, multi-product environment, the grounding and bonding system shall be capable of supporting future expansion of telecommunications system based on projected growth and meeting the electronics warranty requirements of all future gear.

Engineer shall explicitly denote all grounding and bonding components including installation details on the Construction Documents. All grounding and bonding for telecommunications shall be the responsibility of the Engineer, not the Contractor. The Engineer shall be responsible for coordination between electrical and telecommunications grounding and bonding systems to ensure to proper application of this Standard.

6.1.2 Applicable Standards

The following standards, their Addenda, Annexes, Normative References, and all other relevant Codes and Regulations shall be included as part of the requirements of this MTDS.

TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises

TIA-568-C.1, Commercial Building Telecommunications Cabling Standard

TIA-568-C.2, Balanced Twisted-Pair Telecommunication Cabling and Components Standard

TIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces

TIA-606-A, Administration Standard for Commercial Telecommunications Infrastructure

J-STD-607-A, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

TIA-758-A, Customer-owned Outside Plant Telecommunications Infrastructure Standard

ANSI/ICEA S-80-576-1994, Communications Wire and Cable for Wiring Premises

IEEE C2, National Electrical Safety Code

NFPA 70, National Electrical Code

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

BICSI Telecommunications Distribution Methods Manual

BICSI Cabling Installation Manual

BICSI Customer-owned Outside Plant Methods Manual

6.1.3 Design Criteria

The Intrabuilding Telecommunications Grounding and Bonding Infrastructure shall be designed to:

- serve as a reliable grounding reference system for all intrabuilding telecommunications systems.
- ensure a uniform telecommunications grounding and bonding infrastructure arranged to accommodate telecommunications systems and equipment throughout the building.
- adhere to applicable standards irrespective of building design or structural features. Note that this standard applies to the renovation or retrofit of existing buildings as well as new commercial buildings.
- originate at the electrical service equipment ground and extends to areas of the building where telecommunications systems and equipment are located.

The Grounding and Bonding Infrastructure shall function as a singular grounding and bonding infrastructure system utilizing the following major components:

- Telecommunications main grounding busbar (TMGB);
- Bonding conductor for telecommunications;
- Telecommunications Bonding Backbone (TBB);
- Grounding Equalizer (GE);
- Telecommunications grounding busbar (TGB).
- utilize components, cables and connecting hardware listed by a nationally recognized testing laboratory (NRTL). Note that all equipment, including cables and connectors, shall be listed for the intended application as related to each item.

The Grounding and Bonding Infrastructure shall be designed to ensure that all grounding and bonding conductors utilized throughout the grounding system conform to the following requirements:

- conductors shall be copper and may be insulated.
- minimum conductor size shall be No. 6 AWG.
- avoid routing through ferrous metallic conduit.

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

- require labeling of each telecommunications grounding and bonding conductor such that each label is placed as close as practicable to point of termination. Note that labeling and record-keeping requirements shall be in full conformance with the applicable standards.
- provide a ground reference for telecommunications systems within each separate telecommunications entrance facility, telecommunications room, and equipment room.
- provide for bonding of metallic pathways, cable shields, conductors, and hardware at entrance facilities, telecommunications rooms, equipment rooms.
- comply with applicable electrical codes for grounding and bonding for telecommunications.
- comply with applicable local codes as required by the authority having jurisdiction.
- maintain near zero potential difference between the electrical and telecommunications grounding systems.
- telecommunications systems incorporating shielded/screened cables shall have a maximum potential difference not exceeding 1 Volt.
- accommodate grounding conductor for secondary protection devices at nearest telecommunications grounding busbar.

6.2 Telecommunications Main Grounding Busbar (TMGB) Requirements

6.2.1 Design Criteria

In addition to telecommunications grounding and bonding infrastructure requirements, the TMGB shall be designed to conform to the following salient characteristics and testing requirements:

- pre-drilled electrotin plated copper busbar with holes for use with standard sized lugs.
- sized in accordance with twice the immediate application requirements.
- minimum dimensions of 6 mm (0.25 in) thick x 100 mm (4 in) wide and variable in length.
- listed by a nationally recognized testing laboratory.

Minimize the length of the bonding conductor for telecommunications by locating the TMGB as close as practicable to the electrical entrance facility.

Ensure that all metallic raceways for telecommunications cabling shall be bonded to the TMGB where located within the same room or space as the TMGB.

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

6.2.2 TMGB Installation Requirements

The TMGB shall be mounted to the wall with insulated standoffs. Provide a minimum of 2" separation to allow access to the rear of the busbar. Adjust mounting height of the TMGB to accommodate overhead or underfloor cable routing.

The TMGB shall be placed in a location easily accessible to the Owner's IT Staff. The preferred location for the TMGB is in the Telecommunications Entrance Facility (TEF).

Where an electrical power distribution panel occupies the same room or space as the TMGB, the ground bus of the electrical panel shall be bonded to the TMGB. Place the TMGB as close as practicable without infringing on clearances required by applicable codes.

Connections of the bonding conductor for telecommunications (BCT) and telecommunications bonding backbone (TBB) to the TMGB shall utilize listed compression two-hole lugs or other suitable applicable standards compliant connection hardware.

The TMGB shall be bonded to the electrical service equipment ground by means of the bonding conductor for telecommunications; minimum bonding conductor size shall be the same as the TBB.

All connectors used for bonding to the metal frame of a building to TGMB shall be listed for the intended purpose.

6.3 General Telecommunications Grounding Busbar (TGB) Requirements

6.3.1 Design Criteria

In addition to Telecommunications Grounding and Bonding Infrastructure Requirements, the TGB shall be designed to:

- extend reference ground from TMGB to other spaces by installing interconnected TGBs.
- provide bonding interconnections between TBBs and TGBs within the same space using conductors the same size as the TBB.
- ensure that bonding conductors that interconnect a TBB and a TGB are continuous and routed in the shortest straight-line path practicable.
- ensure that all metallic raceways for telecommunications cabling shall be bonded to the TGB where located within the same room or space as the TGB.

The TGB shall conform to the following salient characteristics and testing requirements:

- pre-drilled electrotin plated copper busbar with holes for use with standard sized lugs.

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

- minimum dimensions of 6 mm (0.25 in) thick x 50 mm (2 in) wide and variable length to meet the application requirements.
- listed by a nationally recognized testing laboratory.

6.3.2 TGB Installation Requirements

TGB shall be mounted to wall with insulated standoffs. A minimum of 2" separation is required to allow access to the rear of the busbar. Adjust mounting height of the TGB to accommodate overhead or underfloor cable routing.

The TGB shall be placed in a location accessible to telecommunications personnel. The preferred location for the TGB is in the Telecommunications Entrance Facility (TEF).

Where an electrical power panelboard occupies the same room or space as the TGB, the ground bus of the panelboard shall be bonded to the TGB. Place the TGB as close as practicable without infringing on clearances required by applicable electrical code.

Connections of the Bonding Conductor for Telecommunications and Telecommunications Bonding Backbone (TBB) to the TGB shall utilize listed compression two-hole lugs or other suitable applicable standards compliant connection hardware.

The TGB shall be bonded to the electrical service equipment ground by means of the Bonding Conductor for Telecommunications; minimum bonding conductor size shall be the same as the calculated size for the TBB.

All connectors used for bonding to the metal frame of a building to TGB shall be listed for the intended purpose.

Bond TGB to grounding equalizer (GE) where required.

6.4 Telecommunications Bonding Backbone (TBB) Requirements

6.4.1 Design Criteria

In addition to Telecommunications Grounding and Bonding Infrastructure Requirements, the TBB shall be designed to:

- correlate with the type of building construction, building size, general telecommunications requirements, and the configuration of the telecommunications pathways and spaces.
- be consistent with the design of the telecommunications backbone cabling system.
- permit multiple TBBs as dictated by the building size.
- address routing to minimize the lengths of the TBBs.

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

All TBB implementations shall conform to the following salient characteristics:

- copper conductor, No. 6 AWG minimum size
- sized at 2 kcmil per linear foot of length up to maximum size of 3/0 AWG
- insulated conductors must meet fire ratings corresponding to pathway

6.4.2 TBB Installation Requirements

The TBB(s) shall be connected to the TMGB without exception.

The TBB conductors shall be protected from physical damage.

The TBB conductors should be continuous. Keep splices to a minimum and locate in accessible places within telecommunication spaces. Use exothermic welding or compression-type connectors to join segments of a TBB. All such joints shall be supported and protected from physical damage.

When the design incorporates two or more TBBs in a multistory building, a Grounding Equalizer (GE) must be included to bond the TBBs together. Refer to ANSI/TIA/EIA 607-A for recommended configuration.

6.5 As-Built Documentation Requirements

The Contractor shall install the Grounding and Bonding System Infrastructure according to plans and annotate a set of preliminary as-built drawings to reflect any changes that occur in the field. The Engineer is responsible for approving such changes and updating plans to establish a record set of As-Built drawings upon completion of construction work. The Construction Administration fees will be withheld from the Engineer until the final As-Built drawings are delivered to the IOR.

Chapter 7– Typical Data and Power Outlets

7.1 Overview

7.1.1 Engineering Goals

This chapter describes the typical design guidelines of data data and power locations and quantities. The effective implementation of this MTDS is contingent on the capabilities and diligence of the responsible Engineer. The Engineer shall be required to coordinate with the between all design disciplines to ensure that the building systems will accommodate the requirements of this MTDS unless otherwise directed, in writing, by the Owner.

7.1.2 Applicable Standards

The following standards, their addenda, annexes, normative references, and all other relevant codes and regulations shall be included as part of the requirements of this MTDS.

TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises

TIA-568-C.1, Commercial Building Telecommunications Cabling Standard

TIA-568-C.2, Balanced Twisted-Pair Telecommunication Cabling and Components Standard

TIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces

TIA-606-A, Administration Standard for Commercial Telecommunications Infrastructure

J-STD-607-A, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

TIA-758-A, Customer-owned Outside Plant Telecommunications Infrastructure Standard

ANSI/ICEA S-80-576-1994, Communications Wire and Cable for Wiring Premises

IEEE C2, National Electrical Safety Code

NFPA 70, National Electrical Code

BICSI Telecommunications Distribution Methods Manual

BICSI Cabling Installation Manual

BICSI Customer-owned Outside Plant Methods Manual

7.2 Data Outlet Cabling and Termination Requirements

7.2.1 Design Criteria

The data outlet cabling and termination requirements shall be designed to:

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

- have absolutely no distinction between data and voice cabling media, colors, termination hardware, termination methods, or termination locations. Voice devices are simply computers running a voice application and will herein be referred to only as data.
- ensure the entire data outlet cabling channel materials, termination hardware and methods, testing equipment, and testing procedures be of a matched performance rating of Category 6 UTP unless otherwise specified herein or directed in writing by the Owner.
- coordinate the selection of matched cabling, faceplates, jacks, termination hardware and practices to meet the requirements of the product manufacturer's channel warranty for materials and labor.
- ensure product manufacturers shall be selected based on their ability to provide the telecommunications cabling and termination needs of the entire project.
- ensure specification of three equal manufacturers with competitive and complete cabling and termination product lines. Each specified manufacturer must have a complete complement of indoor and outdoor cabling, faceplates, outlets, and termination hardware to allow a single manufacturer's warranty for materials and labor for the entire installed system for at least twenty (20) years.
- ensure the manufacturer's channel warranty shall be explicitly required within the construction documents and must be listed as a prerequisite Contractor deliverable prior to the Contractor's final retention payment.
- have each data outlet have a 4-port data faceplate with matching color blanks for all unfilled jack positions. Color and materials of the data faceplate and blanks shall match the power faceplate and receptacle. The Architect shall choose power and data faceplate colors.
- ensure all data outlets and cabling shall be dark blue and terminate on matching category rack mount RJ45 patch panels only per applicable standards.

7.3 Typical Classroom Data Outlet Locations

7.3.1 Design Criteria for New Construction Classrooms

The typical new classroom data locations and design philosophies are as follows:

- **Teachers Location:** Owner shall choose and approve the location of the teacher's desk location during the design programming phase. The teacher's desk location shall be supplied with a flush power and data floor box located to the least conspicuous side of the desk location and offset from the expected teachers foot placement. The teacher's desk floor box shall have two (2) duplex power receptacles, one (1) data outlet with three (3) data jacks (data, voice, other), and one (1) A/V. The floor box selection criteria shall be based on the ability to best protect the cable terminations from foot trampling and dirt contamination as well overall durability, outlet accessibility, and pathway inlet capacity.

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

- **Ceiling Projector Location:** The ceiling projector location shall have two (2) duplex receptacles, on the same dedicated 20A/1P circuit, and one (1) data outlet with four (3) data jacks (projector, wireless AP, A/V controller). Leave 10' of neatly coiled, dressed, and supported data cabling in the attic space for future projector relocations.
- **Student Locations:** Students shall use wireless data connectivity exclusively. Student power locations shall be provided via four (4) thoughtfully positioned power only floor boxes allowing all foreseeable student desk locations to be within a 10' radius of an outlet location. The floor box selection criteria shall be based on the ability to best protect power outlets from foot trampling and dirt contamination as well overall durability and outlet accessibility.
- **Front of Classroom:** A single data drop shall be provided, within the backbox or wall opening, centered at the front of the classroom at +96AFF for an IP IEEE 802.3af powered Public Address loudspeaker.

7.3.2 Design Criteria for Remodel Construction Classrooms

The typical remodel classroom data locations and design philosophies are as follows:

- **Teachers Location:** Engineer shall coordinate with Owner to choose a wall nearest an Owner selected teacher desk location during the design programming phase. The teacher's desk location data outlet shall always be fished in hollow wall cavities if possible. Power shall be intercepted and extended from the nearest, or most inconspicuous receptacle location, via color coordinated and modern styled surface raceway. Bring both final power and data outlets adjacent to one another at 18" AFF near the Teacher's desk location. Surface metallic 2-channel floor molding, capacity appropriate and primed and painted to match floor, shall be provided from the wall outlet locations to a surface mount floor box location. Engineer shall ensure that the final floor box location minimizes potential interference with Teacher chair and foot traffic. The Engineer shall devise protection of the power and data wire/cable bend radius and jacket wear at the transition from wall outlets to floor molding. The teacher's desk outlets shall provide two (2) duplex power receptacles, one (1) data outlet with three (3) data jacks (data, voice, other), and one (1) A/V outlet. The surface floor box selection criteria shall be based on the ability to best protect the cable terminations from foot trampling and dirt contamination as well overall durability, outlet accessibility, aesthetics, and pathway inlet capacity.
- **Ceiling Projector Location:** The ceiling projector location shall have two (2) duplex receptacles, on the same dedicated 20A/1P circuit, and one (1) data outlet with four (3) data jacks (projector, wireless AP, A/V controller,). Leave 10' of neatly coiled, dressed, and supported data cabling in the attic space for future projector relocations.
- **Student Locations:** Students shall use wireless data connectivity exclusively and have no floor power locations unless directed by Owner.
- **Front of Classroom:** A single data drop shall be provided, within the backbox or wall opening, centered at the front of the classroom at +96AFF for an IP IEEE 802.3af powered Public Address loudspeaker.

Master Telecommunications Design Standards (MTDS)

Up Valley Support Services JPA

7.3.3 Design Criteria for New Construction Administrative Work Area

The typical remodel classroom data locations and design philosophies are as follows:

- **Administrative Work Area:** Owner shall choose and approve the location of the work area location during the design programming phase. The work area location, if adjacent to an accessible wall, the Engineer shall require one (1) power receptacle and one (1) data outlet with (3) data jacks (data, voice, other). If the work area location is not adjacent to an accessible wall, the Engineer shall require a flush power and data floor box located to the least conspicuous side of the desk location and offset from the expected teacher's foot placement. The teacher's desk floor box shall have two (2) duplex power receptacles, one (1) data outlet with three (3) data jacks (data, voice, other), and one (1) A/V outlet. The floor box selection criteria shall be based on the ability to best protect the cable terminations from foot trampling and dirt contamination as well overall durability, outlet accessibility, and pathway inlet capacity.
- **Public Address Loudspeakers:** All work areas and offices will use their IP phones to receive Public Address notifications. Corridors and areas not adjacent to voice handsets require one (1) data drop in the ceiling for each required IP IEEE 802.3af powered loudspeaker location.
- **Wireless Access Points:** Provide strategically placed ceiling data outlets with one (1) data jack each for wireless access points. Maximum coverage should not exceed 2000 sq. ft. coverage per WAP outlet location.

7.3.4 Design Criteria for Remodel Construction Classrooms

The typical remodel classroom data locations and design philosophies are as follows:

Teachers Location: Engineer shall coordinate with Owner to choose a wall nearest an Owner selected teacher desk location during the design programming phase. The teacher's desk location data outlet shall always be fished in hollow wall cavities if possible. Power shall be intercepted and extended from the nearest, or most inconspicuous receptacle location, via color coordinated and modern styled surface raceway. Bring both final power and data outlets adjacent to one another at 18" AFF