



**NORTH ORANGE COUNTY  
COMMUNITY COLLEGE DISTRICT**

---

***Greatness. Achieved.***

## **CABLING INFRASTRUCTURE STANDARDS**

Guidelines for the Design of  
Telecommunication Infrastructure at  
NOCCCD Facilities

January 27, 2021

---

## Table of Contents

1.	<b>Executive Summary</b> .....	7
2.	<b>Introduction</b> .....	8
2.1	Responsibilities of NOCCCD District IS Department .....	8
2.2	Architect Responsibilities .....	8
2.3	Scope of Work Matrix To Be Included In District Projects .....	9
2.4	Telecommunication Consultant/Designer Role .....	13
2.5	Telecommunication Design Approach .....	13
2.5.1	Rooms, Routes & Risers .....	13
2.5.2	Common Cabling Infrastructure .....	14
2.5.3	Equipment & Systems – Logical Design .....	14
3.	<b>Architectural</b> .....	15
3.1	Campus Information Technology Rooms – Functions .....	15
3.1.1	Main Distribution Frame (MDF) .....	15
3.1.2	Building Telecommunications Room (BDF) .....	15
3.1.3	Telecommunications Rooms (TR) .....	16
3.1.4	Non-Information Technology Systems .....	17
3.2	Information Technology Room Locations .....	17
3.2.1	General .....	17
3.2.2	Telecommunications Rooms (TR) .....	18
3.2.3	Building Telecommunications Rooms (BDF) .....	18
3.3	Information Technology Room Sizing .....	19
3.3.1	General .....	19
3.3.2	Building Telecommunications Room (BDF) .....	19
3.3.3	Telecommunications Rooms (TR) .....	19
3.4	Lighting .....	19
3.5	Water Infiltration .....	20
3.6	Floor .....	20
3.6.1	General Floor Design Elements .....	20
3.6.2	Loading .....	20
3.7	Sprinklers/Fire Suppression .....	21
3.7.1	Sprinklers .....	21

---

3.7.2	Fire Suppression Systems .....	21
3.8	Doors .....	21
3.9	Interior Finishes .....	21
3.9.1	Walls .....	22
3.9.2	Ceilings .....	22
3.9.2.1	Clearance.....	22
3.9.3	Security .....	22
3.10	Information Technology Rooms Construction Sequence .....	22
3.11	Special Design Considerations .....	23
3.11.1	Building Fire Rated Barriers .....	23
3.11.2	Cable Support (General) .....	23
3.11.3	Slab on Grade.....	23
3.12	Work Area Telecommunication Outlet.....	24
3.12.1	General.....	24
3.12.2	Single-Person Office .....	24
3.12.3	Two-Person Office.....	25
3.12.4	Conference Rooms.....	25
3.12.5	Instructional Classrooms.....	25
3.12.6	Cubicle/Partitioned Offices (Modular Furniture) .....	26
3.12.7	Floors .....	26
3.12.8	Wall Mounted Telephones/Payphones/Text Telephones.....	27
3.12.9	Workrooms .....	27
3.12.10	Computer Labs.....	27
3.12.11	Computer Lab – Raised Floor.....	27
3.12.12	Instructional Lab – Slab Floor .....	28
3.12.13	Computer Lab – Student Self-Study .....	28
3.12.14	Specialty Locations .....	29
3.12.15	Maintenance Spaces.....	29
3.12.16	Building Rooftops.....	30
3.12.17	Storage Areas .....	30
3.12.18	Wireless Access Support.....	30
3.12.19	AV Projector Support .....	31

---

---

3.12.20	Security Devices .....	31
3.12.21	Fire/Life/Safety Devices .....	31
3.13	Outside Plant (General).....	31
3.13.1	Campus Environments .....	31
3.13.2	Renovation Projects .....	32
3.14	Construction Documents.....	32
4.	<b>Electrical</b> .....	34
4.1	General Power Requirements .....	34
4.2	Information Technology Room Power Requirements .....	34
4.2.1	General .....	34
4.3	Electromagnetic Interference .....	35
4.4	Generator/UPS .....	35
4.5	Grounding .....	36
4.6	Raised Floor Bonding and Grounding .....	36
4.7	Terminal Board .....	36
4.8	Communication Pathways .....	36
4.9	Fire Stop Penetrations .....	37
4.10	Communication Outlets .....	37
4.10.1	Outlet Location Considerations .....	37
4.11	Floor Boxes .....	38
4.12	Wireless Access Points (WAP).....	38
4.13	AV Projector (AV).....	38
4.14	Communication/Power Raceways .....	39
4.15	Floor Poke-Throughs .....	39
4.16	Building Rooftops.....	39
4.17	Inside Conduits (General) .....	40
4.18	Communications Cable Tray .....	41
4.19	Communications J-Hooks .....	41
4.20	Pull Boxes .....	41
4.21	Underground Conduits.....	42
4.22	Equipment Specifications .....	42

---

---

5.	<b>Mechanical (HVAC)</b> .....	43
5.1	General.....	43
5.2	Thermal Dissipation.....	44
5.3	Coordination with Maintenance and Operations .....	44
6.	<b>Civil (Outside Cable Plant)</b> .....	45
6.1	General.....	45
6.2	Underground Conduits.....	45
6.3	Conduits/Duct Banks .....	46
6.4	Communication Maintenance Hole/Hand Hole Sizes .....	47
6.5	Communication Maintenance Hole/Hand Hole Locations .....	48
7.	<b>Telecommunication</b> .....	49
7.1	Telecommunication Consultant .....	49
7.2	NOCCCD Product Standards.....	50
7.3	Outside Plant.....	50
7.3.1	OSP Design Activities .....	50
7.3.1.1	Outside Plant Fiber Optic Cables.....	50
7.3.2	Tube cabling.....	52
7.3.3	OSP Fiber Optic Cable Sizing .....	52
7.3.4	General Installation Guidelines for Optical Fiber Cables.....	53
7.3.5	Copper Outside Plant Cables .....	54
7.3.6	Copper Protection .....	56
7.4	Riser Segment .....	57
7.4.1	Fiber Optic Riser Cable .....	57
7.4.2	Riser Tube Cable.....	57
7.4.3	Copper Riser Cable .....	57
7.4.4	Coaxial Riser Cable .....	57
7.5	Optical Fiber Terminations .....	57
7.5.1	Fiber Patch Panels.....	57
7.5.2	Optical Fiber Connectors .....	58
7.6	Copper Punch Down Blocks .....	58
7.7	Horizontal Station Cable.....	59

---

---

7.8	Voice/Data Jacks.....	59
7.9	Work Area Outlets .....	60
7.10	Outlet Distribution .....	61
7.11	Faceplates.....	63
7.12	Copper Patch Panels .....	64
7.13	Grounding and Bonding.....	64
7.14	Rack/Cabinet Layout (Elevation) .....	65
7.15	Floor Mounted Racks.....	66
7.16	Wall Mounted Racks.....	67
7.17	Floor Mounted Cabinets .....	68
7.18	Cable Wire Management .....	69
7.19	Cable Runway .....	69
7.20	Cable Pathways .....	70
7.21	Cable Installation Methods .....	70
7.22	Fiber Optic Cable Testing and Test Results .....	71
7.23	Backbone Copper Cable Testing and Test Results .....	72
7.24	UTP Horizontal Cable Testing and Test Results .....	72
7.25	Cable Testing Validation .....	73
7.26	Identification and Labeling.....	73
7.27	Inspection.....	77
8.	<b>Wireless Design and Implementation Guidelines .....</b>	<b>78</b>
8.1	Introduction.....	78
8.2	Aruba ClearPass Compatibility.....	78
8.3	Indoor Wireless Requirements & Service Goals/Targets .....	78
8.4	Outdoor Wireless Requirements & Service Goals/Targets .....	78
8.5	Original Deployment Design Guidelines/Short Cuts.....	79
9.	<b>References, Standards and Codes .....</b>	<b>80</b>
10.	<b>Sample Specifications .....</b>	<b>82</b>

## 1. EXECUTIVE SUMMARY

The intent of this document is to provide the Architect, Electrical Engineer, HVAC Consultant, Civil Consultant and Telecommunication Consultant with the basic requirements and standards for network cabling infrastructure in a new or remodeled facility at the Anaheim, Cypress and Fullerton campuses or any other North Orange County Community College District (NOCCCD) site. It is the expectation of NOCCCD that the information provided in this standard shall be incorporated into the Schematic Design, Design Development and Construction Documents phases for every project. NOCCCD expects any design effort to be an iterative process in which the design team will include campus Academic Computing Technologies (ACT) and District Information Services (IS) staff in review and discussion during the various phases of the design process. Any deviation from these standards must be approved by NOCCCD IT and Facilities staff, with final sign off by NOCCCD Vice Chancellor of Finance and Facilities in writing prior to design.

This document was prepared in collaboration with District IS and campus ACT departments at Cypress College, Fullerton College and North Orange Continuing Education, heretofore referred to as the District IT Group. The duties of this group are to ensure that all the services that the District IT Group manages is well designed. All aspects of the design, construction, and acceptance of the network infrastructure on all campuses must include representation from the District IT Group. The District IT Group is responsible to ensure that representation from both local campus and District IS teams are included throughout the project. Network operations are predominantly supported by the local campus IT teams however networks are designed as a unified system across NOCCCD.

Standardization of materials, installation, labeling, and documentation will ensure that all cabling installation projects have a consistent functionality and operation. This will enable the District IT Group to effectively understand, operate and support the cabling infrastructure and network services traversing that infrastructure.

The objective is to design using standards and materials that will provide the greatest longevity and function for current and future use. Standardization of components, installation methods and labeling will ensure that all cabling installation projects have a consistent functionality and operation. This will enable NOCCCD staff to effectively understand, operate and support the cabling infrastructure and network services traversing that infrastructure.

## 2. INTRODUCTION

### 2.1 RESPONSIBILITIES OF NOCCCD DISTRICT IS DEPARTMENT

The District IT Group department is responsible for provisioning and operating a robust Information Technology Infrastructure. It is expected that the infrastructure will support the connectivity needs for voice, data, video and multimedia communication, and capacity available for current and future applications such as Intelligent Building Management System (BMS), Security, Surveillance, Fire Alarm, etc. District IT Group has responsibility for the transport of all computer network traffic on NOCCCD campuses/sites.

The District IT Group will actively participate in the design process. This includes attending architectural and engineering meetings that will in any way affect the provisioning of any and all information or telecommunication systems during the course of the project.

District IS retains the right to review and approve all construction documents pertaining to or affecting Information Technology Infrastructure systems. District IS also retains the right to be the final reviewer and approval authority for all construction submittals and project acceptance of Information Technology Infrastructure systems. This includes pathways, cabling, quality of workmanship and acceptance testing of any or all cable plant installed, and any other aspect of a construction/renovation project that could affect Information Technology Infrastructure systems. It is the expectation of the District IT Group that the information provided in this document shall be used as the basis of the design of the cabling infrastructure and shall be included in the drawings and specifications for the project.

### 2.2 ARCHITECT RESPONSIBILITIES

When a new building or building renovation is planned, the Architect will ensure that District IT Group representatives are involved in the entire design process, including review of all drawings during the design phases as follows:

<b>Design Phase</b>	<b>Telecommunication Infrastructure Considerations</b>
<b>Schematic Design</b> – These are the initial planning documents and design drawings which assist departments in the early stage of the project.	Building dimensions as related to placement of Information Technology Rooms, cabling distances and riser pathways.  <i>Schematic design submittal.</i>
<b>Design Development</b> – As the architectural design process progresses, overlays are developed to show the various structures and systems planned for the building.	Per-room outlet placement requirements, horizontal cable pathways.  <i>30% and 50% submittal, including project specifications.</i>
<b>Review Set</b> – These documents depict the final design before bid submittal is undertaken.	Detailed drawings and specifications for all outlets, pathways and Information Technology Room designs; cabling terminations, workmanship and testing.



	<i>90% submittal.</i>
<b>Working Copy/Construction Documents</b> – This is the Bid Copy.	<i>100% submittal.</i>
<b>“Record Document” Drawings</b> – These drawings and documents represent the project as it is final-constructed (“as-built”) and are deliverable prior to final inspection of the project.	Actual cabling as constructed, drawings with cable numbers/labels, test results.  <i>Closeout documents.</i>

**2.3 SCOPE OF WORK MATRIX TO BE INCLUDED IN DISTRICT PROJECTS**

For each project, a Scope of Work Matrix is to be created by the construction manager and updated by District IT Group. It identifies the five areas of telecommunication construction for each project: Telephone, Computer Network, Broadband Television, Security Surveillance, and Security Access systems. It also defines any specific tasks to be completed and who is responsible for completing each task, the District or the Contractor. This document is not intended for publication in project prints or bid documents. It is, however, intended to clearly define for the design team the Contractor’s role and responsibilities for the Telecommunication portion of any given project.

<b>Item / or Material</b>	<b>District Purchased</b>	<b>District Installed</b>	<b>Contractor Purchased</b>	<b>Contractor Installed</b>	<b>Note</b>
Determine the telephone system type for this project (VoIP or Standard)					1
<b>Telephone System (select one: VoIP   Standard)</b>					
Site conduits and boxes (If VoIP, coordinate with site)			X	X	
Interior raceways and boxes (If VoIP, coordinate with site)			X	X	
Copper cables (If VoIP, coordinate with site)			X	X	
Termination boxes and terminals (If VoIP, coordinate with site)			X	X	
Modular jacks and plates (If VoIP, coordinate with site)			X	X	
Cable testing and reports (If VoIP, coordinate with site)			X	X	
Telephones	X	X			
Telephone cords	X	X			
Programming	X	X			

Item / or Material	District Purchased	District Installed	Contractor Purchased	Contractor Installed	Note
Account setup, voicemails, etc.	X	X			
Final As-built drawings and documentation			X	X	
<b>Computer Network Wiring</b>					
Site conduits and boxes			X	X	
Interior raceways, cable trays and boxes			X	X	
Fiber optic cable tube cells			X	X	
Fiber optic cables			X	X	
Copper backbone cables			X	X	
Copper station cables			X	X	
Fiber patch panels			X	X	
Category 6A patch panels			X	X	
Jacks and faceplates			X	X	
Patch cords	X	X			
BDF/IDF (racks, backboards, A/C, wiring, etc.) Per specifications.			X	X	
Cable testing and reports (both copper & fiber)			X	X	
Active electronics, including network switches	X	X			
Programming and network implementation	X	X			
Final "As-built" drawings and documentation			X	X	
<b>Broadband Television System</b>					
Site conduits and boxes			X	X	
Interior raceways, cable trays and boxes			X	X	
Fiber optic cable tube cells			X	X	
Single mode fiber optic cables			X	X	
Coax cables			X	X	
Splitters, directional couplers at new building			X	X	
Line extender amplifier at new building			X	X	
Fiber optic transceivers, terminations			X	X	

Item / or Material	District Purchased	District Installed	Contractor Purchased	Contractor Installed	Note
Connection to head-end				X	5
Testing and reports			X	X	
Final As-built drawings and documentation			X	X	
<b>CCTV Surveillance System</b>					
Site conduits and boxes			X	X	
Interior raceways, cable trays and boxes			X	X	
Fiber optic cable tube cells			X	X	
Fiber optic cables from new building to MDF			X	X	
Category 6A cables w/PoE for new building			X	X	
Power testing and reports			X	X	
Cable testing and reports (both copper & fiber)				X	
Camera low voltage power supplies	X	X			
Head-end recorders, switchers, monitors & controls	X	X			
Cameras	X	X			
Camera brackets	X	X			
Final As-built drawings and documentation			X	X	
<b>Security &amp; Access</b>					
Site conduits and boxes			X	X	
Interior raceways, cable trays and boxes			X	X	
Fiber optic cable tube cells			X	X	
Fiber optic cables			X	X	
New building interior wiring (Category 6A, AWG) per specifications.	X	X			6
<b>Schedule interior building wiring</b>					
Cable testing and reports (both copper & fiber)			X	X	
Head-end equipment and software at MDF/BDF	X	X			
Electric door hardware			X	X	2,3,4

Item / or Material	District Purchased	District Installed	Contractor Purchased	Contractor Installed	Note
Card readers	X	X			3,4
Door switches	X	X			3,4
BDF/IDF electronic control enclosures/logic boards	X	X			
Connection to head-end, programming, implementation	X	X			
Final As-built drawings and documentation			X	X	

- Note 1 The Architect and Engineers shall design the telephone system to meet the specifications/requirements as defined in the District Telecommunication Infrastructure Technical Standards for that type; see section 1.02 for clarification of cabling needs. VoIP telephones will use the data cabling system and thus will not require separate horizontal telephone cables and outlets. All telephone system jacks should be red and labeled appropriately. All data cables should be blue and labeled appropriately.
- Note 2 Will initially be key-operated until access control head-end connectivity has been completed.
- Note 3 Will not be operational until head-end is connected.
- Note 4 Hardware type, location and installation to be coordinated with the campus/security vendor. The contractor MUST work with the campus/security vendor PRIOR to installation to procure input to ensure that the installed system will work as expected.
- Note 5 The video contractor must work with District IT Group in establishing connections to the existing campus backbone cable system. A District IT Group representative must be present when the contractor makes the connection to the head-end.
- Note 6 These items must be coordinated with the Security Contractor by the campus.

The Architect shall be the focal point for coordinating the various engineering consultants during the design process. In order to provide an effective architectural design, the Architect needs to understand what the specific requirements are to support current and future telecommunication connectivity and services. The Architect shall engage the District IT Group in design meetings and coordination sessions beginning with the design phase to help define IT requirements in each location. The District IT Group is eager to assist in providing a detailed list of requirements that will aid in programming the required connectivity and telecommunication spaces.

It is the expectation of the District IT Group that the Architect will supply background drawings to the various members of the design team. It is very important for the proper design of the Information Technology Infrastructure that the drawings for the Electrical and Telecommunication Consultants contain furniture information. This will be needed by the Electrical and Telecommunication design team members to correctly locate power and telecommunication outlets.

The Architect shall ensure that, wherever Design Engineers or Consultants for other disciplines require a separate wiring infrastructure to support their systems, those consultants coordinate their design and infrastructure requirements and efforts with the District IT Group. This includes but is not limited to

design parameters such as cable type, cable color, use of supplemental or common pathways and support systems. For any Design Engineers or Consultants that require any communication connection of any sort from the building to any other place on or off the campus, the Architect will ensure that these Engineers/Consultants request and coordinate with the District IT Group for this connectivity. No other system cable(s) that is included in the building will be allowed to use pathway(s) under the District IT Group control without prior approval.

The Architect shall coordinate with the Design Engineers or Consultants for the support of any required video and audio visual (AV) systems. Of particular concern is that installation of the Video and AV systems do not conflict with installation or potential installation of Information Technology Infrastructure. There are to be no local switches that connect to the network. A local switch for a Dante audio or HDMI over IP per room is ok, but the local network may not connect to the campus network. This document does not include a standard for AV cabling and only references AV installations as they may interfere with or affect the voice/data infrastructure.

All video systems shall be designed with the participation of District IT Group.

As full participants in the design process, comments and requests submitted by the District IT Group must be incorporated into the reviewed documents in full for the next review of documents, or an explanation must be provided to the District IT Group, regarding the status of comments and requests. The District IT Group will postpone further reviews until all comments and requests have been addressed or incorporated into current documents and drawings.

## **2.4 TELECOMMUNICATION CONSULTANT/DESIGNER ROLE**

At its option, is the District IT Group may either contract with a Telecommunication Consultant to perform its own communication design or request the Architect to retain the services of a Telecommunication Consultant. Regardless of the approach taken by the District IT Group, the Architect is expected to ensure that communication design input from a qualified Telecommunication Consultant is part of each phase of the design process. The Architect shall incorporate all comments from the Telecommunication Consultant into the various design document packages.

## **2.5 TELECOMMUNICATION DESIGN APPROACH**

In designing a telecommunications system for a building that will not be brought online for a significant amount of time, the best approach to future-proofing the system requires a forward-looking view at the cabling and pathway requirements. Typically, the telecommunications system design can be divided into the following three parts:

### **2.5.1 Rooms, Routes & Risers**

Proper planning for rooms, routes and risers is critical to the successful design of any Information Technology (IT) infrastructure system. Appropriately sized equipment rooms and cabling pathways must be provided in the building. Sufficient capacity must be provided not only to house current IT systems but also to allow for addition of cabling and equipment in the future. Selection of the location of each telecommunication room is critical to ensure that each room is supported by appropriate environmental systems. It is possible to estimate equipment room locations and sizes at

an early stage in the project based on experience in telecommunications system design and national standards. This enables design of the building to progress while ensuring that it will be capable of supporting the wide range of communications systems and technologies currently required to conduct business of the District/College.

Adequate cable pathways are critical for ensuring that current and future cabling needs can be supported. Care must be taken to integrate cable pathways (risers, cable trays and conduits) into the building fabric. Based on ANSI/TIA-569-E, *Telecommunications Pathways and Spaces*, these design guidelines ensure basic telecommunication design requirements are provided to the building design team as early as possible for the programming and schematic phases.

### **2.5.2 Common Cabling Infrastructure**

Selection of the communications cabling system and media is performed towards the end of the design phase to ensure the incorporation of the most recent product changes. Based on ANSI/TIA-568.1-E, *Commercial Building Telecommunications Cabling*, NOCCCD has standardized on **CommScope SYSTIMAX** Category 6A unshielded twisted pair (UTP) and shielded twisted pair (STP) copper for voice and data station cabling and **Sumitomo Future Flex Air Blown** laser-optimized multimode and single mode fiber for backbone interconnection. Refer to Section 4.3 for descriptions of when to use STP cable in lieu of UTP cable.

Proper distribution of this cabling throughout the building and campus is assured by ensuring the cabling pathways are designed to support the required quantities and types of cabling (including additional future expansion) that will be installed. The cabling pathways must also be compatible with the stringent installation requirements, such as those required for optical fiber cables.

### **2.5.3 Equipment & Systems – Logical Design**

Design and procurement of Information Technology equipment will always be performed outside of the construction phase. This includes network switches and routers, desktop systems, telephones and other equipment. Although costs for this equipment may be funded as part of the overall project budget, the equipment and associated installation costs will be procured separately and will not be included in any specification or bid package particular to a specific building construction project. Architect and Engineering teams are required to consider space, power and cooling requirements particular to the equipment that will be housed in the communications rooms.

### **3. ARCHITECTURAL**

When an architect is designing a building, many technology infrastructure issues must be addressed. The following information is provided to the architect so he/she is able to understand what is needed and how it should be incorporated in the final design. The architect shall be responsible to meet all ADA requirements.

#### **3.1 CAMPUS INFORMATION TECHNOLOGY ROOMS – FUNCTIONS**

Information Technology Rooms (ITRs) provide an operating environment for telecommunications and/or computer equipment. Each type of technology deployed in a building or on a campus has specific functions and may have its own individual room within a facility. However, depending on the building size and design, one or more of these functions may be combined into one room.

##### **3.1.1 Main Distribution Frame (MDF)**

The Main Distribution Frame (MDF) is the central connection point between the campus and the Local Exchange Carrier (LEC), Competitive Local Exchange Carriers (CLEC) or Internet Service Provider (ISP). This room or space is considered by the carriers as the Minimum Point of Entry (MPOE) and demarcation point for communication services delivered to the campus from external service providers. The Main Distribution Frame (MDF) may also be referred to as Network Operations Center (NOC).

The MDF houses network interface devices, telecommunications data networking and computer equipment and phone line noise suppressors. Voice and voicemail systems may also be housed in the MDF. In some instances, the MDF may be a stand-alone building that may include the data center and is sized according to equipment and number of cable terminations required.

Communication services are extended from the MDF location to campus facilities by Customer-Owned Outside Plant (CO-OSP) backbone cabling. An outside plant pathway infrastructure system is provided to all campus buildings. Underground infrastructure (conduits, maintenance holes and/or handholes) provides out-of-sight service to a building. Buried entrances (trenched or plowed) are a means of providing out-of-sight service without conduit. The underground conduit method is the required method to service buildings on the NOCCCD sites – direct-buried methods are not acceptable. The number of conduits to be installed to a building will depend on the building size, function and telecommunications services to be provided to the building.

##### **3.1.2 Building Telecommunications Room (BDF)**

The Building Telecommunications Room provides an operating environment for communications and/or network equipment at the main point of campus backbone connectivity to each building. It is generally considered a building-serving facility. A BDF may also be referred to as a Building Distribution Facility (BDF).

BDFs are laid out and built according to stringent requirements because of the nature, cost, size and complexity of the equipment involved. These rooms typically house:

- Racks or cabinets to house equipment and cable ladder system to support cable and connections to various pieces of equipment with supporting grounding infrastructure and electrical outlets.
- LAN equipment, such as routers, switches or fiber optic interface equipment for interbuilding and/or intrabuilding communications.
- Voice cross-connects.
- Cable TV (CATV), CCTV cabling and equipment.
- Generator/UPS system. Access to backup generator power may be needed.
- Independent cooling system.
- Access control door controllers

Given the rapid development of new products in the Information Technology area, BDFs must be designed to accommodate both current and future system requirements.

The BDF houses the conversion point from outside plant cable to inside rated cable, provides the install location for building entrance protectors for all copper cables and serves as the bonding point for all metallic cables or cable components. An outside plant pathway infrastructure system (conduit field) shall be provided to the nearest campus connection point (maintenance hole).

BDFs shall house equipment directly related to the Information Technology systems and their environmental support systems. Typically, other Fire/Life/Safety systems such as access control, security, building management systems, etc., are housed in the same room. A detailed layout for each Building Information Technology Room is required as part of the overall design/project drawing set and must include all systems proposed to be housed within each room.

### **3.1.3 Telecommunications Rooms (TR)**

A minimum of one Telecommunications Room (TR) or Intermediate Distribution Facility (IDF) is located in each building and houses telecommunications equipment, cable terminations and cross-connect wiring. TRs differ from BDFs in that they are generally considered to be floor-serving (as opposed to building-serving) facilities that provide a connection point between backbone and horizontal distribution pathways. TRs provide a safe, environmentally suitable area for installing:

- Cabling.
- Termination fields.
- Premises electronic equipment.
- Related support structures.

The quantity and location of the TRs depends on:

- Size of the building: Typically, one TR is required for every 10,000 square feet of usable floor space.



- Number of floors: A minimum of one TR is required for each floor.
- The shape of the building and its impact on the length of communication cables: Depending on the dimensions and cabling distances required in a particular building, a floor may house multiple TRs, each serving a portion of the floor/building, based on a maximum permissible cable length of 90 meters from wall outlet to TR termination point. If the Telecommunication Consultant's design includes one or more cable runs that will be longer than 90 meters, the Consultant will need to work with the District IT Group to identify whether a variance can be issued or if an additional IDF will need to be created.

### **3.1.4 Non-Information Technology Systems**

The Architect is reminded to increase Information Technology Room dimensions as needed to support such non-information technology systems such as AV equipment, Building Management Systems (BMS), fire alarm panels, public address systems and security equipment. Careful consideration is to be taken in the placement of these auxiliary systems so as to NOT impede or hinder access and maintenance to any or all systems and avoid code violations.

## **3.2 INFORMATION TECHNOLOGY ROOM LOCATIONS**

### **3.2.1 General**

There are a number of factors to be considered when placing Information Technology Rooms within a new or renovated facility. Site selection factors for the various rooms are addressed below. Of these factors, the two most important are "stacking" of the rooms and providing a way to expand the rooms, should that become necessary in the future.

- Information Technology Rooms shall not be located in any place that may be subject to water or steam infiltration, humidity from nearby water or steam, heat, and any other corrosive atmospheric or environmental conditions.
- Information Technology Rooms shall not be located near electrical power supply transformers, elevator or pump motors, generators, x-ray equipment, radio transmitters, radar transmitters, induction heating devices or other potential sources of electromagnetic interference (EMI).
- Information Technology Rooms shall not share space in electrical closets, boiler rooms, washrooms, janitorial closets and storage rooms, nor shall they contain hatches that lead to other spaces.
- Information Technology Rooms shall not be situated in a building in such a way that the walls of the Information Technology Room are not on the building structural support systems. Such placement interferes with installation of the cable riser backbone system.
- Information Technology Rooms shall not be located near sources of mechanical vibration that could be conveyed to the room and the sensitive network equipment contained therein via the building structure.

- Information Technology Rooms shall not be located below grade unless preventive measures against water infiltration are employed. The room shall be free of water or drainpipes not directly required in support of the equipment within the room. If it becomes necessary to locate an Information Technology Room where threat of water ingress exists, design rack elevations so that active equipment and telecommunications components are as high off the floor as possible and provide a floor drain within the room. A water/leak sensor shall also be provided in the room that will notify District IT in the event of water ingress into the room.
- Information Technology Rooms shall be vertically aligned in multistory buildings.

Acoustic noise levels in Information Technology Rooms must be minimized by locating noise-generating equipment outside the Information Technology Rooms. Likewise, the walls of Information Technology Rooms must be of sufficient construction to insulate adjacent offices from noise made by the network equipment.

### **3.2.2 Telecommunications Rooms (TR)**

In addition to the general requirements for Information Technology Rooms, the TR shall be:

- Dedicated to the IT function and related support facilities. No other systems can be housed within the TR without the written approval of the District IT Group.
- A single function room and not be shared with electrical installations or other equipment or building services other than those required in direct support of Technology equipment or services without the written approval of the District IT Group.
- Located as close as practical to the center of the area being served and preferably in the core area. However, the location shall be such that the room can be expanded in the future.
- "Stacked" in multistory buildings (i.e., constructed so that each TR is placed directly above the TR on the floor below).
- Directly accessible from hallways, not through offices, classroom or mechanical spaces. Located such that the average horizontal cable run is 150 feet or less and that no individual cable run exceeds 90 meters.

### **3.2.3 Building Telecommunications Rooms (BDF)**

In addition to the general requirements for Information Technology Rooms, placement of Building Telecommunications Rooms shall:

- Avoid locations that limit expansion, such as structural steel, stairwells, and elevator shafts, outside walls or other fixed building walls.
- Have easy access to distribution cable pathways.
- Be easily accessible for the delivery of large equipment.
- Minimize the size and length of the backbone and horizontal distribution cables.

- Be located so that building entrance cables will not be exposed for a cable length distance of more than 50 feet from the point of building entrance per the California Electrical Code, Articles 770-50 and 800-50.2. If this is not possible, the entrance cable shall be routed to the termination field without breaks using rigid or intermediate rigid conduits within the requirements of a pull box every cumulative 180-degrees of bend and a maximum of 50 feet of cable length from the first pull box, EMT shall not be used in lieu of rigid or intermediate conduit.

### **3.3 INFORMATION TECHNOLOGY ROOM SIZING**

#### **3.3.1 General**

The sizes of Information Technology Rooms described in this document are minimum requirements. Additional space may be required in any given Information Technology Room depending on the requirements, the proposed auxiliary systems sharing the space and/or the services performed by the occupants.

#### **3.3.2 Building Telecommunications Room (BDF)**

During the early phase of the building design, it is best to assume the minimum BDF size to be 12 feet long by 10 feet wide by 10 feet high (interior dimensions).

Building Telecommunications Rooms will house building entrance frames with electrical protectors, service racks or cabinets. For early planning purposes, assume at least three racks or cabinets will be required in any size building. Individual and/or rows of equipment racks/cabinets require a minimum three-foot clearance on all sides. Certain apparatus will be wall-mounted and will project a distance of 12 inches to 24 inches from the wall.

In larger size buildings, additional rows of equipment racks or cabinets may be required. If the new building is more than five stories, the District IT Group will provide specific direction on the size of the Building Telecommunications Room (BDF).

#### **3.3.3 Telecommunications Rooms (TR)**

There shall be a minimum of one (1) Telecommunications Room (TR) per floor. Additional TRs (one for each area up to 10,000 sq. ft.) should be provided when:

- The floor area to be served exceeds 10,000 sq. ft.
- The horizontal distribution distance from the first TR to the workstation exceeds 90 meters.

For planning purposes, the minimum size of each TR shall be 10 feet wide by 8 feet long by 10 feet high (interior dimensions). In small buildings, the BDF and the TR functions may be combined into a single space.

### **3.4 LIGHTING**

It is important that proper work lighting be provided in all Information Technology Rooms. Lighting shall:

- Provide a minimum of 50 foot-candles measured 3 feet above the finished floor (AFF) in the middle of all aisles between racks or cabinets.
- Be controlled by one or more switches located near the entrance door(s) to the Information Technology Room.
- Not be powered from the same electrical distribution panel as the telecommunications or network equipment in the Information Technology Room.
- Not be connected to any timing devices.
- Dimmer switches shall not be used in the Information Technology Rooms
- Have emergency lighting and signs placed within the Information Technology Rooms where an absence of light would otherwise hamper an emergency exit.
- Lighting fixtures shall be located a minimum of 8 feet 6 inches AFF.
- Be placed so the axis of the fixture is 90-degrees relative to the rack or cabinets layouts. If the Information Technology Room is to have a Main Cross-Connect field mounted on a wall, then wall-mounted fixtures will be required to provide light while a technician is working at the field so he/she will not be working in a shadow.

### **3.5 WATER INFILTRATION**

As previously stated, Information Technology Rooms shall not be located below water level. Information Technology Rooms shall be free of water or drainpipes not directly required in support of equipment located within MDFs, BDFs and TRs.

### **3.6 FLOOR**

#### **3.6.1 General Floor Design Elements**

Floors in all Information Technology Rooms shall be covered with an asphalt tile, or like type tile. The flooring material shall have anti-static properties.

The only exception shall be if an access raised floor system is installed. If a raised floor system is used, then the space will have to comply with the requirements of Article 645 *Information Technology Equipment of the California Electrical Code* and NFPA 75 *Standard for the Protection of Electronic Computer/Data Processing Equipment*.

#### **3.6.2 Loading**

Floor loading capacity in the Information Technology Rooms shall be sufficient to bear both the distributed and concentrated load of the installed equipment. Distributed loading capacity shall be at least 250 lb. per square foot; concentrated loading capacity shall be at least 1,000 lbs. over the area of greatest stress. Architects and Engineers must refer to and use the most current BICSI standards.

### **3.7 SPRINKLERS/FIRE SUPPRESSION**

#### **3.7.1 Sprinklers**

If a fire sprinkler system is required within the Information Technology Room, the following details shall be applied to the design.

- The heads shall be provided with wire cages to prevent accidental damage or operation.
- If possible, the sprinkler system in Information Technology Rooms should be a pre-action system.

#### **3.7.2 Fire Suppression Systems**

A Halon substitute system such as FM200 or equal is highly recommended in lieu of sprinkler systems. If a fire suppression system is being considered, then abort and reset switches will be placed near each other near an exit and have protective covers to prevent accidental activation.

A fire alarm system should be provided in all Information Technology Rooms in accordance with all applicable codes.

Portable fire extinguishers with appropriate ratings shall be available in all Information Technology Rooms.

If an access raised floor system is to be installed in any Information Technology Room and a fire detection system is required under the floor, the system shall be a cross-zone detection system. In addition, placement of the detector may affect how cables are routed under the raised floor. If ionization detectors are installed, there is a potential problem with the accumulation of dust under the floor. It is possible during the performance of cable work under the floor that dust could set off the detectors. Provisions shall be made in the fire detection system design to reduce the possibility of false alarms and activation of a fire suppression system, such as but not limited to temporarily disarming the system.

### **3.8 DOORS**

All single doors to any Information Technology Rooms shall be a minimum of 3 feet 6 inches wide, 80 inches high (without doorsill) and shall be fitted with a lock. Space permitting, doors will swing completely open towards the corridor to avoid restricting usable space in the room; exceptions shall be noted in the building plans.

If it is anticipated that large equipment will be delivered to the Information Technology Room, a double door 72 inches wide by 90 inches high (without doorsill) with center post is required (center post shall be removable). The door shall have a gasket to prevent dust from entering the room.

Doors shall have the same fire rating as the room for which they are installed.

### **3.9 INTERIOR FINISHES**

Floors, walls, and ceilings shall be sealed to reduce dust. Finishes shall be light in color to enhance room lighting.

### 3.9.1 Walls

All walls shall have backing to support the plywood telecommunication backboard and wall mounted equipment. The walls shall be capable of support up to 200 lbs. per linear foot of wall space.

Unless otherwise noted, walls will be covered with rigidly fixed ¾" void free, fire-rated AC-grade plywood. The visible side of the plywood shall be painted with two coats of white or other light-colored paint. At least one (1) fire-rated stamp must be visible per sheet or partial sheet of plywood when painting is completed. Plywood shall be installed from 8 inches AFF to 8 feet 8 inches AFF.

### 3.9.2 Ceilings

A drop ceiling shall not be installed in any Information Technology Room.

#### 3.9.2.1 Clearance

The minimum clearance height in the room shall be 10 feet without obstructions.

Provide the following clearances for equipment and cross-connect fields in Information Technology Rooms:

- Allow a minimum of 3 feet of clear working space in front of equipment and cross-connect fields.
- Allow for 12-inch depth off wall for wall-mounted equipment.
- Provide aisles at least 36 inches wide.
- In corners, a minimum side clearance of 12 inches is recommended.

In many cases, equipment and connecting hardware may extend beyond racks and backboards. It is important to note that the clearance is measured from the outermost surface of these devices rather than from the mounting surface of the rack or backboard. As a minimum for relay racks, clearance shall be measured beginning at the base of the foot flange. For self-standing equipment cabinets, clearance shall be measured from the outer doors of the cabinets.

*Note: Equipment cabinets can be 30" to 36" deep, depending on the purpose.*

### 3.9.3 Security

Doors entering into Information Technology Rooms shall have individual locks and may, at the discretion of the District IT Group, be controlled by a card key-based electronic access control system. All keyed locks at any given site must be keyed to match all other existing Information Technology Rooms on the campus/site.

## 3.10 INFORMATION TECHNOLOGY ROOMS CONSTRUCTION SEQUENCE

Before the installation of any cables or telecommunication equipment can commence, all Information Technology Rooms must be completed. In most cases, this means that Information Technology Rooms will have a construction priority and may have to be constructed out of normal construction sequence.

At a minimum, “completed” means all electrical, interior finishes, lighting, air conditioning and lockable doors have been provided and installed.

### **3.11 SPECIAL DESIGN CONSIDERATIONS**

#### **3.11.1 Building Fire Rated Barriers**

Information Technology Rooms shall be constructed with fire-rated walls and ceilings. All penetrations shall be fire-stopped with STI Inc. EZ Path or approved equal type devices to retain the “F” and “T” rating of the room.

#### **3.11.2 Cable Support (General)**

The main routing and support systems to use for communication cables are:

- Cable tray system
- J-Hooks
- Conduit home runs

In main corridors and cable paths, use of a cable tray system is the preferred method. A minimum of 12 inches of clearance is needed above the cable tray and 12 inches to 18 inches on at least one side.

For distribution from the main cable path to discrete outlet locations, J-Hook suspension is acceptable. J-Hooks shall be made part of the work of the cable installation contractor. The use of tray or J-Hooks will require close coordination with Mechanical, Electrical, and Plumbing in the design and installation of the MEP systems.

The use of conduit home runs from work area outlets to Telecommunications Rooms is the least preferred method of providing cable support.

#### **3.11.3 Slab on Grade**

If a slab on grade approach is taken for the first floor of new construction, special attention must be given to potential telecommunication outlets that may be installed in the floor. If possible, the use of telecommunication outlets in the floors shall be avoided. When this is not possible, the District IT Group shall be contacted to determine alternatives.

Outlets in the floor must be installed to meet the following minimum requirements:

- At no time shall the conduit run below the membrane barrier or be in the soil.
- Supporting conduits shall run in the slab and shall be PVC Schedule 40 or better.
- Supporting conduits shall be sized for 20% fill to allow for additional cabling.
- Conduits feeding floor-boxes will be dedicated runs and shall not be chained through multiple floor boxes. Conduits will stub up to the closest wall.
- Floor boxes will be of solid construction to support the anticipated weight and travel.

- Floor boxes will have lids that can be screwed down to hinder unauthorized access.
- Floor boxes shall be coordinated with furniture design locations.
- Floor boxes may support a combination of data and electrical outlets. If so, the design of the floor box must be such that all data and electrical ports can be connected with patch cables without causing any obstructions that would limit the use of any jacks/plugs.

### **3.12 WORK AREA TELECOMMUNICATION OUTLET**

#### **3.12.1 General**

Telecommunication outlets shall be provisioned with double gang back-boxes and faceplates. Each telecommunication outlet shall have one (1) 1-1/4 inch trade size conduit that extends from the back box to the accessible ceiling space. Telecommunication outlets shall not be daisy chained.

Telecommunication outlet locations shall be coordinated with the furniture layout. In offices and conference rooms, typical outlet placement is +18 inches above the finished floor (AFF) and within three feet of a general-purpose single-gang electrical outlet. This may be altered based on the proposed furniture design. Desks that have modesty panels placed against the wall will obstruct access to the electrical and telecommunication outlets; as such, outlets should be located to the right or left of the desk location or at +6" above the desk surface.

In rooms with built-in counters, work surfaces and cupboards, telecommunication outlets shall be placed at +6 inches above counter/surface height and coordinated with placement of the electrical outlets.

In office spaces with built-in work surfaces, computers can be tower or floor standing. Telecommunication and electrical outlets may still be located at +18 inches AFF so as to preserve a clean wall surface. However, this will require the Architect to arrange for the drilling of routing holes in the work surface (installed with grommets) to facilitate the clean routing of patch cords and electrical cables. The grommet will be:

- a minimum of two inches in diameter.
- made of plastic or rubber.
- oval or circular in shape.
- fitted to the hole drilled in the work surface with a replaceable cover that will hold the cabling snug after routing.

Outlets will not be placed such that they are located inside of cupboards and cabinets unless this specific purpose is desired (such as for a concealed fax machine, printer, TV or computer).

#### **3.12.2 Single-Person Office**

A single-person office shall have a minimum of two (2) telecommunication outlets installed, with each outlet installed on opposing or adjacent walls. Outlets should be located to maximize the flexibility of furniture placement and outlet placement shall be coordinated with all furniture plans. In



fixed configuration offices or if built-in furniture is to be constructed, it is preferred that electrical and data outlets be located at +6” above the height of the desk surface or +36 inches AFF. If the office is large enough to support a visitor/conference table, an additional telecommunication outlet shall be installed, typically at +18 inches AFF. Height of electrical outlets shall be consistent with data outlet height.

### **3.12.3 Two-Person Office**

A two-person office shall have a minimum of four (4) telecommunication outlets installed, with each outlet installed on opposing or adjacent walls. Outlets should be located to maximize the flexibility of furniture placement and outlet placement shall be coordinated with all furniture plans. In fixed configuration offices or if built-in furniture is to be constructed, it is preferred that electrical and data outlets be located at +6” above the height of the desk surface or +36 inches AFF. If the office is large enough to support a visitor/conference table, an additional telecommunication outlet shall be installed, typically at +18 inches AFF. Height of electrical outlets shall be consistent with data outlet height.

### **3.12.4 Conference Rooms**

Conference rooms require one (1) telecommunication outlet for every 10 feet of wall space on three sides of the room; an electrical outlet shall be placed at same height and location of each telecommunication outlet. The wall that is considered to be the “front” of the room shall have one (1) telecommunication and one (1) power outlet where the whiteboard is located. In addition, provisions shall be made to have a power and telecommunication outlet flush-mounted to the ceiling for possible use by a projector or wireless access point.

### **3.12.5 Instructional Classrooms**

Instructional classrooms that have a specific teaching wall orientation will be provided with a one (1) telecommunication outlet every 10 feet on each of the three non-teaching walls; one (1) electrical outlet shall be placed at the same height and location. On the teaching wall, a telecommunication outlet shall be located under or in close proximity to the classic or electronic whiteboard. If an instructor’s podium is provided, an electrical and telecommunications outlet will be required. Telecommunication outlets shall be provided flush to the ceiling to support wireless access points and video projectors; electrical outlets shall be provided for video projectors but not wireless access points. AV systems for classrooms shall be installed in a three-gang box with one (1) 1-1/4 inch trade size conduit. The quantity and type of network cables included in each outlet will be defined by the District IT Group for each standard and smart classroom. In-wall conduit pathways are preferred, but surface mount raceway may be used with prior approval from the District IT Group.

At the main entrance to the classroom, a telecommunication outlet for a wall mounted telephone will be provided. This outlet shall be positioned such that it does not interfere with light switches or access to the door. The mounting height shall be +42 inches AFF to ensure compliance with ADA requirements.

### **3.12.6 Cubicle/Partitioned Offices (Modular Furniture)**

Cubicle and partitioned offices will require feed points. A *feed point* is a large (typically a 2-inch trade size conduit or 4-gang box) used to route communication cables into the raceway system of modular furniture. The mounting height and exact location of the feed points will depend upon the modular furniture system to be installed. The type of furniture system to be used shall be conveyed to both the Electrical and Telecommunication Consultants. Splicing of voice and data cables is not permitted and cabling that routes through modular furniture will be installed as home runs from the faceplate to the serving Information Technology Room. Each modular furniture location will be provisioned with at least one communications outlet consisting of up to four (4) Category 6A cables (two (2) voice and two (2) data). One additional telecommunication outlet with up to four (4) cables shall be added for every four (4) cubicles. Conduits routing to the feed points and the raceway system within the modular furniture must be able to hold sufficient cables for each cubicle in the modular furniture system at a fill ratio of 25%. Conduits will typically be 2-inch trade size in diameter. Multiple conduits shall be installed to provide sufficient space for the required number of cables.

When laying out a modular furniture system it is very important to consider how power and communication cable will be connected to the furniture system. If adjacent to the modular furniture, the use of solid walls and columns to route cables to the feed point are encouraged. Using walls with windows should be considered as a last resort because of the difficulty of routing cables to outlets beneath windows. In walls with windows, feed points and outlets should be placed on the solid section of the walls.

Furniture pathways may be entered from building walls, columns, ceilings, or floors. The interface between buildings and furniture requires careful planning and may require special products or furniture options. Modular furniture systems with integral raceways for data/voice cables are preferred. Safety, reliability, and aesthetic concerns all favor concealment of the building-pathway to furniture/pathway interface while maintaining future accessibility. These pathway interfaces shall not trap access covers or otherwise block access to building junction boxes or pathways. Pathways used to interconnect the furniture with building horizontal pathways shall be provided with a cross-sectional area at least equal to the horizontal pathways, cross-sectional area for the floor area being served. The Electrical and Telecommunications Consultants shall coordinate with the Furniture Consult and the District IT Group when planning cabling and pathways to service modular furniture.

### **3.12.7 Floors**

A metallic raceway shall be provided between furniture pathways and horizontal floor pathway terminations (end of conduit, flush junction boxes, and recessed junction boxes, etc.). Alignment of furniture with building module, duct locations and other cable delivery means will be considered as part of the layout planning. Furniture shall not be arranged such that pathway interfaces are in aisle spaces, where people walk or place their feet, or other places where such obstructions could create a hazard.

### **3.12.8 Wall Mounted Telephones/Payphones/Text Telephones**

In order to comply with ADA Accessibility Guidelines, the mounting height of the outlet box for wall-mounted telephones shall be +42 inches AFF. If a wall-mounted telephone is to be installed above a countertop, the clearance for the box shall be +8 inches above the countertop.

The mounting height of the outlet box for wheelchair accessible payphones shall be +42 inches AFF. If a Text Telephone (TTY) is required, it shall not be mounted to the wheelchair-accessible telephone position. The Text Telephone unit will require a power outlet positioned next to or behind the TTY device.

### **3.12.9 Workrooms**

Faculty or administrative workrooms will vary in size and function. These workrooms may be equipped with shared departmental resources including:

- Facsimile machines
- Laser printers
- Desktop computers
- Copiers

A variety of supplemental office devices, such as pencil sharpeners, laminators, electric staplers, etc. may also be located in the workroom.

To facilitate the use of these devices, numerous communication and power outlets are needed. Workrooms are typically configured with counters and storage cupboards. Along countertops where facsimile and printers may be placed, telecommunication outlets, with an appropriate quantity of electrical outlets, will be distributed every six feet. These will be placed at +6 inches above counter height. For self-standing copier machines, a telecommunication outlet will be provided with appropriate dedicated electrical outlets. At the entrance to the workroom, a wall-mount telephone outlet will be required. This outlet shall be placed to avoid space conflict with door swings, cupboards, fire extinguishers, water coolers, panels or any other fixture or device that could interfere with accessibility of the telephone.

### **3.12.10 Computer Labs**

Computer lab layouts vary depending on the type of activity conducted in the lab. Since computer labs may be rearranged, it is important that computer lab telecommunication outlets provide as much flexibility as possible. There are many possible computer lab layouts. Computer labs will be custom designed with the participation of the District IT Group staff. Typical configurations are described below. At the entrance to any lab, a wall-mount telephone outlet will be provided.

### **3.12.11 Computer Lab – Raised Floor**

In new buildings with rooms designed for permanent computer labs, the computer lab design shall include a raised floor environment. For ground floor implementations, a depressed slab is preferred to allow for the raised floor environment without losing room space due to ramps or stairs. The raised floor environment will provide the following:

- Removable floor tiles to grant unhindered access to the floor space. Depth of the raised floor will be determined during design,
- A matrix of telecommunication and power outlets in sufficient quantities to computer tables. The quantity and location of telecommunication and power outlets will vary in accordance with room size and orientation; the Telecommunication Consultant shall work with Campus IT and/or the District IT Group to determine outlet requirements on a case-by-case basis. Each matrix will be custom designed with District (IS) and Campus (ACT) according to room requirements.
- Cables to data outlets will be fully enclosed in a metallic raceway system that provides sufficient space so that the enclosed cabling does not exceed a 25% fill. The raceway system shall consolidate to suitable junction boxes that route conduits back to the serving Telecommunications Room.
- Raceway system will be suspended from the floor and mounted so that the communication and power outlets face horizontally. This will minimize the possibility of dust, particulate matter, and liquid falling into the network jacks.
- The removable floor tiles will be provided with notched access so that patch and power cords can be routed from the raised floor to the computer tables. Floor tiles will be relocatable so that as room configurations change, cable notches can be positioned underneath tables and away from circulation paths.

#### **3.12.12 Instructional Lab – Slab Floor**

In an Instructional Computer Lab, student computers will be oriented towards a whiteboard or teaching wall upon which the Instructor's workstation may project images and perform demonstrations. This lab is typically sized for 30 student computers and an instructor's computer. The lab may also contain 3 to 4 printers, scanners and other network devices. Tables are typically arranged to allow the students to all face in one direction and not need to twist around to watch the instruction. Tables are usually positioned against the walls. Printers, scanners and other network devices are distributed around the room as space permits.

The preferred outlet arrangement for this layout is to provide a divided metal raceway around the periphery of the room with outlets at intervals corresponding to table spacing. Tables will be situated flush against the walls to prevent the stretching of power or data cables across aisles or walkways. Telecommunication and electrical outlets shall be provided at the front of the classroom on either side of the whiteboard.

#### **3.12.13 Computer Lab – Student Self-Study**

In a computer lab where students go to work on assignments, there is typically no formal instruction. As such, the lab layout is oriented to provide the highest number of student stations, with little space reserved for an instructor's workstation or whiteboard. The layout of this type of computer lab will vary with room dimensions and shape. In an arrangement of long tables, typically one computer workstation is provided for every 2.5 feet of tabletop. Circular computer

kiosks vary in size with 6 to 8 stations per kiosk, typically. Outlets for these computer labs should follow the general design guidelines:

- All outlets on walls should be provisioned in metal raceway at a height of +6 inches above the tabletop, typically +36 inches AFF.
- Outlets will be provisioned in intervals corresponding to table spacing. Outlet placement must be coordinated with the District IT Group.
- All rooms that support islands of tables or kiosks will be configured with flush-mount floor boxes. Dual purpose floor boxes (communication and power) are acceptable, provided that adequate separation is maintained so that all power outlets and communication jacks can be used simultaneously without the cords interfering with one another. The preferred design is a flush-mount brass floor box with brass covers that can be accessed when an outlet is used. All floor outlets will be provisioned in the floor slab. No cabling will extend across the floor. Floor mounted raceway (pancake raceway) is not acceptable.
- A sufficient quantity of floor boxes shall be provided to support the required number of computers, printers, scanners and other networkable devices.

#### **3.12.14 Specialty Locations**

The campus will have specialty locations that shall require custom configuration at the time of building design. These locations include but are not limited to:

- Theatres
- Lecture halls (seating capacity > 200)
- Auditoriums
- Athletic broadcasting control rooms
- Scoreboards, electronic advertising boards, etc.

At the time of design, the requirements for each of these locations will be individually determined with the District IT Group.

#### **3.12.15 Maintenance Spaces**

A maintenance space is defined as any room that houses materials, supplies, equipment or tools used for the performance of maintaining systems on campus. These can include but may not be limited to:

- Electrical rooms
- Security rooms
- Mechanical rooms
- Control rooms
- Boiler rooms
- Garages

In these spaces, the minimum telecommunication outlet shall be an outlet for a wall-mount telephone. The estimated size of the wall-mount telephone is 10" H x 12" W, centered on the outlet. This outlet will be located on the same wall as the doorway to the space, with sufficient clearance so that the outlet is not obstructed by light switches, equipment or storage shelves. If the door swings into the room, the outlet shall be located on the wall beside the door lock (i.e., not beside the door hinges), so that the door can swing open without damage to the telephone.

If the maintenance space will also be used as an office for maintenance personnel, the space will be equipped with additional telecommunication outlet(s) located on the wall within three (3) feet of a general-purpose electrical outlet. One (1) telecommunication outlet will be provided for each desk area assigned to the maintenance space.

If the maintenance space contains panels, control systems or other devices that need to remotely communicate status and operation via modem or network connection, each of these devices will be separately equipped with a dedicated data station cable. Determination of which devices/panels require cabling will be performed in conjunction with engineering specialists for each device type. These devices can include HVAC monitors, elevators, EMS panels, etc.

#### **3.12.16 Building Rooftops**

Control equipment located on building rooftops frequently requires special provisioning of communications connectivity. This equipment can include HVAC monitors, cellular/wireless antennas, broadcasting equipment, telescopes, communication relays, etc. Some of these systems may be added after the building is built. The Telecommunication Consultant shall design a conduit pathway to the roof that will provide 25% fill ratio through which connections can be added later. Any control systems that require network connectivity need to be located within 90 meters of an Information Technology Room.

#### **3.12.17 Storage Areas**

All storage areas that will be accessed by NOCCCD staff on a daily basis will be provided with an outlet for a wall-mount telephone. If the storage area will be provisioned with general purpose electrical outlets, at least one communications outlet will be provisioned on each wall where there is an electrical outlet. Frequently, storage areas are redefined in purpose and may change into small meeting rooms, offices or other work areas requiring connectivity.

#### **3.12.18 Wireless Access Support**

For support of wireless access points, provide a ceiling communications outlet with two (2) Category 6A cables. For rooms with hard ceilings, this may take the form of a flush-mount outlet. For dropped ceiling spaces, the outlets may be concealed in the ceiling space with equipment mounted in a pocket door or above the dropped tiles.

Detailed wireless design specifications are provided in Section 8. The actual design will be determined on a room-by-room basis by the District IT Group.

**3.12.19 AV Projector Support**

For video connectivity to an instructor's desk/podium, an AV outlet and pathway shall be provided for a video projector location to the classroom through the AV cabinet. The AV outlet shall provide data connections for AV connectivity and a power outlet for projector support. The actual design will be determined on a room-by-room basis by the District IT Group.

**3.12.20 Security Devices**

As determined by the site security plan, there will be a distribution of telephones that provide ring-down connectivity to campus police. These phones may be implemented along corridors/hallways, in foyers, at bus stops or parking lots. The precise location and functionality of these telephones for each project are to be determined by the District IT Group and Campus Safety personnel.

Additional TCP/IP-enabled security devices, such as cameras, will be connected to the network. These devices may be located on building exteriors, light poles or other internal and external structures. Cabling to these devices require copper or fiber cable, possibly with outside plant sheaths. Pathway and routing to these security devices will be designed on an individual basis. Provisions for these lines and services will need to be coordinated end-to-end to the campus MDF and/or MPOE.

**3.12.21 Fire/Life/Safety Devices**

It is the responsibility of the Telecommunications Design Architect, the District IT Group to clearly identify and make provisions for traditional phone lines/connections for Fire/Life/Safety devices. A careful review of campus systems must be completed to determine other needs for these traditional phone circuits. These devices include but are not limited to elevator phones, emergency phones, off campus security monitoring systems and services. Provisions for these lines and services will need to be coordinated end-to-end to the campus MPOE across the campus copper cable network.

**3.13 OUTSIDE PLANT (GENERAL)**

Provisions must be made in the site work package to provide underground pathway to connect the building to the campus connection point. At least one, possibly more, common utility box/vault (size and location TBD) will be required so telecommunication services can enter the building.

From this new utility box/vault at least four (4) 4-inch Schedule 40 conduits will be run into the building. At least one conduit shall be installed with one (1) 7-cell ABF tube cable. Early in the design effort, a coordination meeting is required between the District IT Group, District Maintenance and Operations, the Civil Contractor and the Electrical Design Consultant to resolve design aspects and requirements.

**3.13.1 Campus Environments**

New construction on the existing campus will require an assessment of the Outside Plant Infrastructure. This assessment is of particular importance if demolition of any structures is required as part of the overall project.

### 3.13.2 Renovation Projects

As part of the construction process for renovation, projects plans must include the removal of any abandoned cable(s) that may be located in the space under renovation. The current California Electrical Code requires removal of accessible abandoned cable. All existing cabling reserved for future use must be identified as such and protected in place for future termination into the replacement structure.

## 3.14 CONSTRUCTION DOCUMENTS

The Telecommunications Consultant will use these standards to produce a comprehensive set of drawings that addresses all specific design requirements of each construction project. The drawings will be provided as a discrete Telecommunications Set (or “T set”) and will meet the following requirements:

- T set drawings will be stamped by the Telecommunications Consultant’s Registered Communications Distribution Designer (RCDD).
- T set drawings will be coordinated with electrical engineering staff to determine suitable placement of power outlets.
- T set drawings will include the following:
  - Outlet locations in all buildings using an industry-standard symbol set.
  - Drawings of standard outlet details.
  - Backbone riser diagrams for each subsystem: voice, data, and video (coax & fiber).
- Detailed drawings of Information Technology Rooms, including:
  - Cable runway design.
  - Wall space allocation and usage.
  - Rack and cabinet equipment layout.
- Detailed drawings of seismic bracing for racks and cabinets.
- Where not provided by others, detailed drawings of fire-stopping around cabling bundles, J-Hook/conduit/raceway suspension, etc.

Every construction project will be supplied with a unique set of specifications that address the specific design needs of the project. These specifications will be written and provided as a separate Division 27 Sections. Division 27 sub-sections shall include but not limited to:

1. General Telecommunication Requirements
2. Telecommunications Equipment Rooms and Spaces
3. Backbone Cabling
4. Horizontal Station Cabling

It shall be the responsibility of the Architect and Telecommunication Consultant to update project specifications in accordance with changes to standards, codes and manufacturers products.



The Architect shall ensure that the District IT Group have the opportunity to review and comment on all drawings and/or specifications that can in the remotest definitions be construed to have any impact on the Telecommunication Infrastructure.

## 4. ELECTRICAL

The following information is the basic guidelines for the Electrical Design Consultant. These design guidelines shall be considered to be minimum requirements. The Electrical Design Consultant shall contact the District IT Group in the Schematic Design phase to determine if there are any additional or special requirements. It is the expectation of the District IT Group that the information from this Guideline shall be included in drawings and specifications. Construction Specifications Institute (CSI) Master-Format Division 27 shall be used, separate sections shall be written to specify:

- Conduits for telecommunication use
- Outlet boxes for telecommunication use
- Telecommunication cable tray
- Telecommunication grounding system

These sections and drawings are to be made available to the District IT Group. Unless otherwise noted, it is the expectation of the District IT Group that the work listed in this section will be installed by an electrical contractor. See NOCCCD Division 27 “Sample Specifications” Section 9.

### 4.1 GENERAL POWER REQUIREMENTS

All outlets shall be installed as double-gang quad-plug outlets. This is to facilitate the use of electrical adapters fashioned with large transformers at the plug end. These transformers frequently obscure more than one electrical plug, thereby limiting the usefulness of the outlet.

The plentiful distribution of electrical circuits is critical to ensuring that equipment does not experience power surges or lulls as everyone “powers on”. A dedicated circuit will be installed for every three computer devices (computer/laptop/printer/scanner) and other circuits will be installed for shared use between offices for supplemental office devices. It is recommended that the outlet designed for computer usage shall be a surge protected power outlet or allow for the placement of a surge protected power strip. These outlets shall be defined for computer usage.

Unless otherwise noted on the Architectural drawings, power outlets shall be mounted within 3 feet of telecommunication outlets and at the same mounting height. For additional information about outlet placement refer to section 3.12.

### 4.2 INFORMATION TECHNOLOGY ROOM POWER REQUIREMENTS

#### 4.2.1 General

To ensure that the Information Technology Rooms have clean power, the electrical panel(s) in Information Technology Rooms shall be connected to an isolation transformer. Each Information Technology Room shall have its own electrical panel. The electrical service shall be at least 100 Amps. The estimated electrical load for Information Technology Rooms shall not exceed 80% of the panel.

As a design alternative, one electrical panel may serve multiple Information Technology Rooms in buildings where multiple small Information Technology Rooms are located. If this design is selected, the Electrical Engineer will coordinate with the District IT Group to estimate the power consumption to provide ample dedicated circuits.

Convenience outlets shall be mounted at +18 inches AFF (just below the plywood backboard). Horizontal spacing between convenience outlets shall not exceed six feet around the edge of the space. Convenience wall outlets shall be split circuited (i.e., outlets on the same wall) will be wired to different circuits. No more than four (4) outlets shall be on the same circuit. Each outlet will be clearly marked with the circuit number. All convenience outlets shall be 120V/20A quad-plug outlets.

If the room has a raised floor, all underfloor outlets will be side mounted on a flex whip not to exceed 30 inches in length. All circuits for underfloor outlets shall be of a ground-fault interrupter type.

To provide power to equipment racks/cabinets, electrical outlets will be provisioned along cable runway and between racks/cabinets. Each rack/cabinet will be provisioned with a dedicated circuit in a quad-plug outlet. The Electrical Engineer shall work with the District IT Group campus representative to determine circuit voltage and amperage to be provided to each rack/cabinet. Specialty outlets may be required to support rack-mount UPS systems. This need will be coordinated with the District IT Group during the design phase. Whether installed nearby, or on racks, the conduits required for power outlets must not interfere with the ability to place equipment in the racks.

HVAC system shall use the same electrical panel as that used to support Information Technology Rooms.

#### **4.3 ELECTROMAGNETIC INTERFERENCE**

Electromagnetic interference shall not exceed 3.0 V/m throughout the frequency spectrum. Special attention shall be given to electrical power supply transformers, motors and generators, X-ray equipment, radio and radar-transmitters, microwaves and induction sealing devices.

#### **4.4 GENERATOR/UPS**

A generator may be required to support ongoing power to critical locations when extended power outages occur. The sizing of the generator will depend upon the nature and function of the equipment at the location to be powered. It is possible that more than one generator may be required.

An Uninterrupted Power Supply (UPS) system may be required to support AC-powered equipment such as routers, switches, etc. at various locations on campus. Each Building Telecommunications Room (BDF) will be provisioned with a UPS. Specialty electrical outlets for the support of rack-mount UPS systems will be identified as needed and provisioned by racks/cabinets. UPS run time must be at least 30 minutes with equipment under full load.

#### 4.5 GROUNDING

Besides the normal electrical ground system, a telecommunications ground system will be designed per ANSI/TIA-607-D, *Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises*. The telecommunications ground system shall be installed to support the Information Technology Rooms and infrastructure.

A Telecommunications Main Grounding Busbar (TMGB) shall be located in the Building Telecommunications Room (BDF). The TMGB shall be a predrilled copper busbar provided with standard NEMA bolt hole sizing and spacing. The TMGB shall be electrotin-plated for reduced contact resistance. The TMGB shall be a minimum size of 5 mm thick, 100 mm wide and 300 mm in length. The TMGB shall be insulated from its support by a two (2) inch separation.

The TMGB will be bonded to the electrical panel ground bus bar and to building steel or ground rod by conventional welds, exothermic welds clamp-and-braze method, or UL approved compression type connectors where practical. Exothermic welds are the preferred method. Because of the high temperatures involved, copper materials may be bonded to iron or steel. The mold size must match the cable or conductor cross section. The size of the weld metal charge must match the size of the mold being used. The connection between the TMGB and the bonding point is to be 3/0 insulated copper ground wire.

In each Telecommunications Room (TR), a Telecommunications Grounding Busbar (TGB) shall be installed. The TGB shall be a minimum size of 5 mm thick, 50 mm wide and 150 mm long. The TGBs shall be bonded to the electrical panel serving the room where the TGB is installed, to building steel, and in series to the main TMGB.

#### 4.6 RAISED FLOOR BONDING AND GROUNDING

If a raised floor is present, the raised floor bonding shall consist of a #6 AWG bare stranded copper ring around the floor perimeter. #6 AWG supplemental cables shall run within the perimeter in both directions to form a grid. All crossovers shall be bonded. The supplemental cables shall bond to each fourth (4<sup>th</sup>) pedestal and both ends will anchor on the perimeter #6 AWG ring.

- A bus bar shall be provided under the floor with a dedicated connection to the Telecommunications Main Grounding Busbar (TMGB). This bus bar shall be labeled "Raised Floor Bus".
- Two diametrically opposed connections shall be made between the raised floor grounding bus bar and the perimeter #6 AWG ring.

#### 4.7 TERMINAL BOARD

The terminal board shall consist of rigidly fixed 3/4-inch void free fire-rated A-C plywood. The visible side of the plywood shall be painted with two coats of white (or other light-colored) paint. At least one (1) Fire-Rated stamp must be visible per sheet or partial sheet of plywood when painting is completed. Plywood shall be installed from 8 inches AFF to 8 feet 8 inches AFF.

#### 4.8 COMMUNICATION PATHWAYS

The main types of horizontal pathways are:

- Ceiling distribution

- Cable tray
- In-floor ducts (one- level or two- level)
- Cellular floors
- Conduit
- Access (raised) floors.

Many buildings require a combination of the above systems. the District IT Group prefers an overhead distribution method based on the use of cable tray/J-Hooks for routing and conduit stub-ups from outlet boxes.

Trays and conduits located within the ceiling shall protrude into the Telecommunications Room (TR) a distance of 1 to 2 inches without a bend and above 8 feet AFF. All conduits and cable tray shall have approved cable radius dropouts. If the wall is a fire rated wall, then Section 4.9 shall be followed.

#### **4.9 FIRE STOP PENETRATIONS**

Each Telecommunications Room (TR) will require an STI Inc. EZ Path 44 type (or approved equal) fire-stop penetration system for all fire rated barriers. A minimum of three (3) EZ Path 44 Type through-wall fire-stopped system pathways are required.

Each Telecommunications Room (TR) will require a minimum of three (3) EZ Path 44 (or approved equal) pathways to be used for risers through the floor. The exact requirements will be coordinated with the District IT Group for final quantities. Current California Building Code requires "The system shall have an F rating and a T rating of not less than one hour but not less than the required rating of the floor penetrated".

The Floor Plan drawings shall show the location and Mechanical type of Fire Stop Penetration systems to be used.

#### **4.10 COMMUNICATION OUTLETS**

During the early part of the design process, the Architectural drawings shall be annotated with the placement of telecommunication outlets. Coordination with both the Architect and Telecommunication Consultant may reveal the need for additional telecommunication outlets as the design details develop.

##### **4.10.1 Outlet Location Considerations**

Telecommunication outlet locations must be coordinated with the furniture layout, particularly in the case of cubicles and built-in furniture. Power outlets shall be installed within 3 feet of and at the same height as each telecommunication outlet box. Outlet Boxes

Unless advised by the District IT Group to the contrary, the typical telecommunication outlet shall consist of a 4-11/16 inch square by 2-1/8 inch deep back box with one (1) 1-1/4 inch trade size conduit that will stub up and out to the closest accessible ceiling space, communications J-Hook or within 6" of a cable tray run. The outlet box shall have a single gang mud ring. Typical mounting height shall be +6 inches above counter/desk surface in offices and workrooms and +18 inches AFF for outlets in classrooms, conference rooms, etc.

Wall mount telephone outlet boxes shall be 4-inch by 2-1/2 inch by 2-1/8 inch deep back box with a single-gang mud ring and one (1) 1-inch trade size conduit that will stub up and out to the accessible ceiling space to the closest communication J-Hook or within 6” of a cable tray run. The back box shall be mounted at +42 inches AFF.

#### **4.11 FLOOR BOXES**

In limited locations where connectivity is required for islands of computers/desks, floor boxes may be installed to minimize the incidence of power and data cables straddling across floors. Outlets installed in floor boxes shall meet the following minimum requirements:

- At no time shall conduit feeding the floor box run below the membrane barrier or be in the soil.
- Supporting conduits shall run in the slab and shall be PVC Schedule 40 or better.
- Supporting conduits shall be sized for 20% fill to allow for additional cabling.
- Conduits feeding floor boxes shall be dedicated runs and shall not chain through multiple floor boxes. Conduits shall stub up to the closest wall.
- Floor boxes will be of metal construction to support the anticipated weight and travel. Typically, this is a brass floor box with brass lids. Lids must be flush to finish floor when the outlet is in use.
- Floor boxes will have lids that can be screwed down to hinder unauthorized access.
- Floor boxes may support a combination of data and electrical outlets. If so, the design of the floor box must be such that all data and electrical ports can be fully connected with cables without causing any obstructions that would limit the use of any jacks/plugs.

For each occurrence, a review of the connectivity density and need will determine the type of box to be used. The selection of floor box will be coordinated with the District IT Group.

#### **4.12 WIRELESS ACCESS POINTS (WAP)**

Communications outlets shall be installed in ceilings to support wireless access points in conference rooms, classrooms and other specified areas. The WAP communications outlet shall consist of two (2) plenum-rated Category 6A cables terminated on a two-port surface-mount biscuit with a 1-meter maintenance loop provided for each cable. WAP cables shall be supported by J-Hooks back to the closest Information Technology Room or within 6” of a cable tray run. The support for the WAP biscuit shall be such that the box is independent of the ceiling. Support hardware for WAP shall be part of the installation and independent of the ceiling support system.

WAPs shall be powered via PoE.

#### **4.13 AV PROJECTOR (AV)**

At locations where ceiling-mounted projectors will be installed, AV, communications and power outlets shall be required. The support for the electrical box shall be such that the box is independent of the ceiling. From the AV Projector, a data cable will route back to the closest Information Technology Room. The data cable shall be supported by J-Hooks or within 6” of a cable tray run. One (1) 2-inch

trade size conduit will route to the AV control cabinet to support AV cabling. Three (3) additional 2-inch conduits will route to each of the Instructor's desk and lecture podium from the AV control cabinet. This provides discrete point-to-point connectivity for AV specialty cables. AV connectivity and placement of the AV control cabinet and Instructor's desk and lecture podium will be custom designed for each room.

In rooms where both ceiling mounted projectors and wireless access points are required, the communications outlets can be consolidated.

#### **4.14 COMMUNICATION/POWER RACEWAYS**

If divided raceways are installed to support communication and power runs, the raceway shall be installed so that the communication channel is located above the power channel. Sizing of the communication channel shall be based upon the following:

- If the raceway system is to support standard outlets in office locations, the outlet faceplate shall be sized for four (4) cables. Conduit stub-up from the raceway must be sized to support the maximum number of cables in that segment of the raceway plus 25%.
- If the raceway system is to support a computer lab facility, then each communication faceplate shall be sized for four (4) or more cables; the Telecommunication Consultant shall work with the District IT Group campus representative to determine actual cable counts on a per-outlet basis. Unless specified otherwise, the telecommunication outlets shall be spaced every four (4) feet. Conduit stub-up from the raceway must be sized to support the maximum number of cables in that segment of the raceway plus 25%.
- In outlet locations, the jacks may protrude into the raceway cavity and pinch the cable connections. Raceways shall not be filled greater than 25% and the fill may be reduced to avoid cable pinching at outlet locations.
- Only metallic raceway is acceptable.
- The mounting height of the raceway should be +6 inches above the tabletop, typically +36 inches AFF. One (1) quad-plug power outlets should be provided with each telecommunication outlet.

#### **4.15 FLOOR POKE-THROUGHS**

The use of floor poke-through should be minimized and considered only on an exception basis with the approval of the District IT Group.

#### **4.16 BUILDING ROOFTOPS**

Each roof shall have at least one location for potential rooftop systems. The location must be such that the distance from the location to the nearest Information Technology Room does not exceed 90 meters of conduit. This location shall consist of a weatherproof electrical box sized to support one (1) electrical quad-plug outlet and two (2) 2-inch trade size conduits. The power outlet shall be fed from the nearest electrical room. The two conduits shall run to the same electrical room. Conduits shall be sealed to prevent moisture or insect ingress.

In addition to electrical connectivity, one (1) 1-inch trade size conduit will be provisioned from the rooftop to the nearest Information Technology Room, terminating on the roof in a weatherproof enclosure within 90 meters of the Information Technology Room. This outlet will support the incidental use of a telephone or data connection. If a permanently installed telephone is required, the termination shall be located in a weatherproof box sized appropriately to house the telephone set.

#### **4.17 INSIDE CONDUITS (GENERAL)**

The Electrical Engineer will design conduit systems in conformance with ANSI/TIA-569-E, *Telecommunications Pathways and Spaces* and the following:

- Run in the most direct route possible (parallel to building lines), with no more than two 90-degree sweeps in any dimensional plane between pull points or pull boxes (PBs).
- An accessible pull box must be added to a conduit run if the run contains more than the equivalent of two 90-degree sweeps in any dimensional plane.
- Contain no straight-through or 90-degree conduits (also known as LBs).
- Contain no flex-conduit material.
- Contain no continuous sections longer than 100 feet. For runs longer than 100 feet. in length, insert pull points or PBs so that no segment between points/boxes exceeds the 100 feet. limit. It is recommended that total conduit runs be kept to 150 feet. or less (including sections through pull boxes).
- All conduits shall have a minimum bend radius 10 times the diameter of the conduit.
- All conduit stub-ups up to 1-1/4 inch trade size shall have a bend radius six (6) times the diameter of the conduit. Conduit stub-ups that are trade size 2-inch or less shall only have a 45-degree bend above the wall.
- Equip all conduits with a plastic or nylon line (also called a fish tape or pull cord) with a minimum test rating of 200 lb.
- Minimum trade size for communication EMT conduits is 1-1/4 inch unless otherwise noted for use with all communication back boxes or J-boxes.
- All telecommunication conduits from telecommunication outlet or J-boxes shall stub up and out to within 6 inches of J-Hooks or cable tray run.
- Conduits will stub up to an accessible ceiling area. No telecommunication conduit is to stub out in a hard ceiling area.
- The conduits shall be reamed at both ends and have a plastic bushing on the stub up end.
- Conduits which feed modular furniture are considered “feed points”. These conduits are sized according to the number of cables and outlets served and are typically 2 inches in diameter. These conduits may terminate on back boxes for use as a pull point during cabling installation. The use of flex conduits to enter the modular furniture cabling channel shall be minimized.



**4.18 COMMUNICATIONS CABLE TRAY**

The preferred method to support telecommunication cables is the use of cable tray. This approach allows for change in direction or elevation without having to install pre-manufactured assemblies. Design of the size and location of the communication cable tray will be coordinated with the District IT Group. Design of the cable tray system will follow the guidelines described below.

Cable tray routing shall follow normal corridor routes. The tray shall be placed in the hallway ceiling space in such a manner that a minimum of 12 inches of space exists above the sides of the cable tray and there is at least 12 inches to 18 inches of clearance on at least one side of the tray. There shall be working space of at least 2 feet on one side of the tray to facilitate the installation of cable. Cable tray shall be supported using a trapeze support system. Steps shall be taken to ensure supports and trays are seismically braced.

All metallic cable trays must be grounded. Cable trays shall not be used as grounding conductors for equipment. Clearly mark all cable trays and grounding conductors in accordance with ANSI/TIA-606-C and ANSI/TIA-607-D.

**4.19 COMMUNICATIONS J-HOOKS**

Information for the general placements of J-Hooks typically will not be included on drawings. The Cabling Contractor is the best choice to determine J-Hook installation due to the adjustments to J-hook routing that may become necessary as the cables are being installed. Unless instructed otherwise by the District IT Group, installation of J-Hooks shall be included in the Scope of Work assigned to the Cabling Contractor.

For additional J-Hook installation information, refer to Section 7.1 and the sample specifications.

**4.20 PULL BOXES**

If an inside pull box is required, the size of pull box shall conform to the following chart.

Maximum Trade Size of Conduit	Size of Box			For Each Additional Conduit Increase Width
	Width	Length	Depth	
3/4	4 in	12 in	3 in	2 in
1	4in	16 in	3 in	2 in
1-1/4	6 in	20 in	3 in	3 in
1-1/2	8 in	27in	4 in	4 in
2	8 in	36 in	4 in	5 in
2-1/2	10 in	42 in	5 in	6 in
3	12 in	48 in	5 in	6 in
3-1/2	12 in	54 in	6 in	6 in
4	15 in	60 in	8 in	8 in

Any pull box installed shall be located in such a manner that the pull box can be accessed during normal working hours. This includes providing wall or ceiling access-panels that can be easily removed to gain entry to the pull box.

#### **4.21 UNDERGROUND CONDUITS**

It is the expectation of the District IT Group that the following information will be placed on the Telecommunication Site Plan.

- Underground conduits are to be 4-inches in diameter, Schedule 40 PVC or equivalent. At least one conduit will contain an Air Blown Fiber (ABF) sub-channel system.
- Changes in direction for underground conduits will occur outside of the maintenance or handhole at a minimum of 20 feet from the maintenance or handhole. Conduit runs will contain no more than a cumulative 180-degrees of bend between pull boxes, vaults, manholes or the Building Telecommunications Room (BDF). This includes the turn from horizontal to vertical when entering the BDF from below.
- All conduits shall have a minimum bend radius ten (10) times the diameter of the conduit.
- If the conduits penetrate from below, the conduits will stub up at least four (4) inches.
- If the conduit penetrates the walls of a TR, the conduits shall stub out 1 to 2 inches from the wall and shall pass through the wall at a downward angle from building interior to building exterior so water will not drain into the room.
- Conduits will have plastic bushings installed at the building end of the conduit.
- A pull rope with a minimum of 200 lbs. of pulling tension shall be installed in all conduits.
- All conduit sub-channel systems shall be sealed at the building end to prevent rodents, water or gases from entering the building.

#### **4.22 EQUIPMENT SPECIFICATIONS**

All network, computer, voice/voicemail, AV or other active equipment shall be procured in a discrete bid and acquisition process that is independent of the building construction. As such, specifications and bid documents shall NOT include descriptions of active components or equipment.

## 5. MECHANICAL (HVAC)

The following information is the basic design guidelines for the Mechanical Design Consultant. These guidelines shall be considered to be minimum requirements. The HVAC Consultant shall contact the District IT Group to determine if there are any additional or special requirements. In addition to the requirements of the Information Technology Rooms, District IS has a vested interest in how thermal dissipation of desktop devices and special equipment is handled.

### 5.1 GENERAL

- Mechanical Drawings shall carry a sheet note to the effect that installation of all duct work must be coordinated with installation of the communication cable tray and the final installation shall be such that the communication cable tray has sufficient clearance to allow access to install and maintain the Information Technology cabling as described in Section 4 of this document.
- All Building and Main Telecommunications Rooms (BDF/MDF) require HVAC 24 hours per day and 365 days per year, separately controlled from adjacent rooms. If the building's HVAC system cannot meet this requirement, then a stand-alone HVAC system with independent controls for the various Information Technology Rooms shall be installed. If a separate unit is to be installed, chilled water; at 45°F is preferred. Otherwise, a non-interrupted water source is acceptable. Note: if water is not available, a way must be found to exhaust hot air from the air conditioning unit's evaporator.
- The HVAC unit will be powered off the same electrical panel as the Information Technology Rooms.
- Final BTU load estimates can be provided after the equipment has been selected. For planning purposes, assume at least 6,000 BTUs per equipment rack/cabinet to be installed.
- In larger or critical installations, the air conditioning system (or that part of a larger system) will be connected into a backup generator system. Provisions must be made so the telecommunications or network equipment will not be exposed to excessive operating temperatures due to a loss of power to the air conditioning system. This shall be coordinated with the District IT Group.
- Data centers shall be designed with a split HVAC system that will continue to provide cooling to the space even in the event of a fire alarm being tripped or tested. Design shall be coordinated with the Architect and District IT Group.
- A positive pressure differential with respect to the surrounding areas shall be provided within the room.
- Ambient temperature and humidity shall be measured at a distance of 5 feet AFF. After the equipment is in operation, the measurement can be taken at any point along an equipment aisle centerline. Normal temperature range is 64°F to 74°F with a humidity range of 35% to 55% relative.
- If the Information Technology Room is fire-rated, fire/smoke dampers will be required for supply and exhaust air.
- HVAC system monitoring shall be integrated into Energy Management Systems (EMS) where applicable.

## 5.2 THERMAL DISSIPATION

Computer devices will add heat to the room in proportion to the power drawn by the device(s). HVAC systems that will service these environments should be designed to dissipate the heat accumulation, particularly in high density areas like computer labs, workrooms, etc. Typical ratings per device are listed below. HVAC design shall include cold isle and hot isle duct work in all Information Technology Rooms and be coordinated between Architect and Mechanical engineer.

- |                                     |             |
|-------------------------------------|-------------|
| • Desktop computer w/LCD monitor    | 1600 BTU/hr |
| • Color inkjet printer              | 250 BTU/hr  |
| • Color LaserJet printer            | 1900 BTU/hr |
| • Scanner                           | 50 BTU/hr   |
| • Facsimile (or all-in-one printer) | 250 BTU/hr  |
| • Servers                           | 4750 BTU/hr |

The Mechanical Design Consultant will coordinate with the District IT Group for the specific equipment installation in each Building Information Technology Room (BDF). This will allow for the accurate calculation of thermal dissipation requirements. Typical values are:

- |                                       |             |
|---------------------------------------|-------------|
| • Network switch (48 port)            | 250 BTU/hr  |
| • Network switch (fiber concentrator) | 4000 BTU/hr |
| • Network router                      | 600 BTU/hr  |

With the approval of the new Enhanced Power over Ethernet standard 802.3bt (PoE++), the amount of power that can be provided to an end device via PoE increases from approximately 30 W to 90W. Depending on the number of installed network switches that support the new standard and the number of end devices drawing higher levels of power, the level of cooling required in a Telecommunications Room may increase considerably. The Architect and Telecommunications Consultant should be familiar with these changes and the potential impact that the use of PoE++ within an installation can have on Telecommunications Room cooling requirements.

## 5.3 COORDINATION WITH MAINTENANCE AND OPERATIONS

While District IS will act as a focal point for all issues associated with Information Technology Rooms, computers and network equipment, the Mechanical Design Consultant must coordinate with the District and campus Maintenance and Operations departments to address more global HVAC issues for each renovated space. Coordination with campus Maintenance & Operations for all site work regarding the Plumbing, Electrical, and Fire Alarm trades must be maintained at all times.

## 6. CIVIL (OUTSIDE CABLE PLANT)

The following information is the basic design guidelines for the Civil Design Consultant. These guidelines are to be considered the minimum requirements. The Civil Consultant shall contact the District IT Group to determine if there are any addition or special requirements. The outside plant conduit system must be designed and installed to the NESC and ANSI/TIA-758-D specifications for outside plant construction.

### 6.1 GENERAL

The outside plant conduit system provides interbuilding pathway for communication cables and services. The conduit system is typically a combination of communication vaults, maintenance holes (MH), handholes (HH) and conduit runs.

Maintenance holes are typically used in main and branch conduit systems that require four (4) or more 4-inch trade size conduits. If placed in a traffic area, the maintenance hole box and cover shall be rated for the indented traffic loads. Unless directed to the contrary by the District IT Group, the typical maintenance hole shall have center-conduit window and be a Type A configuration as defined in ANSI/TIA-758-B. The maintenance hole shall be a pre-cast unit and shall contain all necessary hardware such as but not limited to cable racking, pulling iron, and provisions for bonding and grounding.

Handholes differ from maintenance holes in that they provide full access to the entire space inside the hole (i.e., you can stand in a handhole with your head above finished grade). Handholes are usually pre-cast and require the same hardware as a maintenance hole.

### 6.2 UNDERGROUND CONDUITS

The following information is supplied as information only. It is the expectation of the District IT Group and Campus ACT that this information will be placed on the Electrical Site Plan.

- Each building shall have at a minimum of four (4) 4-inch trade size conduits for routing communication cables into the building. The quantity of conduits may be increased for multi-story buildings where larger backbone cables must be routed.
- Conduits are to be Schedule 40 PVC or equivalent.
- At least one (1) conduit will contain a 7-cell ABF sub-channel system.
- The conduit runs will contain no more than two (2) 90-degree turns or a cumulative 180 degrees of bend between vaults, maintenance holes (MH) or handholes (HH) and the termination point in the Information Technology Rooms. This includes kicks, offsets and the turn from horizontal to vertical when entering Information Technology Rooms from below.
- If conduits penetrate into the Information Technology Room from below, they shall stub up at least 4 inches from the floor.
- If the walls of the Information Technology Room are penetrated, the conduits shall stub out 1 to 2 inches and conduits shall pass through the wall at a downward angle from building interior to building exterior so water will not drain into the room.

- Conduits shall have plastic bushings installed at the building end of the conduit.
- A 3/8" nylon pull rope rated for a minimum of 200 lbs. of pulling tension shall be installed into all conduits.
- Measurement (true tape) in one conduit in a multi-conduit run.
- All conduits, sub-channel systems shall be sealed at the building end to prevent insects, rodents, water, or gases from entering the building.
- Jack plugs shall be installed in all vacant conduits in the underground system.

### **6.3 CONDUITS/DUCT BANKS**

The Telecommunication Consultant shall work with the Architect to design underground conduits and duct banks. Routing of these conduits must be designed based upon the approved engineering drawings. These drawings must include the following information:

- Details of typical trench cross sections showing duct locations in the trench, clearances from final grade, backfill materials and depths, pavement cutting information, and compacting requirements for both paved and unpaved areas.
- Construction notes applicable to the work being performed.
- A scale drawing showing location ties to existing structures, cable, conduit, utility boxes, and any conflicting substructures and profile drawings of congested areas where vertical and horizontal separation from other utilities is critical during cutting and placing operations and any other areas as requested by the District IT Group.
- A legend explaining symbols of all relevant structures and work operations.
- Conduit types, dimensions, and wall-to-wall measurements when used with MH, HH, PB, pedestals, electrical rooms and Information Technology Rooms.
- Warning tape containing metallic tracings must be placed a minimum of 12 inches above the underground conduit/duct structure to minimize any chance of an accidental dig-up. The American Public Works Association has adopted the color orange for the telecommunications cables. The metallic warning tape shall be inspected from both ends after installation. the District IT Group must approve the installation prior to completion of conduit/duct bank.
- The minimum depth of a trench must allow 24 inches of cover from the top of the conduit/cable to final grade for conduits that traverse areas with no vehicular traffic. Depth must be increased with the increasing incidence of vehicular traffic to a maximum of 6 feet for constant traveled roadways. Conduits that route underneath pedestrian pathways that also support vehicular traffic must be buried with appropriate depths so that maintenance vehicles or fire trucks driving over the pathways will not inadvertently crush the underground conduits.
- Conduits shall be designed so that changes in cable routing direction occur outside of the man-hole. Sweeps must occur at least 20 feet away from the box. No sweeps greater than 90 degrees are permitted. Reversal of conduit paths are not allowed.

- Local underground utilities must be contacted 48 hours prior to excavation or in accordance with statutes regulation utilities, an Underground Service Alert (USA) call number receipt (ticket) must be present onsite during any construction, and utilities must be located before digging to locate all subsurface facilities such as power, gas, water and outdoor lighting.
- Conduit penetration of a building must be located so that the outside plant cable termination area is within 50 feet of the building entrance point of penetration. If the cable must extend inside the building for more than 50 feet, it must be encased in rigid or intermediate conduit that does not expose the cable for more than 50 feet. The rigid or intermediate conduit must conform to the same requirements of requiring a pull box after two 90-degree or cumulative 180 degrees of bend. From the point of the first pull box, the outside plant cable can only run 50 feet until its termination point, including routing and service loop lengths.
- All conduits in a duct bank that enter a MH or building shall be sealed at the time of installation with universal blank duct plugs to prevent the intrusion of liquid or gases into the MH or building. Seal after pull rope is installed. The seals shall be opened while cable is being installed and shall be resealed with a duct plug after cable installation, testing and acceptance is completed.
- Per ANSI/TIA-758-B, a drain slope of 0.125 inches per foot toward the MH/HH shall be provided.
- The following table shows the vertical or horizontal separations that must be maintained between telecommunications facilities and other facilities sharing a common trench.

Adjacent Structure	Minimum Separation
Power or other foreign conduit	3 inches of concrete, or 4 inches of masonry, or 12 inches of well-tamped earth
Pipes (gas, oil, water, etc.)	6 inches when crossing perpendicular 12 inches when parallel

**6.4 COMMUNICATION MAINTENANCE HOLE/HAND HOLE SIZES**

The size of a maintenance hole or handhole will depend upon the number of conduits it will have to support. The typical maintenance hole is 12 feet long by 6-feet wide with an interior height of 6-feet. Handholes will vary in size from 4 feet long by 4 feet wide by 4 feet high to as small as 17 inches wide by 30 inches long by 36 inches deep.

All maintenance and handholes must be sized for the current conduit capacity requirement with a minimum of 30% spare capacity. Conduits will be added to MHs and handholes as additional buildings are constructed on campus; as such, MHs and handholes must not be sized so that they are at their maximum capacity during the initial installation.

At the time of construction of a new maintenance or handhole, the conduits for immediate use and any stub-outs that may be prepared for future buildings will be installed.

## **6.5 COMMUNICATION MAINTENANCE HOLE/HAND HOLE LOCATIONS**

Vaults and maintenance holes shall be located such that they:

- Provide a safe work area.
- Allow for proper traffic control during operations at the vault or MH.
- Provide proper space for cable reel dollies, winch trucks, etc.
- Shall not overly restrict the flow of vehicular or pedestrian traffic.
- Are located out of the roadway whenever possible.
- The distance between vaults or MHs shall not exceed 300 feet.

Handholes shall be located such that they:

- Expedite cable placement.
- Provide for drainage requirements (e.g., drain holes, sump hole).
- Aid cable pulling when sweeps in the conduit run exceed either two 90-degree sweeps or a total of 180 degrees in any dimensional plane or when the conduit section is so long it must be installed in two segments.

Vaults, MHs and HHs located in pedestrian pathways designated as emergency fire routes or routes for maintenance vehicles must be constructed with traffic-rated boxes.

MHs and HHs must be located so that they are accessible for future conduit additions. In particular, MHs and HHs are best located in lawns, beddings or soft ground that can be more easily accessed for the addition of conduits. Installation of maintenance or handholes in pavement, sidewalks, roadways, specialized stonework surfaces, or other concrete or permanent material must be avoided so that future conduit additions will not mar the surface or cause undue expense to recreate after the conduit addition. Stub-outs that extend 5 to 10 feet from the maintenance and handholes should be included in all new installations to facilitate future conduit additions.



## 7. TELECOMMUNICATION

### 7.1 TELECOMMUNICATION CONSULTANT

The primary role of the Telecommunication Consultant is to act on behalf of and at the direction of the District IT Group to provide a Telecommunication Cabling Design for NOCCCD building and infrastructure projects. The Telecommunication Consultant shall be a BICSI Registered Communications Distribution Designer (RCDD). The Telecommunication Consultant may be retained by the Architect or directly by NOCCCD.

The Telecommunication Consultant shall:

- Ensure all information in this Standard is followed by the Architect and other consultants. Any discrepancies noted by the Telecommunication Consultant that are not corrected by the Architect or other consultants are to be brought to the attention of the District IT Group by the Telecommunication Consultant.
- Develop a Telecommunication Cabling Design based upon the current published ANSI/TIA Standards, BICSI manuals and other standards produced by the District IT Group.

7.1.1 The Design Documents shall include, but may not be limited to Drawings consisting of:

- Legend
- Site plan showing OSP conduits and boxes, etc.
- Floor plans showing the type and number of communication cable(s) to be installed at each outlet
- Cable infrastructure (cable pathway, outlet boxes locations, conduit, cable tray or J-Hook routing)
- Information Technology Rooms detailed drawings
- Single Line Drawing for backbones
- Other construction details

7.1.2 Project Manual Specifications or Scope of Work (SOW) documentation.

7.1.3 Provide the point of coordination between the Architect and Engineering team and the District IT Group.

The Telecommunication Consultant is responsible for advising the Architect and other consultants when multiple Information Technology Rooms are needed in a specific building. Most frequently this will occur when the building has multiple floors. Information Technology Rooms shall be located so that the installed length of any data cable does not exceed 100 meters. Every building will be examined on an individual basis.

Before actual design work commences, the Telecommunication Consultant will meet the District IT Group to determine what active equipment such as network equipment (voice/data/video), servers, etc., will be installed in each Information Technology Room in each building. This will include a discussion of computer lab and server rooms in the building. If there are to be multiple lab and server rooms in the facility, each lab/server room will be treated as an Information Technology Room. Although active equipment will never be specified as part of a construction projects, it is important that a clear understanding of the electrical and HVAC loading, space and connectivity requirements be documented and understood as part of the design process for the Information Technology Rooms.

## 7.2 NOCCCD PRODUCT STANDARDS

NOCCCD has standardized on Category 6A data cabling components from the **CommScope SYSTI-MAX** system (includes copper station cables, patch panels, termination blocks and jacks) and fiber backbone cable from the **Sumitomo FutureFlex** system. A 19-cell tube cable shall be provided as the main backbone system and shall feed through the underground conduit system back to the MDF; 7-cell tube cables shall feed from each building BDF to the nearest underground manhole/handhole, where they shall interface with the main 19-cell tube cable. Smaller buildings may use 4-cell tube cable from the manhole/hand hole to the BDF.

## 7.3 OUTSIDE PLANT

The outside plant consists of the outside plant (OSP) cables and structures needed to connect the new building to the campus. The supporting structure includes underground (in conduit) cables, conduits, maintenance holes (MHs), handholes (HHs), pull boxes (PBs), pedestals and outside building terminals. The outside plant must be designed and installed to the NESC and ANSI/TIA-758-B, *Customer-Owned Outside Plant Telecommunications Infrastructure Standard*. Direct buried cables and aerial cable runs are not acceptable.

### 7.3.1 OSP Design Activities

The Telecommunication Consultant will work with the District IT Group and other consultants and engineers to:

- Identify cable routes from building to building.
- Determine the underground cable requirements.
- Identify the types of cable used in the campus segment.
- Determine conduit, maintenance hole, handhole, and pull box requirements.
- Determine electrical protection and bonding/grounding requirements.

#### 7.3.1.1 Outside Plant Fiber Optic Cables

Each building shall be provisioned with multi-mode and single-mode fiber backbones installed as a home run to the MDF on campus.

OSP fiber optic cables shall:

- Meet or exceed Underwriters Laboratory 1666 (UL-1666) requirements

- Have fibers that are separated into color-coded binder groups inside a tube filled with water-blocking agent.
- Have tube cables comprised of 19-, 7- or 4-cell.
- Each tube cell shall be sealed and tested per the manufacturer’s requirements.
- Have the designation “UL®” printed every two (2) feet on the cable jacket.
- The cable shall have individual fiber colors per TIA/EIA-598-C.
- The cable shall be suitable for temperatures of -40° C to +75° C.
- Multi-mode fiber bundles shall be OM4 and shall have a minimum of twelve (12) fiber strands per bundle.
- Single-mode fiber bundles shall be OS2 and shall have a minimum of eighteen (18) fiber strands per bundle.

Multi-mode fiber optic cables shall:

- Be graded-index optical fiber with nominal 50/125µm-core/cladding diameter.
- Shall support data transmission rates up to the maximum distances listed in the table below:

Throughput	Maximum Distance
1 Gbps	1000 meters
10 Gbps	550 meters
40 Gbps	150 meters
100 Gbps	150 meters

- Meet the graded performance specifications shown in the table below. Testing of the optical fiber shall be in accordance with ANSI/TIA-526-14-C using power meter testing Type B. The measurements shall be performed at 23° C +/- 5°.

**Transmission Characteristics:**

Maximum Attenuation	Minimum Bandwidth
3.5 dB/km @ 850 nm	3500 MHz.km @ 850 nm
1.5 dB/km @ 1300 nm	500 MHz.km @ 1300 nm

The performance characteristics of the fiber shall also comply with those specified in ANSI/TIA-568.3-D.

Single mode fiber optic cables shall be:

- Class IVa Dispersion-Unshifted single mode optical fibers complying with TIA-492CAAA.
- The zero-dispersion wavelength shall be between 1300 nm and 1324 nm. The maximum value of the dispersion slope shall be no greater than 0.093 ps/km-nm<sup>2</sup>. Dispersion measurements shall be made in accordance with TIA-455-175-C.
- The nominal core diameter shall be 8.3 μm to 10.0 μm with a tolerance of +/- 0.5 um at 1300 nm when measured in accordance with TIA-455-175-C.
- Meet the graded performance specifications shown in the table below. Testing of the optical fiber shall be in accordance with TIA-526-7-A, using testing Type A.1. The measurements shall be performed at 23 degrees C +/- 5 degrees.

**Transmission Characteristics:**

Maximum Attenuation	Cable Type
1.0 dB/km @ 1310/1550 nm	Riser (inside) Plant (Tight Buffered)
0.50 dB/km @ 1310/1550 nm	Outside Plant (Loose Tube)

**7.3.2 Tube cabling**

All fiber backbone cabling shall be installed using the Sumitomo Future Flex Tube cabling system. For outside plant installations, the tube cabling will be 19-cell back to the MDF. The tube cabling will be 7-cell to each building.

Where new conduit infrastructure is installed with unused conduits, all shall be equipped with a 3/8” nylon pull rope to facilitate future cabling installations.

**7.3.3 OSP Fiber Optic Cable Sizing**

Permanent buildings are defined as single or multi-story buildings or clusters of portable structures that will remain in place and in use for the foreseeable lifetime of the campus. One or more Information Technology Rooms may be located in these buildings, depending on the purpose, dimensions and/or square footage of the buildings.

Semi-permanent or temporary buildings structures consist of trailers, modular buildings or other structures defined to have a limited life span and usage of less than three years. Semi-permanent buildings may be used as “swing space” during renovations, (i.e., temporary offices for contractors and consultants) or as special purpose buildings for campus activities. As such, they are provided with a limited complement of fiber backbone cabling compared to permanent buildings.

### **Design Guidelines for Permanent Buildings**

Permanent buildings will be equipped with outside plant backbone cables to the Main Telecommunications Room (MDF). For each building, outside plant backbone fiber will consist of Sumitomo Future Flex Air Blown Fiber with, at a minimum, an 18-strand singlemode bundle and 12-strand 50/125-micron multimode bundle (18SM-12MM50/125um). This can be provided as two separate cables. The backbone cables will be run as home runs with no splices back to the MDF for the campus or site.

Where diverse pathways exist, a redundant set of backbone fiber cables shall be required for building connectivity. Redundant backbone cabling shall be of the same type and composition as the primary fiber backbone cabling. Routing and termination points of redundant fiber backbone cabling will be determined in conjunction with the District IT Group.

### **Design Guidelines for Semi-Permanent or Temporary Buildings**

Semi-permanent buildings typically house smaller numbers of staff/students and require less connectivity than permanent buildings. Outside plant fiber backbones feeding semi-permanent buildings will consist of, at minimum, a 6-strand 50/125-micron multimode fiber bundle (6MM 50/125um). Fiber backbones for semi-permanent buildings shall route either to the Building Distribution Room (BDF) of the nearest permanent building or the Main Distribution Room (MDF). The design of the backbone routing will be determined in conjunction with the District IT Group.

#### **7.3.4 General Installation Guidelines for Optical Fiber Cables**

All fiber optic cable shall be installed within ABF tube cable except horizontal station fiber.

- Use pulling compound when necessary. Pulling compound must be a water-base pulling lubricant that will not deteriorate the cable or conduit.
- All cabling shall be kept a minimum of 30 inches away from any heat source (i.e., steam valves, etc.).
- Cables shall be pulled free of sharp sweeps, kinks, twists or impact damage to the sheath.
- Cables shall not be pulled across sharp edges. All conduits and sleeve with rough edges will be provided with plastic bushings on both ends. Cables shall not be forced or jammed between metal parts, assemblies, etc.
- Cables shall not be pulled across access doors or pull box covers. Access to all equipment and systems must be maintained.
- Cable splicing will not be permitted at any point within a cable run.
- Conduits will not be filled to greater than a 25% fill.
- Outside plant conduits must have appropriately sized pull boxes every 300 feet. When conduit routes through up to two 90-degree sweeps (180 degrees total) in any dimensional plane, additional pull boxes shall be required. Cabling will not be installed in conduits that do not meet these specifications.

- Cable mountings and service loops on backboards inside Information Technology Rooms will be installed efficiently to minimize the backboard space consumed. All cables will be routed at right angles in accordance with bend radius specifications for the type of cable being routed. Cables will be tie-wrapped every 4 to 6 feet.
- All outside plant cables will be terminated within 50 feet of the building entrance point. This is a maximum cable length measurement and includes lengths for service loops, routing, backboard and patch panel mounting inside the building.
- Polarization for the entire system shall be maintained as described in ANSI/TIA-568.3-D section 12.7.1.
- All optical fiber cables shall be terminated on rack-mounted optical fiber patch panels. No fiber will be left unterminated.
- All vacant tube cable cells shall be tested and capped.

### **7.3.5 Copper Outside Plant Cables**

A minimum of 25 pairs per building pulled back to the MPOE is required. This needs to be carefully evaluated during the design process. All pair counts for backbone UTP cabling will be verified with the District IT Group during the design phase.

#### **Physical Characteristics:**

- Backbone UTP copper cables shall consist of a core of 24 AWG solid annealed copper conductors, color-coded in accordance with telephone industry standards.
- As a minimum, UTP copper backbone cables will be UL Verified Category 3 and will meet or exceed the Category 3 requirements in ISO/IEC 11801, CENELEC EN50173 and EIA/TIA 568B. Category 5e cable, white in color, shall be used for the connection between the block and the handset jack.
- Conductors shall be twisted to form pairs. Cable having more than 25 pairs shall be assembled in units, each individually identified by color-coded unit binders.
- The mutual capacitance of any pair shall not exceed 5.6 nF per 100 m at 1 kHz.
- The core shall be covered with a plastic tape.
- The cable will be designed for use in the outdoor environment, with a gel filled design to be used in wet locations. This includes aluminum steel with polyethylene (ASP) sheath and a core of solid-copper conductors, dual insulated with foam skin and plastic, and surrounded by a gel filling compound.
- Outside Plant Cable installations will meet all ISO/IEC 11801 requirements for a horizontal link. No more than 4 connections are allowed, including the protection devices at each end.

#### **Design Guidelines for Permanent Buildings:**

The current voice/voicemail systems at NOCCCD are based on analog and digital connections requiring one twisted pair per telephone set. OSP pair counts will be estimated based on the following

active pair utilization. VoIP implementations may use data cabling to support phones except as noted in 3.12.16:

- Classroom: one telephone
- Computer lab: one telephone
- Large lecture hall: two telephones
- Theatre: two telephones
- Single-person office: one telephone
- Partitioned office: one per cubicle, plus three additional per ten cubicles
- Conference room: one telephone, one speaker phone
- Maintenance room<sup>1</sup>: one telephone

This does not include estimates for phones external to buildings such as parking lot call boxes, pedestal payphones, etc. Additional pair counts will be included when the analysis of the building location is performed. The Telecommunication Consultant will allow for a growth factor of 20% and estimate the pair count upward to the next size cable.

Consideration for installing a redundant copper cabling for building connectivity will be determined on a building-by-building basis. Redundant backbone cabling is defined as the use of two copper OSP connections between equipment rooms routed via separate pathways to ensure no single point of failure.

#### **Design Guidelines for Semi-Permanent or Temporary Buildings:**

Backbone UTP copper cabling for these structures shall follow the same design requirements as stated above for permanent buildings, except to add a growth factor of 10%.

#### **General Installation Guidelines for Copper Cables:**

- Use pulling compound when necessary. Pulling compound must be a water-base pulling lubricant that will not deteriorate cable or conduit. Adhere to all manufacturer's requirements regarding pulling tension and allowable lubricants.
- All cabling shall be kept a minimum of 30 inches away from any heat source (i.e., steam valves, etc.).
- Cables shall be pulled free of sharp sweeps, kinks, twists or impact damage to the sheath.
- Cables shall not be pulled across sharp edges. All conduits and sleeves with rough edges will be provided with plastic bushings on both ends. Cables shall not be forced or jammed between metal parts, assemblies, etc.
- Cables shall not be pulled across access doors and pull box covers. Access to all equipment and systems must be maintained.

---

<sup>1</sup> Maintenance room is defined as: Information Technology Room, electrical room, HVAC/EMS control room, other control space.

- Cable splicing will not be permitted at any point within a cable run.
- All outside plant backbone cables will be installed in conduit. Aerial runs are not permitted.
- Conduits will not be filled to greater than a 25% fill.
- Conduits must have appropriately size pull boxes every 300 feet. When the conduit routes through up to two 90-degree sweeps (180 degrees total) in any dimensional plane, additional pull boxes shall be required. Cabling will not be installed in conduits that do not meet these specifications.
- Backbone cables will be installed with a 30-foot service loop. At each building, the service loops will be coiled neatly in the pull box or nearest handhole on the building's exterior wall. Cable mountings and service loops on backboards will be installed efficiently to minimize the backboard space consumed. All cables will be routed at right angles in accordance with the bend radius specifications for the type of cable being routed. Cables will be tie-wrapped every 4 to 6 feet.
- Cable shall be continuous and without splices. (Splices imply same pair count cable splices: i.e.: 200-pair to 200-pair.)
- Actual cable distances shall not exceed 100 meters.
- All outside plant cables will be terminated within 50 feet of the building entrance point. This is a maximum cable length measurement and includes lengths for service loops, routing, backboard and patch panel mounting inside the building.

### **7.3.6 Copper Protection**

All copper backbone cables that extend between buildings will be terminated at both ends on protector blocks.

- All pairs at both ends of the copper backbone cable shall be protected.
- Protector blocks shall be housed within a covered case. Protectors shall be sized so as to enable termination of all pairs in the copper backbone cable.
- Protector blocks shall be fully populated with solid-state or gas-tube protection fuses.
- Protector blocks shall contain an integrated 110 block for extension to the building cross connect fields or patch panels.
- Protector blocks shall have an integrated 26 AWG stub.
- Protection blocks shall be grounded with a #6 AWG copper bonding conductor between the protector ground lug and Telecommunications Grounding Busbar (TGB).
- Copper extension cables shall be installed from the protector blocks to the copper patch panels (one extension pair per jack).



In the event that copper backbone cabling is added to building areas where existing cabling is not protected, the Contractor shall retrofit the existing cabling with protector blocks in accordance with this standard.

## **7.4 RISER SEGMENT**

NOCCCD campuses have a limited number of multi-story buildings. However, the layout of the buildings may require several distributed closets to allow station cabling to stay within the 295 foot length limitation or to accommodate difficult or limited cabling pathways. As such, the installation of “riser” cabling includes vertically stacked or horizontally dispersed Telecommunication Rooms (TR).

### **7.4.1 Fiber Optic Riser Cable**

Buildings that contain multiple Information Technology Rooms will require fiber backbone cabling to be installed between the rooms. All riser fiber backbones will consist of, at minimum, an 18-strand singlemode fiber bundle and a 12-strand 50/125-micron multimode fiber bundle (18SM-12MM 50/125um). This can be provided either as two separate cables or one composite cable.

### **7.4.2 Riser Tube Cable**

The riser systems for multi-story building shall consist of riser rated tube cable. The Telecommunication Consultant shall call for all tube cables, tube couplings, tube distribution units (TDUs), fiber bundles, fiber termination units (FTUs) and connectors. The size and type of tube cable to be used shall be coordinated with the District IT Group at the time of design.

### **7.4.3 Copper Riser Cable**

The copper riser pair count shall be equal to the number of voice stations served by the Telecommunications Room, with a 20% growth factor. Cable sizes will be rounded to the next multiple of 25, 50 or 100 pairs. All buildings are required to have a minimum 25 pair count cable installed and connected to the campus backbone voice network.

The cable shall be Category 3 UL listed. All pair counts for backbone UTP cabling will be verified with the District IT Group during the design phase.

### **7.4.4 Coaxial Riser Cable**

The coaxial riser cable shall be .500 plenum (rigid or quantum reach) cable. The cable may also be used to distribute signal on to each floor to ensure a balanced distribution of CATV signals throughout each floor and building. Refer to **Section 27 12 00** of the “Sample Specifications” document set for a complete description of specifications.

## **7.5 OPTICAL FIBER TERMINATIONS**

### **7.5.1 Fiber Patch Panels**

Optical fiber patch panels shall meet or exceed the following specifications:

- Shall be rack mounted.
- Shall be configured in duplex LC style termination configurations.
- Shall be completely covered.

- Shall be available as a high-density shelf for MDF and BDF installations.
- Shall include a maintenance loop secured at the Fiber Termination Unit (FTU).
- Shall use 24-connector 1U trays for smaller Telecommunication Room (TR) backbone terminations where fiber counts are less than 24 fibers.

### **7.5.2 Optical Fiber Connectors**

Field termination is required for all fiber strands in the telecommunications closets. No fiber shall be left unterminated.

- All connectors shall be glass-in-ceramic LC-compatible field-installable duplex connectors.
- LC connectors shall meet ANSI/EIA/TIA-604-3 standards.
- Connectors shall have a locking feature to the coupler to prevent optical disconnect.
- The connector shall have an optical axial pull strength of 2.2 N at a 0-degree angle and an optical off-axial pull strength of 2.2 N at a 90-degree angle, with a maximum 0.5 dB increase in attenuation for both tests when tested in accordance with TIA-455-6-B.
- Adhere to all manufacturer installation guidelines.
- Multimode duplex connectors shall be aqua.
- Singlemode duplex connectors shall be blue.
- The maximum optical attenuation per each mated field installed connector pair shall not exceed 0.75 dB.
- The total optical attenuation through the cross-connect from any terminated optical fiber to any other terminated fiber shall not exceed 1.5 dB.
- Multimode fiber shall have a return loss greater than or equal to 20 dB.
- Singlemode shall not have a return loss greater than or equal to 26 dB.
- Connectors shall sustain a minimum of 500 mating cycles without degrading this performance.

### **7.6 COPPER PUNCH DOWN BLOCKS**

All new copper backbone cables shall be terminated on rack-mounted patch panels (one pair per RJ-45 jack) to facilitate moves and changes via patch cords from the station jack.

Punch down blocks will be used for cross-connecting existing copper backbone. Blocks shall meet or exceed the following specifications:

- 110 style termination blocks.
- 100- or 300-pair blocks as appropriate for the density of the terminations.
- Labeled per ANSI/TIA-606-C.

- Supplies with the connecting clips, designation strips, plastic covers and retaining clips necessary to terminate cables, including but not limited to:
  - 4-pair connecting clip for horizontal copper cabling (when terminating 4-pair cables).
  - 5-pair connecting clip for backbone copper cabling (when terminating high pair-count copper cables).
- Installed on plywood backboard so that the top of the highest block is no higher than 5 feet 6 inches above the finished floor.

## **7.7 HORIZONTAL STATION CABLE**

All cabling projects at the NOCCCD sites shall be installed with the most current ratified standard available at the time of the cabling project. At the time of publication of this document, the current cabling standard is Category 6A. All horizontal cabling system components must be certified for Category 6A transmission, including patch panels, cross-connect blocks, patch cords and outlet jacks.

During design, the Architect or Consultant shall determine Category 6A cable outside diameter (O.D.) size. Conduits will need to be sized to maintain a 25% fill.

This document requires the specification of plenum cabling rated as “CMP” for all new installations of cabling at campus sites. Station cabling for different transmissions systems (i.e., data, VoIP, WAPs, IP surveillance cameras, etc.) shall be cabled with different color cable sheaths for ready identification. The cable sheaths will be blue for data and white for voice. Other low-voltage subsystems must specify cabling with different color sheaths so as to avoid confusion with voice/data cabling. The Telecommunication Consultant will coordinate with other consultants and designers of other cabling systems to ensure that cable sheath colors are kept discrete. Cable colors for different low-voltage systems will be coordinated by the District IT Group.

With the approval of the new Enhanced Power over Ethernet standard 802.3bt (PoE++), the amount of power that can be provided to an end device via PoE increases from approximately 30 W to 90W. This change can result in a significant increase in the amount of electric current that passes over data cables, which in turn can result in heat buildup within data cable bundles that can adversely affect cable performance. Accordingly, the most recent versions of the NEC and CEC introduce new limits in sizing cable bundles based on how much electrical current passes through the individual cables in a cable bundle. The Architect and Telecommunication Consultant should be familiar with these changes and the potential impact that the use of PoE++ within an installation can have on cable performance.

## **7.8 VOICE/DATA JACKS**

Voice/Data jacks shall be 8-position modular jacks and shall be rated for Category 6A performance as defined by the references in this document, including ANSI/TIA-568.2-D performance requirements. All pair combinations must be considered, with the worst-case measurement being the basis for compliance.

Modular jack performance shall be third-party verified by a nationally recognized independent testing laboratory.

- The jack shall be a punch down on a 110-IDC connector.
- The punch down scheme shall be T-568B.
- The jack shall be Power Sum rated, with a Power Sum NEXT performance equal to or better than the Category 6A pair-to-pair NEXT performance specifications and shall have a mark to indicate compliance.
- The eight-position jack shall accommodate six-position modular plug modular cords without damage to either the cord or the module.
- The jack shall have all of its housing components made of fire-retardant UL 94V-0 plastic.
- The jack shall have a protective cap that snaps in the back of the module to provide strain relief for the conductors after termination.
- The jack shall have a minimum insulation resistance of 200 megaohms.
- The jack shall be FCC Part 68, Subpart F compliant.
- The jack shall be IEC-603-7 compliant.
- The jack durability shall be greater than 750 mating cycles (cable insertion/removals).
- The jack maximum current rating shall be 1.5 amperes.

**7.9 WORK AREA OUTLETS**

The Telecommunications Consultant and the District IT Group shall work together to define the requirements for this type of installation. For VoIP installations, all station cable shall be terminated in the TRs on 48-port rack-mounted patch panels.

NOTE: Responsibility for Elevator and Fire/Life/Safety systems falls outside of the District IT Group’s purview, but the District IT Group is responsible for design and provision of low-voltage cabling for these systems. The Telecommunication Consultant shall work with the Architect, the District IT Group, and the campus entities listed in the table below when designing for Elevator and Fire/Life/Safety low-voltage cabling:

<b>Campus</b>	<b>Fire/Life/Safety</b>	<b>Elevators</b>
Anaheim	Campus Facilities	Campus Facilities
Cypress	Campus Facilities	Campus IT
Fullerton	Campus Facilities	Campus Facilities

Project prints and Bid Documents must clearly indicate the type and style of cable and jacks to install, including provision for adequate services for Fire/Life/Safety devices as defined in Section 3.12.21.

- **Type A:** Voice/Data outlet with two (2) data cables terminated in a six-port faceplate, usually at a height of +18 inches AFF. *Typical installation: Conference Room.*
- **Type B:** Data outlet with two (2) data cables terminated in a four-port faceplate, usually at a height of +18 inches AFF. *Typical Installation: Classroom.*

- **Type C:** Data outlet with two (2) data cables terminated in a six-port faceplate, usually at a height of +18 inches AFF. *Typical installation: Administrative Office.*
- **Type D:** Data outlet with a minimum of four (4) data cables, terminated in an eight-port faceplate. Height varies with installation. *Typical installation: Computer Lab.*
- **Type E:** VoIP outlet with one (1) data cable terminated in a one-port metal faceplate, for wall-mount telephones at a height of +48 inches AFF. *Typical installation: Classroom, Corridor.*

**7.10 OUTLET DISTRIBUTION**

The typical outlet types described in the preceding section will be installed according to room function. In addition to the general outlet information detailed in Section 3.11, the following specific outlets types are required for each room:

Room Type	Outlet Types
Single Person Office <sup>2</sup>	Two (2) Type C outlets to maximize flexibility in placing desks and furniture.  One (1) Type C outlet at conference table.
Cubicle/Partitioned Office	One (1) Type C outlet per cubicle in modular furniture communications raceway/trough as available. Outlet provisioned with fittings to hold jacks securely.  One (1) additional Type C outlet for each four cubicles for support of fax/shared printers, etc.
Conference room (variable size)	One (1) Type A outlet on front wall by “whiteboard” or presentation screen.  One (1) Type A outlet every ten feet of wall within three feet of electrical outlets, minimum one outlet per wall.  One (1) Type B outlet centered in ceiling by location for ceiling projector.
Instructional Classroom	One (1) Type C outlet at instructor’s podium.  One (1) Type B outlet every ten feet of wall within three feet of electrical outlets, minimum one outlet per wall.  One (1) Type B outlet centered in ceiling by location for ceiling projector.  One (1) Type E outlet at main entrance to classroom, for wall-mount telephone.  Where classrooms contain network-attached electronic whiteboards, add one (1) data cable to whiteboard location as needed, routed in-wall.

---

<sup>2</sup> Single Person offices may often be reconfigured to be shared by multiple part-time staff, with several desks, phones and computers.

<b>Room Type</b>	<b>Outlet Types</b>
Work/Prep room	One (1) Type E outlet at room entrance. Multiple Type A outlets distributed every six feet above countertop. One (1) Type C outlet at photocopier location.
Storage Rooms <sup>3</sup>	One (1) Type E outlet at room entrance.
Maintenance Room	One (1) Type E outlet at room entrance. Multiple voice/data cables to system controllers that have modem or Ethernet connection requirements. If an office/desk for maintenance personnel are included in the maintenance room, add: One (1) Type A outlet for every desk location.
Rooftops	One (1) Type A outlet in weatherproof box. Multiple voice/data cables to rooftop HVAC or other controllers that have modem or Ethernet connection requirements routed in conduit with weatherproofing.
Payphone	One (1) Type E outlet at each location designated for payphone or TTY phone.
Emergency Phones (corridors, elevators, foyers, parking lots, bus stops)	One (1) Type E outlet or cable with custom termination located at every location as required by security plan. OSP cable required for all below grade or routing to building exterior.
Change Rooms	One (1) Type E outlet at room entrance.

The following are general guidelines for computer labs. Each computer lab must be custom designed, incorporating the size, purpose, furniture layout, and floor type into the detailed design.

<b>Room Type</b>	<b>Outlet Types</b>
Instructional Computer Lab	Two (2) Type B outlets on front wall, one on each side of the “whiteboard” or teaching wall. One (1) Type B outlet centered in ceiling by location for ceiling projector. One (1) Type E outlet at main entrance to classroom, for wall mount telephone.

---

<sup>3</sup> Storage rooms are often converted to offices after the fact.

Room Type	Outlet Types
	Multiple Type D outlets distributed around room periphery, usually in metallic raceway mounted at +6” above tabletop. Number and exact location of outlets varies with room size and placement of computer tables in room.
Self-Study Computer Lab	<p>One (1) Type B outlet centered in ceiling by location for ceiling projector.</p> <p>One (1) Type E outlet at main entrance to classroom, for wall mount telephone.</p> <p>Multiple Type D outlets distributed in walls, wall-mount raceways and flush-mount floor boxes. Pathways will not obstruct pedestrian traffic or viewing. In particular pancake raceway, or power poles are to be avoided.</p>

Specialty locations such as theaters, auditoriums, press boxes, large lecture halls, pools, playing fields and for scoreboards and advertisement boards require custom design according to the proposed functionality. It should be assumed that each specialty device will require a data or voice connection for current or future connectivity. As a minimum, two Category 6A cables shall be provisioned for each location. Where cabling runs below grade or is exposed to the building exterior, outside plant cable shall be required. Cables will be provisioned within the 90-meter length requirement for data connectivity.

**7.11 FACEPLATES**

The standard faceplate configuration is a single-gang faceplate providing for four ports of connectivity. Configurations of any additional number of ports are subject to the approval of the District IT Group.

- The faceplate housing the jacks shall provide a symmetrically centered appearance for the modules.
- Snap-in inserts shall be provided to cover any unused openings in the faceplate. Inserts are removable for future installation of additional jacks.
- It shall be possible to install the jacks in wall-mounted single- and dual-gang electrical boxes, utility poles and modular furniture (cubicle) access points using manufacturer supplied faceplates and/or adapters.
- The faceplate housing the jacks shall have a labeling capability using built-in labeling windows, to facilitate outlet identification and ease of network management.
- The faceplate housing the jacks shall accommodate up to a maximum of six modules in a single-gang form and up to a maximum of twelve modules in a dual-gang form.
- The faceplate housing the jacks shall provide flexibility in configuring multimedia workstation outlets that meet present and future network needs, such as audio, video, coaxial and optical fiber applications (where required).

- The color of the faceplate shall be coordinated with the color of the surrounding electrical outlets, usually as Electric Ivory or Electric White. No metal faceplates will be allowed, except as required for extra durability at wall-mount telephone locations.

## 7.12 COPPER PATCH PANELS

Category 6A patch panels shall be used for termination of all voice and data station cabling. Category 6A patch panels shall meet or exceed the following specifications:

- ANSI/TIA-568 Category 6A standard.
- Rack mounted with front-facing RJ-45 patch panels and rear-facing 110 blocks.
- Shall be T568-B wired.
- Shall have a paired punch down sequence to allow pair-twist within ½-inch of the termination.
- RJ-45 jacks shall be modular to allow discrete removal and replacement of jacks without removal of the entire patch panel, as maintenance issues arise.
- Shall be UL listed.
- Shall be made of rolled edge black anodized aluminum construction.
- Shall have 48 ports with integrated cable management ring and rear cable suspension racks.
- Shall be from the same manufacturer as the other connectivity products (cable, jacks, faceplates, etc.).

Rear patch panel cable management should include 2-inch or 5-inch cable support bars. Category 6A installation requirements specify that the cable shall enter the patch panel perpendicular to the termination – the cable bar facilitates this requirement. All cable bundles on cable support bars will be managed with Velcro straps. Tie-wraps are not acceptable.

## 7.13 GROUNDING AND BONDING

The Telecommunication Consultant will work with the Electrical Designer to ensure a telecommunication ground system is provided and installed in accordance with ANSI/TIA-607-D, *Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises*. The telecommunications ground system shall be installed to support the Information Technology Rooms and infrastructure. The design of the grounding infrastructure is described below.

A Telecommunications Main Grounding Busbar (TMGB) shall be located in the Building Telecommunications Room. The TMGB shall be a predrilled copper busbar provided with standard NEMA bolt hole sizing and spacing. The TMGB shall be electrotin-plated for reduced contact resistance. The TMGB shall be a minimum size of 5 mm thick, 100 mm wide and 300 mm in length. The TMGB shall be insulated from its support by a 50 mm separation.

The TMGB shall be bonded to the electrical panel ground bus bar and to building steel or ground rod by conventional welds, exothermic welds clamp-and-braze method, or UL-approved compression type



connectors where practical. Exothermic welds are the preferred method. Because of the high temperatures involved, copper materials may be bonded to iron or steel. The mold size must match the cable or conductor cross section. The size of the weld metal charge must match the size of the mold being used. The connection between the TMGB and the bonding point is to be 3/0 insulated copper ground wire.

In each Telecommunications Room (TR), a Telecommunications Grounding Busbar (TGB) shall be installed. The TGB shall be a minimum size of 5 mm thick, 50 mm wide and 150 mm long. The TGB shall be bonded to the electrical panel serving the rooms where the TGB is installed, to building steel, and in series to the main TMGB.

All metallic structures (racks, cabinets, cable runway, etc.) shall be attached to the TGB using grounding straps. Use minimum of #6 AWG, green jacket, stranded grounding wire between all equipment racks and the existing telecommunications grounding busbars. Metallic straps shall be used to join individual segments of cable runway, relay racks, equipment and other metallic structures. All metallic structures will be stripped of the paint coating at the point of grounding connection to ensure that the metallic straps and ground wires mate to the metal structure with sufficient contact.

The electrical contractor shall install and bond the main components of the system (busbar, ground rod, ground wire to grounding source, etc.) The cabling contractor shall install the connectivity to the metal components of the cabling system, including voice protectors, racks, cable runway, cabinets, patch panels, etc. The Telecommunication Consultant shall ensure that the communication specification/RFP calls for the bonding of all components within the Information Technology Rooms.

#### **7.14 RACK/CABINET LAYOUT (ELEVATION)**

All equipment in racks must follow the general guidelines provided below in regard to placement within the rack or cabinet.

**Fiber Patch Panels:** Fiber patch panels shall be placed at the highest point possible in the rack or cabinet. Singlemode fiber patch panels shall be mounted above multimode fiber patch panels. Fiber patch panels shall have integrated cable management in the front and cable guides in the rear.

**Copper Patch Panels:** Copper patch panels shall be installed below the fiber patch panels. Wire management shall be integrated in the copper patch panels.

**Wire Management:** Horizontal wire managers shall be provided to route patch cords to the network equipment. One (1) 2U horizontal wire manager shall be provided for each 48-port patch panel or 48-port network switch.

**Network Equipment:** All network equipment will be installed such that wire management is located directly above and below each network switch, alternating down the rack. For easy access, network equipment will be mounted between waist and neck height on the rack (3' to 5' AFF). **NOTE:** Network equipment will not be included as part of any construction bid but are important considerations in the design of appropriate racking/cabinet layouts.

**Power management:** Where rack-mount uninterruptible power supplies (UPS) are provided, UPS units shall be installed at the base of the rack. Surge-protected power strips shall be installed midway in the

rack/cabinet, above the network equipment, to allow for easy access to equipment power cords. Care must be exercised to ensure that power conduits do not block access to mountable rack space. UPS run time shall be a minimum of 30 minutes.

### **7.15 FLOOR MOUNTED RACKS**

Floor-mount racks shall be open, self-standing relay racks and shall meet the following physical specifications:

- Shall have a 19-inch-wide rack mounting space.
- Shall be 84 inches high.
- Shall be constructed of lightweight aluminum.
- Black polyurethane or powder coat finish.
- Shall be equipped with four (4) 3/4-inch bolt-down holes.
- Shall have double-sided tapped holes with standard EIA/ECA-310-E hole pattern. Preferred screw size is #10-32.

Each rack shall have an integrated vertical cable channel with a minimum of 6.5 inches of channel space to facilitate vertical cable management of cables entering the rack from the under-floor and above-ceiling cable tray. Each rack will be supplied with a bag of bolts and cage nuts, if needed, attached to the rack and matching the rack color and threading. There should be enough bolts and nuts to fill every opening. All racks will be installed with a minimum of 3' of clearance from the mounted equipment on front and rear sides. All racks shall be properly anchored to the slab floor using all four (4) holes. Per DSA-approved design, rack anchoring will use Hilti 1/2" anchor bolts that pass a 45 lb. torque test. If racks are located over raised floors, the racks shall be installed with raised floor rack support units that include threaded rod, z-braces and anchors that securely attach the rack to the building structure (slab).

Electrical outlets that will service floor mounted racks shall typically be installed either at the top or at the bottom of the rack. The Electrical Engineer shall consult with the District IT Group to determine requirements on a per-rack basis.

Each rack shall be equipped with a rack-mounted horizontal power strip. All power strips shall meet or exceed the following specifications:

- Shall be 20A/115V.
- Shall be rack mounted.
- Shall be non-switched.
- Shall be fusible and provide surge suppression.
- Shall have a visible AMP meter.
- Shall have a minimum of 6 outlets – transformer spaced.
- Shall have a lockable power switch to prevent accidental power-down.
- Power cord shall be a minimum of 10 feet in length.
- Shall meet UL 1363 and 1449 requirements.

Per grounding requirements described above, floor-mounted racks shall be grounded to the TGB with a minimum #6 AWG copper wire.

## **7.16 WALL MOUNTED RACKS**

Wall-mount racks shall meet the following physical specifications

- Shall have 19-inch-wide rack mounting space.
- Shall be 15U high (1U = 1.75 inches).
- Rear of rack shall swing out from the wall for easy access to the back of the rack.
- Shall have double-sided tapped holes with standard EIA/ECA-310-E hole pattern.
- If the rack is enclosed, it shall have knockouts for enclosure fans and cable routing. Any knockouts used for cable routing will be wrapped with plastic bushings to prevent the rough edges of the knockout from damaging the cabling.
- The rack shall be installed on the fire-rated backboard and must not support more weight than what the fire-rated back board can safely support.

Each rack will have an integral vertical cable channel with a minimum of 6.5 inches of channel space to facilitate vertical cable management of cables entering the rack from underfloor and above-ceiling cable tray. If the rack comes with fastening hardware, it must be physically attached to the rack when the rack is provided to NOCCCD. There should be enough bolts, nuts, or screws provided to fill every opening. All racks will be installed with a minimum of 3 feet of clearance from the mounted equipment on front and rear sides. The ¾" fire-rated AC plywood shall be painted with two coats of white (or other light-colored) paint. At least one (1) fire-rated stamp must be visible per sheet or partial sheet of plywood when painting is completed. All racks shall be properly anchored to the wall per DSA. Power for the rack must be delivered by an outlet installed inside the rack.

Electrical outlets that will service wall mounted racks shall typically be installed adjacent to the rack. The Electrical Engineer shall consult with the District IT Group to determine requirements on a per-rack basis.

Each rack shall be equipped with a rack-mounted horizontal power strip. All power strips shall meet or exceed the following specifications:

- Shall be 20A/115V.
- Shall be rack mounted.
- Shall be non-switched.
- Shall be fusible and provide surge suppression.
- Shall have a visible AMP meter.
- Shall have a minimum of 6 outlets – transformer spaced.
- Shall have a lockable power switch to prevent accidental power-down.
- Power cord shall be a minimum of 3 feet in length.
- Shall meet UL 1363 and 1449 requirements.

Per grounding requirements described above, wall-mounted cabinets shall be grounded to the TGB with a minimum #6 AWG copper wire.

### **7.17 FLOOR MOUNTED CABINETS**

When Information Technology Rooms must coexist with infrastructure for other electrical or low-voltage systems, the Information Technology infrastructure shall be completely concealed in lockable telecommunication cabinets. Floor-mounted cabinets are preferred. These cabinets shall be:

- Self-standing structures.
- Sized as a 24" W x 24" D x up to 84" H.
- 19-inch-wide rack mounting space.
- Lockable, with common key set for all cabinets from one manufacturer.
- Black in color, with smoked glass, removable front and back doors and vented side panels.
- Equipped with circulation fan.
- Equipped with manufacturer-provided seismic kit rated for Zone 4.
- Contain internal adjustable rails upon which patch panels, wire managers and network equipment shall be installed.
- Include knockouts for ceiling fans and cable routing. Any knockouts used for cable routing shall be wrapped with plastic bushings to prevent the rough edges of the knockout from damaging the cabling.

All cabinets shall be mounted with a minimum of 3 feet clearance in the front, back and sides of the cabinet. All cabinets shall be properly anchored to the slab floor using a manufacturer-provided seismic bracing kit. Per DSA-approved design, the anchoring will use Hilti ½" anchor bolts which pass a 45 lb. torque test. Each cabinet will be supplied with a bag of bolts and cage nuts, if needed, attached to the rack and matching rack color and threading. Enough nuts and bolts should be provided to fill every opening.

Electrical outlets that will service floor mounted racks shall typically be installed either at the top or at the bottom of the rack. The Electrical Engineer shall consult with the District IT Group to determine requirements on a per-rack basis.

Each rack shall be equipped with a rack-mounted horizontal power strip. All power strips shall meet or exceed the following specifications:

- Shall be 20A/115V.
- Shall be rack mounted.
- Shall be non-switched.
- Shall be fusible and provide surge suppression.
- Shall have a visible AMP meter.
- Shall have a minimum of 6 outlets – transformer spaced.

- Shall have a lockable power switch to prevent accidental power-down.
- Power cord shall be a minimum of 10 feet in length.
- Shall meet UL 1363 and 1449 requirements.

Per grounding requirements described above, floor-mounted cabinets shall be grounded to the TGB with a minimum #6 AWG copper wire.

### **7.18 CABLE WIRE MANAGEMENT**

Where integrated cable management systems are not available, vertical and horizontal cable management systems will be provided. Horizontal and vertical cable management shall be provided for all racks. Cabinets shall be provided with horizontal and vertical cable management. Use of finger duct style management with hinged covers is preferred.

Vertical cable managers with covers are required for all racks and shall be provided between racks and at each end of each row of racks to facilitate cable management and routing between the racks. Vertical cable managers shall be the finger-duct style with integrated cable guides. For single racks, a minimum size of a 4" W x 8" D channel is required on each side of the rack. For multiple racks, a minimum 6" W x 16" D channel is required between the racks. If two or more racks are installed side-by-side, install cable managers in between and on the end of racks. Vertical cable managers will be double-sided with lockable hinged covers that can open in either direction or be removed completely. Pass-through slots will provide access from the front to rear cable channels. Vertical cable managers shall extend the complete height of the rack. The covers will be one piece for the entire height of the rack.

One (1) horizontal cable manager shall be provided for every 48-port patch panel that is installed to manage patch cord connections to the network switch equipment. Horizontal cable managers shall be double-sided and 3.5" H. The covers shall be hinged and shall open up or down or be completely removable as needed.

All cable bundles within cable managers will be managed with Velcro straps. Tie-wraps are not acceptable.

### **7.19 CABLE RUNWAY**

All exposed cabling running horizontally in an Information Technology Room must be routed using cable runway (i.e., ladder rack).

- Cable runway shall be appropriately secured to walls and top of equipment rack/cabinet per manufacturer recommended guidelines.
- Cable runway shall be grounded to the telecom grounding bus bar using a minimum #6AWG ground wire. Metallic straps shall be used to join individual segments of cable runway. All metallic structures will be stripped of the paint coating at the point of grounding connection to ensure that the metallic straps and ground wires mate to the metal structure with sufficient contact.
- In new construction, all cable runways will be black in color. In existing spaces, installation of additional ladder rack should match manufacturer and color of existing ladder, if any exists.

## 7.20 CABLE PATHWAYS

In accessible main corridors, the use of a communication cable tray system is the preferred method for the main cable path. At least 12 inches of clearance is required above the cable tray and the cable tray must have a minimum clearance of 12 to 18 inches on one or both sides. Cable tray shall be appropriately secured to ceiling deck and grounded per manufacturer recommended guidelines.

For distribution from the main cable path to discrete outlet locations, J-Hook suspension is acceptable. Cables shall be supported by J-Hooks every 4 to 6 feet. A J-Hook shall be installed above every outlet location, on which a ten (10) foot service loop of station cabling will be attached. J-Hooks shall be independently supported and not attached to existing conduit, ceiling/lighting structures or other suspension apparatus. J-Hooks shall be installed according to the manufacturer's instructions.

J-Hooks will not be filled beyond their specified capacity. Where dense cable runs create large bundles of cables and cable runway is not available, the cable bundles shall be split and supported on multiple J-Hook routes. Cable bundles will not exceed 50 cables and shall be tie-wrapped to the J-Hook to prevent cables from spilling out in the event of an earthquake or other disturbance. J-Hook installation shall be made part of the work of the cable installation contractor.

## 7.21 CABLE INSTALLATION METHODS

The Contractor shall adhere to cable installation methods that will ensure that data transmission across unshielded copper cables is not adversely affected by environmental factors. This includes strictly adhering to the manufacturer's installation methods and workmanship described as follows:

1. When placing copper cable, the contractor shall maintain the following clearances from sources of electromagnetic interference (EMI) exceeding 5 kVA (unless shielded Category 6A cable is used):
 

• Main power panel:	6 feet
• Power cable:	12 inches
• Fluorescent lights:	5 inches
• Heat source:	30 inches
• Electric motors and transformers	48 inches
2. All power feeds crossing the path of the unshielded copper cables at right angles must be a minimum of 12 inches in distance from the UTP cables.
3. Cables shall be placed a minimum of 18 inches above the tile ceiling.
4. Cables shall be as accessible as possible.
5. Pull conductors together where more than one is being installed in a raceway. Cable bundles in suspension systems or on wallboards must be Velcro-wrapped every 4 feet. Strapping to any other wires (e.g., lighting ceiling grid, etc.) is not permitted. Station wire cannot be attached to electrical conduit, gas or sprinkler piping, or other code-restricted items.
6. Use pulling compound when necessary. Pulling compound must be a water-base pulling lubricant that will not deteriorate cable sheath or conduit.

7. No cabling shall rest on any ceiling tile or suspension system.
8. Cables shall be pulled free of sharp sweeps, kinks, twists, or impact damage to the sheath.
9. Cables shall not be pulled across sharp edges. Plastic bushings shall be installed on rough sleeve or conduit edges before cable installation takes place. Cables shall not be forced or jammed between metal parts, assemblies, etc.
10. Cables shall not be pulled across access doors and pull box covers. Access to all equipment and systems must be maintained.
11. Insulation shall be removed to expose shielding and conductors to the exact length required by manufacturer for proper termination of plugs and pins and as specified in ANSI/TIA 568/569.
12. Pins and plugs, upon termination, shall not be damaged in any way.
13. Cable guides and suspensions (J-Hooks, cable runway, waterfalls, etc.) shall be provided to ensure that the cable path is securely suspended and adheres to the manufacturer's bend radius.
14. Cable splicing will not be permitted at any point within a cable run.
15. Cable mountings on backboards shall be installed efficiently (no divers) to minimize the backboard space consumed. All cables will be routed at right angles, in accordance with the bend radius specifications for the type of cable being routed. Cables will be Velcro-wrapped every 4 to 6 feet and routed through D-rings for a neat appearance and manageability.

## **7.22 FIBER OPTIC CABLE TESTING AND TEST RESULTS**

### General Test Requirements:

- The tester shall be capable of performing the tests required by ANSI/TIA-568.3-D, TIA-526-14-C, and TIA-526-7-A.
- A manufacturer-certified calibration facility shall have calibrated the tester dated no more than 60 days prior to the start of testing.
- All testing procedures and testers shall comply with applicable requirements of ANSI/TIA-568.3-D.
- End-to-end attenuation testing using an approved Power Meter and Light Source per TIA-455-C.
- Backbone multimode fiber shall be tested in one direction at both 850nm and 1300 nm in accordance with TIA-526-14-C, method B.
- Backbone single mode fiber shall be tested at both 1310nm and 1550 nm in accordance with TIA-526-14-C, method A.1.
- The acceptable link attenuation for backbone 50/125 OM4 multimode fiber based on distance shall be 2.5 dB/km @ 850 nm or 1.0 dB/km @ 1300 nm.
- The acceptable link attenuation for backbone 8.3 to 9/125 single mode fiber, based on distance, shall be 1.0 dB/km @ 1310 nm and 1550 nm for inside plant.

All fiber optic cables shall be tested and results shall be submitted for all fibers in an electronic format on CD-ROM; tester will also provide one (1) soft copy of the test results showing graphically the entire length of the fiber. The Contractor shall submit (1) copy of software capable of viewing the electronic test result files. Test results shall be provided with warranty registration no later than 14 days after completion of approved test results.

### **7.23 BACKBONE COPPER CABLE TESTING AND TEST RESULTS**

The Specifications or RFP shall require the Contractor to perform tests on the copper backbone cable (OSP and riser). Tests shall be performed from each termination block for each pair on 100% of the copper cable pairs. The end-to-end test shall include the following:

- DC Continuity
- Reversals
- Shorts
- Opens
- Overall loop resistance/cable length
- Attenuation
- Spits
- Transpositions
- Grounds
- Presence of AC voltage.

The technician will examine open and shorted pairs to determine if the error is a termination issue. If not correctable, the technician shall tag bad pairs at both ends, and make note on the as-built documentation. If copper backbone cable contains more than one percent (1%) bad pairs, the Contractor shall remove and replace the cable at the Contractor's expense.

The cable test results shall be submitted in electronic format on CD-ROM, with the resulting file formatted with one test result per 8.5-inch x 11-inch page. Files exported and saved as \*.txt files are NOT acceptable; test results must be provided in the native format of the tester and PDF format. The Contractor shall submit (1) copy of software capable of viewing the electronic test result files with each set of As-Built drawings that are delivered with the closeout documents. Test results shall be provided with warranty registration no later than 14 days after completion of approved tests.

### **7.24 UTP HORIZONTAL CABLE TESTING AND TEST RESULTS**

#### **General Test Requirements:**

All horizontal UTP cabling shall be tested and certified to meet CommScope SYSTIMAX performance standards when all pairs are terminated on a patch panel port and an outlet port. If the overall distance between patch panel and outlet or patch panel to patch panel is less than 50 feet in length, a patch cable must be added to the link being tested to achieve the desired minimum length of 50 feet in order to verify Category 6A testing parameters.

- Testing shall conform to ANSI/TIA-568.2-D.
- Testing shall be accomplished using a UL certified Level III tester.



- Any cable failing the prescribed certification testing shall be removed and replaced at the Contractor's expense.

The Contractor shall provide Category 6A, channel test results on all pairs of cable, including but not limited to cable length, wire map, NEXT, Power Sum NEXT, ACR, Power Sum ACR, ELFEXT, Power Sum ELFEXT, Return Loss, Propagation Delay and Delay Skew.

All cables will be tested and the results and submitted in electronic format on CD-ROM, with the resulting file formatted with one test result per 8.5-inch x 11-inch page. Files exported and saved as \*.txt files are NOT acceptable; test results must be provided in the native format of the tester and PDF format. If the test results are not pdf viewable, the Contractor shall submit (1) copy of software capable of viewing the electronic test result files with each set of As-Built drawings that are delivered with the closeout documents. Test results shall be provided with warranty registration no later than 14 days after completion of approved tests

### **7.25 CABLE TESTING VALIDATION**

After cable installation has been completed and the Telecommunication Contractor has completed testing, the District IT Group reserve the right to separately test up to 100% of the installed cables using the Telecommunication Contractor's testing equipment or with NOCCCD-provided computer/network equipment. Cables that fail to meet performance requirements as stated in the specifications shall be removed and replaced with all new material and re-tested at no cost to the college or the District. The Telecommunication Consultant will verify that these requirements are reflected in the RFP or specification details. Test results shall be provided with warranty registration no later than 14 days after completion of approved tests.

### **7.26 IDENTIFICATION AND LABELING**

District IT Group will work with the Telecommunication Consultant to implement a consistent and unique labeling scheme across all buildings. All labels shall:

- Horizontal cables shall be marked on the sheath at each end of the cable indicating the Telecommunications Room (TR) and jack number to which the cable is wired.
- Backbone cables shall be marked at each endpoint and at all intermediate pull/access points or junction boxes. Labels shall indicate origination and destination Telecommunication Rooms (TR), sheath ID and strand or pair range.
- Meet the legibility, defacement, exposure and adhesion requirements of UL 969.
- Be pre-printed or laser printed type.
- Where used for cable marking, a label with a vinyl substrate and white printing area and a clear "tail" that self laminates the printed area when wrapped around the cable shall be provided. The label color shall be different than that of the cable to which it is attached.
- Where insert-type labels are used, provide clear plastic covers to go over label.

- The Contractor shall confirm specific labeling requirements with the District IT Group prior to cable installation or termination.

#### Information Technology Room Naming

Each Information Technology Room will be named and numbered with an individual numeric identifier. Current room naming conventions at the Colleges use a unique room number that correlates to the floor and building number. For example, the second floor TC in Building 300 at Fullerton College is in room 307.

#### Fiber Backbone Cable Labels

All backbone fiber cables (riser cables) shall be labeled at each end of the cable bundle at the furthest point where the sheath is intact (before breakout). If the riser cables pass through multiple pull boxes, Information Technology Rooms or riser openings, they will be labeled at each opening.

All outside plant backbone fiber cables shall be labeled at each end and in each handhole or maintenance hole that they pass through. Labels will be heatproof and waterproof so that they do not decay when exposed to the elements. All labels must be visible at point of access.

All cables shall be labeled according to the guidelines as set forth in the EIA/TIA 606-C standard. This shall include:

- The campus (i.e., Anaheim, Cypress, Fullerton)
- The origination point (i.e., building number)
- The destination point (i.e., building number)
- The type of cable (i.e., SMF, 50MMF)
- The fiber strand count

Example: The-48 strand single mode backbone cable that runs between Building 600 and Building 300 at Fullerton College shall be labeled F600-300-SMF-48.

#### Optical Fiber Patch Panel Labels

Fiber patch panels shall be marked using adhesive labels indicating the range of fibers installed in it. Each panel shall be labeled with the origination and destination Telecommunication Rooms and the strand count. Each fiber strand shall be labeled with a unique strand ID.

All fiber patch panels will be labeled according to the guidelines as set forth in the ANSI/TIA-606-C standard. This shall include:

- Name of source Telecommunication Room
- Name of destination Telecommunication Room
- Fiber pair number

### Riser/Backbone Copper Cable Labels

All riser copper cables shall be labeled at each end of the cable bundle at the furthest point where the sheath is intact (before breakout). If the riser cables pass through multiple pull points, Information Technology Rooms or riser openings, the cables shall be labeled at each opening.

All outside plant backbone copper cables shall be labeled at each end and in each handhole/maintenance hole that they pass through. Labels will be heatproof and waterproof so that they do not decay when exposed to the elements. All labels must be visible at every point of access.

All cables will be labeled according to the guidelines as set forth in the EIA/TIA 606-C standard. This shall include:

- The campus (i.e., Anaheim, Cypress, Fullerton)
- The origination point (i.e., building number)
- The destination point (i.e., building number)
- The type of cable (i.e., Category 3, Category 5e)
- The pair count

Example: The 25-pair, Category 3 backbone cable that runs between Building 300 and Building 500 at Fullerton College shall be labeled F300-F500-CAT3-25.

### Copper Protector Labels

Copper protectors shall be marked using adhesive labels indicating the range of copper backbone pairs installed in it. Each panel shall be labeled with the origination and destination Telecommunication Rooms and the pair count.

All protectors shall be labeled according to the guidelines as set forth in the EIA/TIA 606-C standard. This shall include:

- The campus (i.e., Anaheim, Cypress, Fullerton)
- The origination point (i.e., building number)
- The destination point (i.e., building number)
- The type of cable
- The pair count

Example: At Fullerton campus, the 50-pair copper backbone cable starting in the Building 400 and running to the Building 500 shall be labeled F400-500-50.

Where protectors terminate multiple backbone pairs, each backbone shall be clearly and discretely labeled.

### Faceplate/Outlet Labels

All faceplates/outlets for station cable terminations shall be labeled. This includes wall outlets, wall phones, faceplates in floor boxes and all other termination points. For faceplates equipped with a label trough and plastic cover, the Contractor shall include the jack designation in the label trough. If upper

and lower troughs are available, the Contractor shall divide the jack labeling horizontally, labeling the top two jacks in the upper trough and the bottom two jacks in the lower trough.

All faceplates/outlets will be labeled according to the following guidelines:

- The Telecommunications Room (TR) based on the floor the room is at. There is no floor indicator
- Each data port will be labeled D for Data.
- If there is more than one TR on a floor, then the next one shall be indexed with an incremental digit skipping 1.
- The port number which is continuous. If there are two 48 patch panels. The first panel is number 1-48 the next one is numbered 49-96

Example: A station cable fed from data port 50 in the first TR on a floor would be labeled D-50. A station cable fed from data port 49 in a second TR on the same floor would be labeled D2-49. Every faceplate shall have a unique faceplate/outlet number, incrementing numerically.

#### Station Cable Labels

All station cables shall be labeled at each end of the cable within 6 inches of the termination. At the patch panel end, all labels must be visible and shall not be placed inside wire management. Station cables will also be labeled on the faceplate. All cables will be labeled according to the guidelines as follows:

- Name of the Telecommunications Room where the cables terminate.
- Faceplate/outlet number
- Jack label – numeric (1, 2, 3, and 4) labeled left to right, top to bottom.

#### Copper Patch Panel Labels

All ports on the station patch panels shall be labeled with the station cable labels described above. Cables will be terminated in ascending outlet and jack order and be so labeled.

Patch panels which provide cabling connection to voice riser and backbone pairs shall be labeled using a similar convention as the backbone/riser cable labeling. The patch panel will be labeled with the cable name including:

- Origination point
- Destination point
- Type of cable

Each jack will be labeled for each pair in the riser/backbone cable.

## **7.27 INSPECTION**

The District IT Group shall participate in the inspection and acceptance of all cabling installations. During the construction process, inspections will be coordinated with the Inspector of Record and Engineering teams. As a minimum, periodic inspections will occur at the following phases of construction:

1. Submittals Review and Approval
2. RFI clarifications
3. Fiber Reel testing (prior to installation)
4. Cable tray/J-Hook installation
5. Information Technology Space construction (rack/cable runway installation)
6. Cable installation
7. Cable termination
8. Labeling
9. Testing and review of test results
10. Final construction inspection
11. Manufacturer's inspection and warranty approval

The District IT Group will participate in the acceptance of all construction projects to verify that the installation is compliant to these standards and the design documents.

## 8. WIRELESS DESIGN AND IMPLEMENTATION GUIDELINES

### 8.1 INTRODUCTION

The purpose of this section is to document basic requirements and service goals for any Wi-Fi systems designed and installed at any NOCCCD campus or office so as to provide an acceptable level of service for a given quantity of users and end point devices.

### 8.2 ARUBA CLEAR PASS COMPATIBILITY

NOCCCD uses Aruba ClearPass network management software to manage user/device access to its network. Any wireless access point proposed for use at any NOCCCD campus or office must be compatible with the version of Aruba ClearPass in use at the District at that time (currently v6.9).

### 8.3 INDOOR WIRELESS REQUIREMENTS & SERVICE GOALS/TARGETS

- Capacity: Desired system capacity is seventy-five (75) connections per wireless access point (WAP) at 60 Mbps per device.
- Coverage: Minimum RSSI for indoor Wi-Fi service shall be -60dB.
  - This value assumes system is designed against MCS 11 802.11ax HE40 (aka Wi-Fi using 40 MHz channel width).
- The target device-to-user ratio shall be three (3) devices for each user. If more than twelve WAPs are within range of one another, the user density ration shall drop to 1:1.
  - WAPs are defined as being “within reach of one another” if, at the design power level and expected level attenuation, any WAP’s 5 GHz radios will interfere with another WAP on the same 5GHz channel.
- The transmit power of each WAP shall be designed to mitigate co-channel interference between WAPs.
- For any internal space, user density shall be based on the maximum room occupancy as determined by the local Fire Marshall. This information will be provided to the Designer by NOCCCD.

***NOTE: The RSSI and throughput requirements shall not be enforced in stairwells in order to prevent blocking of emergency exit routes.***

### 8.4 OUTDOOR WIRELESS REQUIREMENTS & SERVICE GOALS/TARGETS

- Capacity: In lieu of a capacity estimate, the Campus shall specify where effort will be expended to provide usable Wi-Fi service.
- Coverage: Minimum RSSI for outdoor Wi-Fi service shall be -70dB using best-effort coverage based on WAP placement.

- There are currently no mesh Wi-Fi systems installed at any NOCCCD campus/office.
- Currently all exterior WAPs are installed on building exteriors located within 100 meters of an MDF/BDF/IDF.

***NOTE: The Fullerton campus includes historical buildings where extra consideration to design and installation of exterior WAPs must be provided due to historical preservation requirements.***

## **8.5 Original Deployment Design Guidelines/Short Cuts**

### *Wireless Design Parameters*

- The software used to perform the predictive survey was Ekahau Pro and Ekahau Survey.
  - Ekahau Sidekick hardware was also used.
- Standard User Density Value used for design: 30 to 75 users in a location served by two (2) Aruba 535 WAPs.
- High User Density Value used for design: 30 to 75 users in a location served by two (2) Aruba 535 WAPs.
- Large Venue Density Value used for design: 150 users. WAP configuration varied based on room size, user density, wall composition and obstructions.
  - In high and large venue density areas, WAP power can be adjusted (i.e., reduced) to support a higher concentration of WAPs while avoiding co-channel interference between WAPs. This was taken into consideration during creation of the prediction designs.

### *Attenuation Considerations*

- Wall composition information used for design was provided by NOCCCD.
  - Examples: Drywall, cinder brick wall, wall thickness, e-glass windows, etc.
- The design assumed an initial attenuation of -3 dB for most classrooms with drywall composition walls per Ekahau configuration. This value was adjust as needed for other wall types.
- Attenuation was modified based on measured results from active surveys the original designers performed using Ekahau Survey and Sidekick. Actual attenuation ranged from -3 dBm to -5 dBm depending on size and wall composition. Only slight adjustments were necessary for the final predictive designs.

## 9. REFERENCES, STANDARDS AND CODES

The Architect, Engineers and Telecommunication Consultant shall be responsible to verify and use the most current Codes, Standards and References.

American National Standards Institute (ANSI)/Telecommunications Industry Association (TIA)  
ANSI/TIA 526-7-A, *Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant*.

ANSI/TIA 526-14-C, *Measurement of Optical Power Loss of Installed Multimode Fiber Cable Plant*

ANSI/TIA-568.0-E, *Generic Telecommunications Cabling for Customer Premises* (March 2020)

ANSI/TIA-568.1-E, *Commercial Building Telecommunications Cabling* (March 2020)

ANSI/TIA-568.2-D, *Balanced Twisted-Pair Telecommunications Cabling and Components* (September 2018)

ANSI/TIA-568.3-D, *Optical Fiber Cabling Components* (January 2019)

ANSI/TIA-569-E, *Telecommunications Pathways and Spaces* (May 2019)

TIA-455-6-B, *FOTP-6 Cable Retention Test Procedure for Fiber Optic Cable Interconnecting Devices* (March 1992)

TIA-455-175-C, *IEC-60793-1-42 Optical Fibres - Part 1-42: Measurement Methods and Test Procedures- Chromatic Dispersion* (December 2020)

TIA-455-C, *General Requirements for Standard Test Procedures for Optical Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and other Fiber Optic Components* (August 2014)

TIA-492CAAB, *Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers with Low Water Peak* (August 2000)

TIA-526-7-A, *Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant, Adoption of IEC 61280-4-2 edition 2: Fibre-Optic Communications Subsystem Test Procedures – Part 4-2: Installed Cable Plant – Single-Mode Attenuation and Optical Return Loss Measurement* (July 2015)

ANSI/TIA-598-D, *Optical Fiber Cable Color Coding* (July 2014)

ANSI/TIA-607-D, *Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises* (July 2019)

ANSI/TIA-758-B, *Customer-Owned Outside Plant Telecommunication Cabling Standard* (March 2012)



Building Industry Consulting Service International (BICSI) *Telecommunications Distribution Methods Manual, (Latest Edition)*

Building Industry Consulting Service International (BICSI) *Outside Plant Design Reference Manual, (Latest Edition)*

Most current California Electrical Code

Most current National Electrical Code

Most current California Building Code

## **10. SAMPLE SPECIFICATIONS**

The following specifications are supplied as templates for incorporating into the project manual of construction projects. These specifications provide the basis of content and shall be reviewed and updated for each construction project as required.

Project Specification format must be reviewed and approved by NOCCCD for each project.