NORTH ORANGE COUNTY
COMMUNITY COLLEGE DISTRICT

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CABLING INFRASTRUCTURE STANDARDS

Guidelines for the Design of
Telecommunication Infrastructure at
NOCCCD Facilities

September 20, 2017

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1. EXECUTIVE SUMMARY

The design, implementation, and support of the telecommunications network for the North Orange County Community College District (NOCCCD) is a cooperative effort of District Information Services (IS) and the Academic Computing Technologies (ACT) departments at Cypress College, Fullerton College and School of Continuing Education. District Information Services represents the telecommunications interests of the District as a whole and is responsible for developing and maintaining telecom standards throughout the campuses, insuring that all affected parties are represented in the process. Cypress College ACT is responsible for the operation of the Cypress campus network and Fullerton College ACT is responsible for the operation of the Fullerton campus network. District IS, is responsible for the operation of the Anaheim Campus network and for the wide area network connecting the three campuses to each other and to our internet service provider.

This document is intended 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, Fullerton Campuses or any other NOCCCD site. It is the expectation of NOCCCD that the information provided in this Standard shall be incorporated into the Schematic, Design Development and Construction Documents for each project. NOCCCD expects any design process to be an iterative process, where the design team will engage the local Academic Computer Technology area staff as well as District IS in review and discussions during the many steps of the design process; all deviations from these standards must be approved by District IS Department and District Facilities with final sign off by NOCCCD Vice Chancellor of Finance and Facilities in writing prior to design.

The objective is to design using standards and materials that will provide the greatest longevity and function for current and future application areas. Standardization of components, installation methods and labeling will ensure that all cabling installation projects have a consistent functionality, and operational appearance. This will allow 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

District IS department is responsible for provisioning and operating a robust Information Technology Infrastructure. It is expected that the infrastructure will support the connectivity needs of 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 IS owns the responsibility for the transport of all TCP/IP based traffic on the NOCCCD campuses/sites, both internally and externally.

District IS staff in conjunction Campus ACT staff, will actively participate in the design process. This includes attending architectural and engineering meetings that in any way will affect the provisioning of any and all information or communication 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. 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, the quality of workmanship and acceptance testing of any or all cable plant installed, and any other aspect of the construction/renovation project that could affect the Information Technology Infrastructure. It is the expectation of District IS that the information provided in this document shall be used for the basis of the design of the cabling infrastructure and 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 IS and Campus ACT representatives are involved in the entire design process, including review of all drawings during the design phases as follows:

Design Phase	**Telecommunication Infrastructure Considerations**
Schematic Design – 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. Schematic design submittal.
Design Development— As the architectural design process progresses, overlays are developed to show the various structures and systems planned for the building.	Outlet placement per room requirements, horizontal cable pathways. 30% and 50% submittal including project specifications.
Review Set — These documents depict the final design before bid submittal is undertaken.	Detailed drawings and Specifications of all outlets, pathways, Information Technology Room designs, cabling terminations, workmanship, and testing. 90% submittal
Working Copy/ Construction Documents — This is the Bid Copy.	100% submittal
"Record Document" Drawings – These drawings and documents represent the project as it is finally constructed ("as-built")and are deliverable prior to final inspection of the project.	Actual cabling as constructed, drawings with cable numbers/labels, test results. Close out documents.

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 IS and Campus ACT. It identifies the five areas of telecommunication construction for each project: Telephone, Computer Network, Broadband Television, Security Surveillance, and Security Access systems. It defines specific tasks that must be completed and who is responsible for 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 Telecommunications portion of any given project.

Item / or Material	District Purchased	District Installed	Contractor Purchased	Contractor Installed	Note
Determine the telephone system type for this project (VoIP or Standard)					1
Telephone System (select one: VoIP | Standard)					
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			
Account setup, voicemails, etc.	X	X			
Analog Technology	X	X			
Final cross connection to Avaya switch if required	X	X			
Final As-built drawings and documentation			X	X	
Computer Network Wiring					
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	
BDF/IDF racks			X	X	
Copper cables			X	X	

Item / or Material	District Purchased	District Installed	Contractor Purchased	Contractor Installed	Note
Fiber patch panel			X	X	
Cat 6A patch panel			X	X	
Jacks and plates			X	X	
BDF/IDF (racks, backboards, a/c, wiring, etc.) Per specifications.			X	X	
Cable testing and reports (both copper & fiber)			X	X	
Patch cords	X	X			
Active electronics including network switches	X	X			
Programming, network implementation	X	X			
Final "As-built" drawings and documentation			X	X	
Broadband Television System					
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	
Connection to head-end				X	5
Testing and reports			X	X	
Final As-built drawings and documentation			X	X	
CCTV Surveillance System					
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	

Item / or Material	District Purchased	District Installed	Contractor Purchased	Contractor Installed	Note
Coax, power and control cables 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	
Security & Access					
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 (Cat 6A, AWG) per specifications.	X	X			6
Schedule interior building wiring			X	X	
Cable testing and reports (both copper & fiber)			X	X	
Head-end equipment and software at MDF/BDF as needed.	X	X			
Electric door hardware			X	X	2,3, 4
Card Reader	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	

TYPICAL NOTES:

Note 1 ***Anaheim Campus and Cypress College Note:*** The location will determine the telephone type for the project (Voice over IP or Standard PBX). The Architects/ Engineers are to design the 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 Computer Network Wiring so will not require separate horizontal telephone cables and outlets.

Note 1 ***Fullerton College Note:*** The Fullerton campus is on VoIP (Voice over IP) for its phone system. The Architects/ Engineers are to design the system to meet those 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 Computer Network Wiring so will not require separate horizontal telephone cables and outlets. All jacks should be red and labeled appropriately. All cables blue and labeled appropriately.

Note 2 Initially key operated until head-end connectivity is completed.

Note 3 Will not be operational until head-end is connected.

Note 4 Hardware type/location and install to be coordinated with campus/security vendor. The contractor installs, but the contractor MUST work with the campus/security vendor PRIOR to installation in order to provide input to make sure that the final product will work as expected.

Note 5 The video contractor must work together with District IS staff member(s) in establishing any and all connections to the existing campus backbone cable systems. A District IS 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 is 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. Much can be gained in the design process if the Architect engages District IS in design meetings and coordination sessions beginning at the programming phase. The District IS department is eager to assist in providing a detailed list of requirements that will aid in programming the required connectivity and communication spaces.

It is the expectation of District IS 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 both Electrical and Telecommunication Design team members to correctly locate power and communication outlets.

The Architect will ensure that where other Design Engineers or Consultants need a separate wiring infrastructure to support their systems, that those consultants coordinate their design and infrastructure requirements with the District IS and Campus ACT staff. This includes, but not limited to design items such as cable type, cable color, use of supplemental or common pathways and support systems. For any Design Engineers or Consultants that need 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 District IS for this connectivity. No other system cable(s) that is included in the building, will be allowed to use the pathway(s) under District IS control without prior approval.

District IS expects the Architect to provide coordination with the Design Engineers or Consultants for the support of any required Video and Audio Visual (AV) systems. Of particular concern is that the installations of the Video and AV systems do not conflict with installation or potential installation of Information Technology Infrastructure. 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 IS and Campus ACT staff.

As full participants in the design process, comments and requests submitted by District IS and Campus ACT must be incorporated into the reviewed documents in full for the next review of documents, or an explanation must be provided to District IS and Campus ACT, regarding the status of comments and requests. District IS 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

District IS, at its option, may contract with a Telecommunication Consultant, to do its own communication design or may request the Architect to retain the services of a Telecommunication Consultant. Regardless of the approach taken by District IS, the Architect is expected to ensure that communication design input from a qualified Telecommunications 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 on line for a significant amount of time, the safest approach calls for a forward-looking view into the cabling and pathway requirements. Typically, the telecommunications system design can be divided into the following three parts:

2.5.1 Rooms, Routes & Risers

The planning for Rooms, Routes and Risers are critical to the successful design of any Information Technology (IT) system. Appropriately sized equipment rooms and cabling pathways must be provided in the building. Sufficient capacity must be provided not only to house the current IT Systems, but also to allow for additional cabling and equipment to be installed or replaced in the future. Site location of each room is critical to ensure that each room is supported by appropriate environmental systems. Based on experience in telecommunications system design

and National Standards, it is possible to estimate equipment room locations and sizes at an early stage in the project. This input will allow the 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 (rises, cable trays and conduits) into the building fabric. Based on the EIA/TIA 569B Commercial Building Standard for 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

The selection of the communications cabling system and media is specified towards the end of the design phase to ensure the incorporation of the most recent product changes. Based on the EIA/TIA 568B Commercial Building Telecommunications Cabling Standard, NOCCCD has selected a wiring standard based on the most current cabling standards: **CommScope Systimax** - Category 6A unshielded twisted pair copper for voice and data station cabling, and **Sumitomo Future Flex Air Blown** laser-optimized multimode and single mode fiber for backbone interconnection. (Note that **CommScope Systimax** Category 5E is an acceptable alternative).

Support of the distribution of this cabling is made possible by ensuring the cabling pathways are designed to support the required quantity and type of cabling (including additional future expansion). 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

The design and procurement of the 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 NOT be included in any specification or bid package particular to a specific building construction project. Architect and Engineering teams are required to take into account 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 will 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 (ITR's) are special-purpose rooms that provide an operating environment for telecommunications and/or computer equipment. At one time, these spaces were an after-thought to the design process; this can no longer be the case. Each type of technology has specific functions and it 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 contains network interface devices, protectors and telecommunications data networking and computer equipment. Voice and voicemail systems may also be housed in the MDF. At some point the MDF may become 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 (the use of conduits, maintenance holes and or hand holes) 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 will depend on the building size, function and telecommunications services to be provided to the building.

3.1.2 Building Telecommunications Room (BDF)

The BDF is a special-purpose room that 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. The BDF may also be referred to as a Building Distribution Facility (BDF).

The 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 for 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 within-building or campus 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.

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

The BDF houses the conversion of Outside Plant cable to inside rated cable, provides Building Entrance Protectors for all copper cables and 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).

The BDFs shall house equipment directly related to the Information Technology systems and its 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 all Building Information Technology Rooms are required as a part of the overall design/project prints and is to include all systems proposed to be housed within each room.

3.1.3 Telecommunications Rooms (TR)

The TR or Intermediate Distribution Facility (IDF) is located on each floor or building quadrant, and houses telecommunications equipment, cable terminations, and cross-connect wiring. TRs differ from Building Telecommunications (BDF) rooms in that they are generally considered 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 number and location of the TRs depends on the:

a. Size of the building. Typically one TR is required for every 10,000 square feet of usable floor space.
b. Number of floors. One TR is required for each floor.
c. 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 quadrant of the building. This is based on a maximum cable length of 90 meters from wall outlet to TR termination point.

3.1.4 Non-Information Technology Systems

The Architect is reminded to expand the Information Technology Room dimensions for such non-information technology systems such as AV equipment, Building Management System (BMS)

systems, 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 prohibit code violations.

3.2 INFORMATION TECHNOLOGY ROOM LOCATIONS

3.2.1 General

There are a number of factors that need 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 the rooms can be expanded, if required in the future.

- The 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.
- The 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, and other potential sources of electromagnetic interference (EMI).
- The Information Technology Rooms **shall not** share space in electrical closets, boiler rooms, washrooms, janitorial closets, and storage rooms, nor hatches that lead to other spaces.
- The 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 the installation of the cable riser backbone system.
- The Information Technology Rooms **shall not** be located near sources of mechanical vibration that could be conveyed to the room and the sensitive network equipment via the building structure.
- The Information Technology Rooms **shall not** be located below water level unless preventive measures against water infiltration are employed. The room shall be free of water or drain pipes not directly required in support of the equipment within the room. A floor drain shall be provided within the room if risks of water ingress exist.
- Information Technology Rooms **shall be** vertically aligned in multistory buildings.

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

3.2.2 Building Telecommunications Room (BDF)

In addition to the general requirements for Information Technology Rooms, the Building Telecommunications Room **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.
- Access must be directly from hallways, not through offices, classrooms or utility spaces.
- Must allow for door openings into the hallways and not the room.
- Be located so 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 inside in lieu of rigid or intermediate conduit.

3.2.3 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 District IS.
- 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.
- Located as close as practical to the center of the area 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 a building, that is, constructed so each TR is placed 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.

3.3 INFORMATION TECHNOLOGY ROOM SIZING

3.3.1 General

The sizes of Information Technology Rooms are **minimum requirements.** However, additional space may be required depending on the requirements, the proposed auxiliary systems sharing the space, and/or the services performed by the occupants. See Section 5 for HVAC Requirements.

3.3.2 Building Telecommunications Room (BDF)

During the early phase of the building design, it will be best to assume the BDF basic size will be 12 feet long by 10 feet wide by 10 feet high, interior dimension.

The Building Information Technology 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. Racks/cabinets require a three-foot clearance on all

sides. Certain apparatus will be wall-mounted and will project a distance of 12”-24” 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, District IS 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 TR per floor. Additional TR, 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 to the workstation exceeds 90 meters.

For planning purposes, the basic size of each TR shall be a minimum of 8-feet wide by 8-feet long by 10-feet high, interior dimension. In small buildings, the BDF and the TR functions may be combined into one joint space.

3.4 LIGHTING

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

- Have a minimum of 50 foot candles measured 3' above the finished floor 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 Rooms.
- Not be powered from the same electrical distribution panel as the telecommunications or network equipment in the Information Technology Rooms.
- Not be connected to any timing devices. Dimmer switches shall not be used in the Information Technology Rooms
- Emergency lighting and signs should be properly placed in the Information Technology Rooms where absence of light would hamper an emergency exit.
- Be located a minimum of 8'6" above finished floor.
- Be placed so the axis of the fixture is 90 degrees 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 stated earlier, Information Technology Rooms shall not be located below water level. The Information Technology Rooms shall be free of water or drain pipes not directly required in support of the equipment within the MDFs, BDFs, and TRs.

3.6 FLOOR

3.6.1 General Floor Design Elements

The floors of 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. The distributed loading shall be at least 250-lbs/sq. ft. and the concentrated loading 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 Rooms, then the following details shall be applied to the design. See Section 5 for HVAC Requirements.

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

3.7.2 Fire Suppression Systems

A Halon substitute systems such as FM200 or equal are 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.

Portable fire extinguishers shall be available in the 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 the way cables are routed under a 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. Provision shall be made in the fire detection system design to reduce the possibly 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’ 6” wide and 80" high, without doorsill, and 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 Rooms, a double door 72" wide by 90" high, without doorsill and center post is required. The door shall have a gasket to prevent dust from entering the room.

3.9 INTERIOR FINISHES

The floor, wall, and ceiling 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 with 3/4" 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 flush 6 inches A.F.F. to 8 feet 6 inches A.F.F.

3.9.2 Ceilings

A drop ceiling **shall not** be installed.

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 the 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, the clearance shall be measured beginning at the base of the foot

flange. For self-standing equipment cabinets, the 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

The doors to Information Technology Rooms shall have individual locks and may at the direction of District IS be controlled by a "card key" access control system. The locks must be commonly keyed to match other existing Information Technology Rooms on the campuses/sites.

3.10 INFORMATION TECHNOLOGY ROOMS CONSTRUCTION SEQUENCE

Before the installation of any cables or telecommunication equipment 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 building sequence. At a minimum completed means all electrical, interior finishes, lighting, air conditioning and lockable doors have been provided.

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 for communication cables to use are:

- A cable tray system
- J-Hooks
- Conduit home runs

In main corridors and cable paths, the use of a Cable tray system is the preferred method. At least 12" of clearance is needed above the cable tray and the cable tray must have a minimum clearance of 12" to 18" 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 Mechanical, Electrical, and Plumbing coordination in the design and installation of the MEP systems.

The use of conduit home runs from the work area outlets to the 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 communication outlets that may be installed in the floor. If possible, the use

of communication outlets in the floors shall be avoided. When this is not possible, District IS 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 cables without causing any obstructions that would limit the use of any jacks/plugs.

3.12 WORK AREA TELECOMMUNICATION OUTLET

3.12.1 General

Telecommunications Outlets are provisioned with double gang back-boxes and faceplates. Each Telecommunications outlet will have a 1 1/4-inch conduit that extends from the back-box to the accessible ceiling space. Each Telecommunications Outlet shall have a dedicated 1 1/4 inch conduit. Telecommunications Outlets **shall not** be daisy chained.

Telecommunications outlet locations shall be coordinated with the furniture layout. In offices and conference rooms, the typical outlet placement is +18” 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 designs. Desks that have modesty panels placed against the wall will obstruct access to the electrical and telecommunications 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, the outlets shall be placed at +6” above counter/surface height, coordinating with the placement of the electrical outlets.

In office spaces with built-in work surfaces, computers can be tower or floor-standing. The telecommunications and electrical outlets may still be located at +18” 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 can 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 minimum of two telecommunications outlets shall be installed per single-person office and on opposing or adjacent walls. Since outlets should be located to maximize the flexibility of furniture placement, outlet placement should be coordinated with all furniture plans. In fixed configuration offices or if built-in furniture is to be constructed, it is preferred that the electrical and data outlets be located at +6" above the height of the desk surface or +36" A.F.F. If the office is large enough to support a visitor/conference table, an additional telecommunication outlet shall be installed, normally at +18" A.F.F. Electrical outlets shall be placed consistent with the data outlet height.

3.12.3 Conference Rooms

Conference Rooms will require one communication outlet for every 10-feet of wall space on three sides of the room and an electrical outlet shall be placed at same height and location. The wall that is considered to be the "front" of the room shall have one communication and power outlet where the "whiteboard" is located. In addition provisions shall be made to have a power and communication outlet flush mounted to the ceiling for possible use of a projector or wireless access point.

3.12.4 Instructional Classrooms

Instructional Classrooms that have a specific teaching wall orientation will be provided with a communication outlet every 10 feet on each of the three non-teaching walls and an electrical outlet shall be placed at same height and location. On the teaching wall, a communication outlet shall be located under or in close proximity to the classic or electronic whiteboard. If an instructor's podium is provided, an outlet will be required. Communication outlets shall be provided flush to the ceiling to support wireless access points and video projectors. AV systems for classrooms shall be installed in a three gang box with a 1.25" conduit. The number and type of network cables included in each outlet will be defined by District IS and Campus ACT for each standard and smart classroom.

At the main entrance to the classroom, a communication 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" AFF to ensure compliance with ADA requirements.

3.12.5 Cubicle/Partitioned Offices (Modular furniture)

Cubicle and partitioned Offices will require "feed points". A feed point is a large (usually a two inch 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 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 two voice and two data (4 Category 6A cables). One additional communications outlet with up to four cables shall be added for every four 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 40%. Typically conduits will be 2" in diameter, and multiple conduits will 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 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 underneath 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.

3.12.6 Floors

A metallic raceway shall be provided between furniture pathways and horizontal floor pathway terminations (end of conduit, flush junction boxes, and recessed junctions 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.

3.12.7 Wall Mounted Telephones/Payphones/Text Telephones

In order to comply with the 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 counter top, the clearance for the box shall be 8 inches above the counter top.

The mounting height of the outlet box for wheel chair accessible payphones shall be +42-inches AFF. If a Text Telephone is required, it **shall not** be mounted to the wheel chair accessible telephone position. The text telephone unit will require a power outlet.

3.12.8 Work Rooms

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 work room.

To facilitate the use of these devices, numerous communication and power outlets are needed. Workrooms are typically configured with counters and storage cupboards. Along counter tops where facsimile and printers may be placed communication outlets, with appropriate electrical outlets, will be distributed every six feet. These will be placed at +6" above counter height. For self-standing copier machines, a communication 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 will be situated to avoid space conflict with door-swings, cupboards, fire extinguishers, water coolers, panels and any other fixture or device that could interfere with the accessibility of the telephone.

3.12.9 Computer Labs

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

3.12.9.1 Instructional Lab – Slab Floor

In an Instructional Computer Lab, the student computers will to 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 a class of 30 student computers and an instructor's computer. The lab may also contain 3-4 printers, scanners and other network devices. The 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 the table spacing. Tables will be situated flush against the walls to prevent the stretching of power or data cables across

aisles or walkways. At the front of the classroom, on either side of the whiteboard, outlets are provisioned.

3.12.9.2 Computer Lab for Student Self-Study

In a computer lab where students come 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 table top. Circular Computer Kiosks vary in size, typically 6-8 stations per kiosk. 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" above the table top, typically +36" A.F.F. Outlets will be provisioned intervals corresponding to the table spacing. Outlet placement must be coordinated with District IS and Campus ACT staff.
- All rooms which support islands of tables or kiosks will be configured with flush-mount floor boxes. Dual purpose floor boxes (communication and power) are acceptable providing that there is adequate separation maintained so that all power outlets and all communication jacks can be used simultaneously without the cords interfering with each other's access. 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.
- Sufficient floor-boxes will be provided to support the required number of computers, plus supplemental printers, scanners and other networkable devices.

3.12.9.3 Computer Lab – Raised Floor

In new buildings with rooms that are 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 rooms space due to ramps or stairs. The raised floor environment will provide the following:

- The raised floor will be provided with removable floor tiles to grant unhindered access to the floor space. Depth of the raised floor will be determined during design,
- Within the raised floor there will be a matrix of power and communication outlets that provides sufficient density to computer tables. Typically, this will be communication outlets each equipped with four data jacks, spaced every four feet, and equivalent power plugs and circuits to power computers and network devices plugged in to every network jack and powered on concurrently. The number and location of communication and power outlets will vary with room size and orientation. Each matrix will be custom designed with District (IS) and Campus (ACT) according to room requirements.
- Cables routing to the data outlets will be fully enclosed in a metallic raceway system that provides sufficient space so that the enclosed cabling does not exceed a 40% 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 re-locatable so that as room configurations change, cable notches can be positioned underneath tables and avoiding circulation paths.

3.12.10 Specialty Locations

The campus will have specialty locations that will 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 District IS and Campus ACT.

3.12.11 Maintenance Spaces

A Maintenance space is defined as any room that contains 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 communications 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 will be located on the wall beside the door lock, i.e. NOT beside the door hinges, so that the door can swing open and damage the telephone.

If the Maintenance Space will also be used as an office for maintenance personnel, the space will be equipped with additional communication outlet(s), located on the wall within three feet of a

general purpose electrical outlet. One communications 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. The definition of which devices/panels need cabling will be done in conjunction with engineering specialists for each device type. These can include: HVAC monitors, elevators, EMS panels, etc.

3.12.12 Building Rooftops

Control equipment that is 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. It is more important to provide a clear pathway 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.

3.12.13 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.

3.12.14 Wireless Access Support

For support of wireless access points, a ceiling communications outlet shall be installed adjacent to a power outlet in the ceiling. 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. The actual design will be determined on a room-by-room basis by District IS and Campus ACT.

3.12.15 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 actual design will be determined on a room-by-room basis by District IS and Campus ACT.

3.12.16 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 District IS, Campus ACT 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.

3.12.17 Fire Safety Devices

It is the responsibility of the Telecommunications Design Architect, District IS, and Campus ACT staff 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. PCI-DSS is mandatory for all organizations dealing with credit, debit and ATM cards, as defined by the PCI Security Standards Council, which includes industry giants like Visa, Master Card and American Express required to meet the requirements of industry regulations such as PCI DSS. 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 three (4) four inch Schedule 40 conduits will be run into the building. At least one conduit shall be installed with (1) 7 cell ABF tube cable. Early on in the project, a coordination meeting is required between District IS, Campus ACT, 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 in the space. The current California Electrical Code requires removal of accessible abandoned cable. All cabling reserved for future use, must be identified as such and tagged.

3.14 CONSTRUCTION DOCUMENTS

The Telecommunications designer will use these standards to produce a comprehensive set of drawings that address all the specific design requirements of each construction project. This includes:

- Drawings will be provided as a discrete Telecommunications Set or "T" set.
- T set drawings will be stamped by the Registered Communications Distribution Designer (RCDD).
- T set drawings will be coordinated with electrical engineering staff for 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 as and must be in 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 District IS and Campus ACT 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 are to be considered to be minimum requirements. The Electrical Design Consultant shall contact District IS and Campus ACT in the Schematic Design phase to determine if there are any other or special requirements. It is the expectation of District IS and Campus ACT 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 District IS. Unless otherwise noted, it is the expectation of District IS 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 communication 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. This applies to buildings where multiple small Information Technology Rooms are located. If this design is selected, the Electrical Engineer will coordinate with District IS and Campus ACT to estimate the power consumption to provide ample dedicated circuits.

Convenience outlets shall be mounted at +18-inches AFF (just below the plywood backboard). See comments in previous sections about backboard mounting. 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 the 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 20 Amp, quad-plug outlets.

If the room has a raised floor, all under-floor outlets will be side mounted on a flex whip not to exceed 30 inches in length. All circuits for under floor 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. Specialty outlets may be required to support rack-mount UPS systems. This need will be coordinated with District IS and Campus ACT 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. For example: a generator to maintain the PBX equipment may have to have a longer power life than the PBX equipment if the facility is acting as a center for other campus locations.

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.

4.5 GROUNDING

Besides the normal electrical ground system, a Telecommunications Ground System will be designed per J-STD- 607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications. This 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 and 50 mm wide and 150 mm long. The TGBs shall be bonded to the electrical panel serving the rooms were the TGB is installed, bonded to building steel, and bonded 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 (4th) 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 ¾-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 66 inch AFF to 8 feet 6 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. District IS 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 ft. high. All conduits and cable tray shall have approved cable radius drop outs. 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 a 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 the wall fire-stopped system pathways are required.

Typically 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 District IS and Campus ACT for final quantities. The 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

4.10.1 Communication Outlets

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

4.10.2 Outlet location considerations

Telecommunications 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 each telecommunications outlet box. Telecommunications outlet locations are typically at the same height as the power outlet.

4.10.3 Outlet Boxes

Unless advised by District IS to the contrary, the typical communication 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 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 mounted Telephones outlet boxes shall be 4-inch by 2-½ inch by 2-1/8-inch deep back box with 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

Floor boxes will be used in limited locations where connectivity is needed for islands of computers/desks, in order to alleviate the incidence of power and data cables straddling across floors. If outlets must be installed in the floor, they 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 will be dedicated runs and not chain through multiple floor boxes. Conduits will 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 District IS.

4.12 WIRELESS ACCESS POINTS (WAP)

For support in conference rooms, classrooms and other specified areas, ceilings will be installed with communications and power outlets to support wireless access points. The WAP shall consist of a telecommunication biscuit box with a 1 meter maintenance loop. WAP cables shall be supported by J-Hooks 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. A power outlet, adjacent to the communications outlet **may be** required. Support hardware for WAP shall be part of the installation and independent of the ceiling support system.

4.13 AV PROJECTOR (AV)

At ceiling-mounted projector location, 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 2-inch trade size conduit will route to the AV control cabinet to support AV cabling. Three 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 communication/power divided raceways are being installed, the communication channel shall be above the power. The sizing of the communication channel shall be based upon the following:

- If the raceway system is to support "standard" outlet in office locations, the outlet faceplate shall be sized for 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 40%.
- If the raceway system is to support a computer lab facility, then each communication faceplate shall be sized for 4 or more cables. Unless specified otherwise, the communication outlets shall be spaced every 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 40%.
- In outlet locations, the jacks may protrude into the raceway cavity and pinch the cable connections. Raceways shall not be filled greater that 40% 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" above the table top, typically +36"AFF. Quad-plug power outlets should be provided with each communication outlet.
- Raceways will be provided with custom fittings to data jacks.

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 District IS staff.

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 an electrical weatherproof box sized to support one electrical 4-plug outlet and two (2) 2" conduits. The power outlet shall be fed from the nearest electrical room. The two conduits shall run to the same electrical room. The conduits shall be sealed to prevent moisture or insect ingress.

In addition to the electrical connectivity, one (1) one-inch conduit will be provisioned from the roof top to the nearest Information Technology Room, terminating on the roof within 90 meters of the Information Technology Room. This outlet shall be in a weatherproof enclosure. 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 conduits conforming to EIA/TIA 569 B Commercial Building Standard for 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 any dimensional plane between pull points or pull boxes (PBs).

- An accessible pull box must be added to a conduit run if it 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 ft. For runs that total more than 100 ft. in length, insert pull points or PBs so that no segment between points/ boxes exceeds the 100 ft. limit. It is recommended that total conduit runs be kept to 150 ft. or less (including the 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 trade size 1¼" shall have a bend radius 6-times 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 ¼" inch unless otherwise noted for use with all communication back boxes or J-boxes.
- All communication conduits from communication 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 communication 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, 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 installing pre-manufactured assemblies. Design of the size and location of the communication cable tray will be coordinated with District IS and Campus ACT. In general the design of the cable tray will follow the guidelines described below.

Cable tray routes will follow normal corridor routes. The tray shall be placed in the hallway ceiling space in such a manner such that at least 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 support shall be a trapeze support system. Steps shall be taken to ensure the support and trays are seismically braced.

All metallic cable trays must be grounded, but shall not be used as grounding conductors for equipment. Clearly mark all cable trays and grounding conductors in accordance with ANSI/ TIA/ EIA- 606 and J-STD- 607-A.

4.19 COMMUNICATIONS J-HOOKS

Typically, information on the general placements of J-hook will not be included on drawings. The Cabling Contractor is in a better position to install J-hooks due to the adjustments that need to be made to J-hook runs to support the cable runs as the cables are being installed. Unless instructed otherwise by District IS, the installation of J-hooks shall be covered 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	
¾	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 District IS that the following information will be placed on the Telecommunication Site Plan.

- Conduits are to be 4” 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 conduits will occur outside of the maintenance or hand hole at a minimum of 20 feet from the maintenance or hand-hole. The conduit runs will contain no more than cumulatively, 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 Building Telecommunications Room (BDF) from below.
- All conduits shall have a minimum bend radius 10-times the diameter of the conduit.
- If the conduits penetrate from below, the conduits will stub up at least 4-inches.

- If the walls of the Telecommunications room are penetrated, the conduits shall stub out 1 to 2-inches and conduits shall pass through the wall at an upward angle so water will not drain into the room.
- The conduits will have plastic bushings at the building side end.
- A pull rope with a minimum of 200 pounds of pulling tension will be installed in all conduits.
- All conduits, 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 guidelines for the Mechanical Design Consultant. These design guidelines are to be considered to be minimum requirements. The HVAC Consultant shall contact District IS and Campus ACT to determine if there are any other 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 the 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 45^0F 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 purpose 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 District IS and Campus ACT.

- A positive pressure differential with respect to the surrounding areas shall be provided.
- The ambient temperature and humidity shall be measured at the distance of 5' above the floor level. After the equipment is in operation, the measurement can be taken at any point along an equipment aisle centerline. The normal temperature range is 64°F to 74°F with a humidity range of 35% to 55% relative.
- If the Information Technology Rooms are 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). Planning for air flow systems that service these environments should be equipped 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.
Ceiling projector	00 BTU/hr.
Servers	4750 BTU/hr.

The Mechanical Design Consultant will coordinate with District IS and Campus ACT 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.

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. Additionally, 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 guideline for the Civil Design Consultant. These design standards are to be considered to be minimum requirements. The Civil Consultant shall contact District IS to determine if there are any other or special requirements. The Outside Plant Conduit System must be designed and installed to the NESC and ANSI/EIA/TIA-758 and 758-1 Specifications for Outside Plant Construction.

6.1 GENERAL

The Outside Plant Conduit System provides inter-building pathway for communication cable(s) and services. The conduit system is typically a combination of a number communication vaults, maintenance holes (MH), hand-holes (HH) and conduit runs.

Maintenance Holes are typically used in main and branch conduit systems that require four or more trade size 4 conduits. If placed in a traffic area, the "box" and cover will be rated for the indented traffic loads. Unless directed to the contrary by District IS, the typical Maintenance Hole shall have center conduit window and be a Type A configuration as defined in ANSI/TIA/EIA-758. 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.

Hand-holes differ from Maintenance Holes in that they provide full access the entire space inside the hole, i.e. you can stand in a Hand-hole with your head above finished grade. Hand-holes are usually pre-cast and also 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 District IS and Campus ACT that this information will be placed on the Electrical Site Plan.

- Each building shall have, at a minimum, three trade 4-size conduits for routing communication cables into the building. The number 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 conduit will contain a 7 cell (ABF) sub-channel system.
- The conduit runs will contain no more than two 90 degree turns or cumulatively 180 degrees of bend between vaults maintenance holes (MH) or hand-holes (HH) and the termination point in the Information Technology Rooms. This includes kicks, offsets and the turn from horizontal to vertical when entering the Information Technology Rooms from below.
- If the conduits penetrate from below, the conduits will stub up at least 4-inches.
- 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 an upward angle so water will not drain into the room.
- The conduits will have plastic bushings at the building side end.
- A 3/8" nylon pull rope with a minimum of 200 lbs. of pulling tension will be in 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

Underground routes must be designed from 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 District IS and Campus ACT .
- 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. District IS 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 manhole. Sweeps must occur at least 20 feet away from the box. No sweeps greater than 90 degrees are permitted. Reversals of conduit path 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 and on site 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 point of penetration. If the cable must extend inside the building for greater 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 cumulatively 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. The cable length includes routing and service loop lengths.

- All conduits in a duct bank that enter a Maintenance Hole or Building shall be sealed at the time of installation with a Universal Blank duct plugs to prevent the intrusion of liquid or gases into the MH or Building. Seal after pull rope is installed. During cabling, the seals will be opened and resealed with a duct plug after cable installation, testing and acceptance is completed.
- Per ANSI/TIA/EIA-758 a drain slope of 0.125 inches per foot toward the HN/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 HOLES/ HAND-HOLES SIZES

The size of a Maintenance Hole or hand-hole will depend upon the number of conduits it will have to support. The typical maintenance hole is 12-feet long, 6-feet wide with an interior height of 6-feet. Hand-holes 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 hand-holes must be sized for the current conduit need with a minimum of 30% spare capacity. Conduits will be added to maintenance and hand-holes when additional buildings are constructed on campus and as such, maintenance and hand-holes must not be sized so that they are at their maximum during the initial installation. At the time of construction of a new maintenance or hand-hole, the conduits for immediate use and any stub-outs that may be prepared for future buildings will be installed.

6.5 COMMUNICATION MAINTENANCE HOLES/ HAND-HOLES LOCATIONS

Vaults and Maintenance Holes (MH) shall be located such that it:

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

Hand-holes shall be located such that it should:

- Expedite cable placement.
- Provide for drainage provisions (e.g., drain holes, sump hole).
- Aid cable pulling when the sweeps in the conduit run exceeds 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 pulled in two segments.

Vaults, maintenance holes and hand-holes that are located in pedestrian pathways that are designated as emergency Fire Routes or routes for maintenance vehicles must be constructed with traffic-rated boxes.

Maintenance and hand-holes must be located so that they are accessible for future conduit additions. In particular, Maintenance and hand-holes are best located in lawns, beddings or soft ground that can be more easily accessed for the addition of conduits. Installation of maintenance or hand-holes 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 5-10 feet from the maintenance and hand-holes 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 the behalf and at the direction of District IS to provide a Telecommunication Cabling Design for NOCCCD building and infrastructure projects. Telecommunication Consultant **shall be** a Registered Communications Distribution Designer (RCDD). The Telecommunication Consultant may be retained by the Architect or directly by NOCCCD. The Consultant shall:

- Ensure all information in this Standard is followed by the Architect and other consultants. If the discrepancies are not corrected by the Architect or other consultants, the discrepancy is to be brought to the attention of District IS.
- Develop a Telecommunication Cabling Design based upon the current, published EIA/TIA Standards, the latest BICSI Manuals and other Standards produced by District IS.

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 District IS.

The Telecommunications 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 is multiple floors. The Information Technology Rooms shall be situated so that the wiring length will not exceed 100 meters. Every building will be examined on an individual basis.

Before actual design work commences, the Telecommunication Consultant will meet with District IS and Campus ACT to determine what active equipment such as network equipment (voice/data/video), servers, PBX equipment 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 the 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 understood as part of the design process for the Information Technology Rooms.

7.2 NOCCCD PRODUCT STANDARDS

The cabling materials standards were established in 2001, specifying data cabling components from **CommScope Systimax**. This includes copper station cables, patch panels, termination blocks and jacks. The fiber backbone cable shall consist of the **Sumitomo FutureFlex** system. A 19 cell tube cable shall be provided as the main backbone system back to the MDF and 7 cells to each building BDF. Smaller buildings may use 4 cells to the BDF. As NOCCCD moves forward, the voice and data infrastructure must be constructed in a homogeneous, standardized fashion. This includes the specification of one manufacturer's product line as the standard, so across all buildings, the faceplates, patch panels and cabling will have an identical design, implementation, appearance, functionality and labeling. This will ensure a consistent functionality across all buildings.

7.3 OUTSIDE PLANT

The outside plant consists of the Outside Plant (OSP) cables and structures needed to interconnect the new building to the campus. The supporting structure includes underground (in conduit) cables, conduits, maintenance holes (MH), hand holes (HH), pull boxes (PB), pedestals and outside terminals. The outside plant must be designed and installed to the NESC and ANSI/EIA/TIA-758 and 758-1 Specifications for Outside Plant Construction. Direct buried cables and aerial cable runs are **not acceptable.**

7.3.1 OSP Design Activities:

The Telecommunications Consultant will work with District IS, Campus ACT, and other consultants and engineers in:

- Identifying cable routes from building to building.

- Determining the underground cable requirements.
- Identifying the types of cable used in the campus segment.
- Determining conduit, maintenance hole, hand hole, and pull box requirements.
- Determining electrical protection and bonding/grounding requirements.

7.3.1.1 Outside Plant Fiber Optic Cables

NOCCCD has specified that each building will be provisioned with multimode 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
- Fibers are separated into color-coded binder groups inside a tube filled with water-blocking agent.
- The tube cable shall consist of 19, 7 or 4 cells.
- Each cell shall be sealed and tested per the manufacturer's requirements.
- The designation "UL®" shall be printed every two (2) feet on the cable jacket.
- The cable shall have individual fiber colors per TIA/EIA-598-B.
- The cable shall be suitable for temperatures of -40° to +75° C.

Multimode Fiber Cables shall:

- Be graded-index optical fiber with nominal 50/125μm-core/cladding diameter.
- Shall conform to the composition specified for Laser Optimized Multimode Fiber specifications ANSI/EIA/TIA 492AAAC as well as the OM3 specifications in ISO/IEC 11801 2nd Edition and EN50173 2nd Edition.
- Meet the graded performance specifications below. Testing of the optical fiber shall be in accordance with TIA/EIA 526-14A, using power meter testing Type B. The measurements shall be performed at 23 degrees C +/- 5 degrees.

Transmission Characteristics:

Maximum Attenuation	Minimum Bandwidth
3.5 dB/km @ 850 nm	1500 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 TIA/EIA568-B.3.1 Addendum 1 – Additional Transmission Performance Specifications for 50/125 μm Optical Fiber Cables.

Single Mode Fiber Cables shall be:

- Class IVa Dispersion-Unshifted single mode optical fibers complying with ANSI/EIA/TIA-492BAAA.

- The zero dispersion wavelength shall be between 1300 nm and 1324 nm. The ANSI/EIA/TIA-455-168 maximum value of the dispersion slope shall be no greater than 0.093 ps/km-nm^2. Dispersion measurements shall be made in accordance with ANSI/EIA/TIA-455-169 or ANSI/EIA/TIA-455-175.
- 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 ANSI/EIA/TIA-455-164 or ANSI/EIA/TIA-455-167.
- Meet the graded performance specifications below. Testing of the optical fiber shall be in accordance with TIA/EIA 526-7, 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
0.50 dB/km @ 1310/1550 nm	Outside Plant

7.3.2 Tube cabling

All fiber backbone cabling shall be installed in Sumitomo Future Flex Tube cabling system. For outside plant installations, the tube cabling will be 19 cells back to the MDF. The tube cabling will be 7 cells 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 for the foreseeable lifetime of the campus. Depending on the purpose, dimension or square footage of these buildings, there may be one or more Information Technology Rooms identified in these structures. Semi-permanent or temporary buildings structures consist of trailers, modular buildings or other structures defined to have a limited life span and usage less than three years. Semi-permanent buildings may be used as "swing space" during renovations, temporary offices for contractors and consultants or special purpose buildings for campus activities. As such, they are provided with a limited complement of fiber backbone cabling, compared to that for 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, as a minimum, an 18-strands single mode fiber and 12-strands 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 is required for building connectivity. Redundant backbone cabling will be of the same type and composition as the primary fiber backbone cabling. The route and termination point of redundant fiber backbone cabling will be designed in conjunction with District IS and Campus ACT.

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 at a minimum, of a 6-strands 50/125 micron multimode fiber bundle (6MM 50/125um). Fiber backbones for semi-permanent buildings may route to the Building Distribution Room (BDF) of the nearest permanent building, or may route back to the Main Distribution Room (MDF). The design of the backbone routing will be determined in conjunction with District IS and Campus ACT staff.

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 cable/cabling shall be kept 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 a 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.
- Cable splicing will not be permitted at any point within a cable run.
- Conduits will not be filled to greater than a 40% fill.
- Outside Plant Conduits must have appropriately sized pull-boxes every 300 to 500 feet. When the conduit routes through up to a total of two 90 degree sweeps (180 degrees total) in any dimension plane, additional pull-boxes are also 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 the 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 entrance point. This is a maximum cable measurement and includes lengths for service loops, routing, back-board, and patch panel mounting inside the building.
- Polarization for the entire system shall be maintained as described in ANSI/EIA/TIA568-B section 12.7.1.
- All optical fiber cables shall be terminated on rack-mounted optical fiber patch panels. No fiber will be left un-terminated.

- All vacant tube cable cells tested and capped.

7.3.5 Copper Outside Plant Cables

NOCCCD is in the process of converting to voice-over-IP connectivity on a campus to campus basis which may have significant implications for Unshielded Twisted Pair cabling. In those cases, a minimum of 25 pairs per building pulled 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 District IS and Campus ACT 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.
- 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 PBX voice/voicemail systems 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[1]:	one telephone

[1] Maintenance room is defined as: Information Technology room, electrical room, HVAC/EMS control room, other control space.

Security/Monitoring:	one telephone per 1000 square feet
Payphones:	one per building

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 Telecommunications 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 a two copper connections between equipment rooms, ideally routed in separate paths to ensure no single point of failure.

Design Guidelines for Semi-Permanent or temporary Buildings:

Backbone UTP copper cabling for these structures are to follow the same usage estimates as shown 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 manufacturers' requirements regarding pulling tension and allowable lubricants.
- All cable/cabling shall be kept 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 and 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.
- All outside plant backbone cables will be installed in conduit. Aerial runs are not permitted.
- Conduits will not be filled to greater than a 40% fill.
- Conduits must have appropriately size pull-boxes every 300 feet. When the conduit routes through up to a total of two 90 degree sweeps (180 degrees total) in any dimensional plane, pull-boxes are also 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 hand hole 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).
- Verify all actual cable distances. Shall not exceed 100 meters.
- All outside plant cables will be terminated within 50 feet of the entrance point. This is a maximum cable measurement and includes lengths for service loops, routing, back-board 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.
- The protector blocks will be housed within a covered case. Protectors will be sized for the termination of all pairs in the copper backbone cable.
- The protector blocks shall be fully populated with solid-state or gas-tube protection fuses.
- The protector blocks will contain an integrated 110 block for extension to the building cross connect fields or patch panels.
- The protection block shall have an integrated 26 AWG stub.
- The protection blocks shall be grounded with a #6 AWG copper bonding conductor between the protector ground lug and Telecommunications Grounding Busbar.
- Copper extension cables shall be installed from the protector blocks to the copper patch panels, extending one 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 according 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 Telecommunication Rooms (TR), 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 installed between the rooms. All riser fiber backbones will consist, at a minimum, of an 18-strands single mode fiber bundle and 12-strands 50/125-micron multimode (18SM-12MM 50/125um). This can be provided 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 designer shall call for all Tube Cables, Tube Couplings, Tube Distribution Units (TDUs), Fiber Bundles, Fiber Termination Units (FTUs) connectors. The size and type of tube cable is to be coordinated with District IS and Campus ACT at the time of design.

7.4.3 Copper Riser Cable

The 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. Therefore, in the event of VoIP installations, the requirement is still in effect and cabling must be terminated and ready for use via simple cross connection from the campus MPOE to the campus copper network.

The cable shall be Category 3 UL listed CMP rated. All pair counts for backbone UTP cabling will be verified with District IS and Campus ACT during the design phase.

7.4.4 Coaxial Riser Cable

The coaxial riser cable shall be .500 plenum (rigid or quantum reach) cable run between and interconnecting each serving BDF/IDF. From each BDF/IDF, the cable will 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:

- Must be rack mounted.
- Shall be configured in duplex SC 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 Rooms (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 is to be left unterminated.

- All connectors are to be glass-in-ceramic SC-compatible field-installable duplex connectors.
- 568SC connectors shall meet ANSI/EIA/TIA-604-3 standards.
- Connectors must 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 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 ANSI/EIA/TIA-455-6B.

- Adhere to all manufacturer installation guidelines (CommScope & Sumitomo).
- Multimode duplex connectors shall be aqua.
- Single mode 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.
- Single mode shall not have a return loss greater than or equal to 26 dB.
- The connectors shall sustain a minimum of 500 mating cycles without degrading this performance.

7.6 COPPER PUNCH DOWN BLOCKS

All **new** copper backbone cables will be terminated on rack-mounted patch panels, one pair per RJ-45 jack. This will facilitate moves and changes via patch cords from the station jack instead of cross-connect wire.

Punch down blocks will be used for cross-connect of **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/EIA-606-A
- Supplies with connecting clip, designation strip, plastic covers and retaining clip 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. As an option, a project may require Category 5e cabling. To support a complete system Category 5e or Category 6A channel is required, all cabling components will be certified for Category 5e or 6A transmission. This includes patch panels, cross-connect blocks, patch cords and outlet jacks.

During design the Architect or Consultant shall anticipate Category 6A cable outside diameter (O.D.) size. The conduits will need to be sized to maintain a 40% fill.

This document requires the specification of plenum cabling rated as "CMP" for all new installations of cabling at campus sites. Although functionally identical, station cabling for different transmissions systems 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 Telecommunications Consultant will coordinate with 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 District IS.

7.8 VOICE/DATA JACKS

Although the cabling infrastructure for voice and data jacks is functionally identical, at the work area outlet, the modular jacks shall be color coded to designate the preferred purpose of the jack. The jack colors are white for voice and red for data.

Voice/Data jacks shall be 8-position modular jacks and shall be Category 6A performance as defined by the references in this document including ANSI/TIA/EIA-568-B.2 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 mega ohms.
- 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 standard work area outlet configurations used on the campus are as follows:

For non-VoIP installations:

- **Type A:** Voice/Data outlet is defined as one (1) voice and one (1) data cable, terminated in a six-port faceplate, usually at a height of +18" A.F.F. Typical installation: conference room.
- **Type B:** Data outlet is defined as two (2) data cables usually at a height of +18" A.F.F. Typical Installation: classroom.
- **Type C:** Voice/Data outlet is defined as two (2) voice and two (2) data cables, terminated in a six-port faceplate. Typical installation: administrative office.
- **Type D:** Data outlet is defined as four (4+) data cables, terminated in an eight-port faceplate. Height varies with installation. Typical installation: computer lab.
- **Type E:** Voice outlet is defined as one (1) voice cable, terminated in a one-port metal faceplate, for wall-mount telephones at a height of +48" A.F.F. Typical installation: Classrooms, corridor.

For VoIP installations:
The Telecommunications Design Consultant, District IS, and Campus ACT must meet to define the requirements for this type of installation. For VoIP installations, all station cable shall be terminated in the TR's on 48 Port Rack Mounted Patch Panels. Project prints and Bid Documents need to be clear as to the type and style of cable and jacks to install including provision for adequate services for Fire/Life/Safety devices as defined in Section 3.12.17.

- **Type A.V:** Voice/Data outlet is defined as two (2) data cables, terminated in a six-port faceplate, usually at a height of +18" A.F.F. Typical installation: conference room.
- **Type B.V:** Data outlet is defined as two (2) data cables usually at a height of +18" A.F.F. Typical Installation: classroom.
- **Type C.V:** Data outlet is defined as two (2) data cables, terminated in a six-port faceplate. Typical installation: administrative office.
- **Type D.V:** Data outlet is defined as four (4+) data cables, terminated in an eight-port faceplate. Height varies with installation. Typical installation: computer lab.
- **Type E.V:** VoIP outlet is defined as one (1) data cable, terminated in a one-port metal faceplate, for wall-mount telephones at a height of +48" A.F.F. Typical installation: classroom, corridor.

7.10 OUTLET DISTRIBUTION

The typical outlet styles 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[2]	Two (2) Type C/C.V outlets to maximize flexibility in placing desks and furniture.

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

Room Type	Outlet Types
	One (1) Type C/C.V outlet at conference table.
Cubicle/Partitioned Office	One (1) Type C/C.V outlet per cubicle in modular furniture communications raceway/trough as available. Outlet provisioned with fittings to hold jacks securely. One (1) additional Type C/C.V outlet for each four cubicles for support of fax/shared printers, etc.
Conference room (variable size)	One Type A outlet on front wall by "whiteboard" or presentation screen One (1) Type A/A.V outlet every ten feet of wall within three feet of electrical outlets, minimum one outlet per wall. One (1) Type B/B.V outlet centered in ceiling by location for ceiling projector.
Instructional Classroom	One (1) Type C/C.V outlet at instructor's podium. One (1) Type B/B.V outlet every ten feet of wall within three feet of electrical outlets, minimum one outlet per wall. One (1) Type B/B.V outlet centered in ceiling by location for ceiling projector. One (1) Type E/E.V outlet at main entrance to classroom, for wall-mount telephone. Where classrooms contain network-attached electronic whiteboards, add one data cable routed in wall as needed to whiteboard location.
Work/Prep room	One (1) Type E/E.V outlet at room entrance. Multiple Type A/A.V outlets distributed every six feet above counter top. One (1) Type C/C.V outlet at photocopier location.
Storage Rooms[3]	One (1) Type E/E.V outlet at room entrance.
Maintenance Room	One (1) Type E/E.V 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/A.V outlet for every desk location.
Rooftops	One (1) Type A/A.V 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.

[3] Storage rooms are often converted to offices after the fact.

Room Type	Outlet Types
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.

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

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 single-gang faceplate providing for four ports of connectivity. Configurations of any additional number of ports are subject to the approval of District IS.

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

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

Rear patch panel cable management should include the 2-inch or 5-inch cable support bars. Category 6 requirements require the cable to enter perpendicular to the termination and 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 insure a Telecommunication ground system is installed per J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications. This 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 contract 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 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 and 50 mm wide and 150 mm long. The TGBs shall be bonded to the electrical panel serving the rooms were the TGB is installed, bonded to building steel, and bonded 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 regards to placement within the rack or cabinet.

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

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

Wire Management: The horizontal wire managers will be supplied to route patch cords to the network equipment. One horizontal wire manager is required for each 48-port patch panel or 48port 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' A.F.F). **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.

7.15 FLOOR MOUNTED RACKS

All racks will be floor-mounted, open, self-standing relay racks. Racks shall meet the following physical specifications:

- 19-inch wide rack mounting space.
- 84 inches high.
- Lightweight aluminum construction.
- Black polyurethane finish.
- Equipped with four (4) ¾-inch bolt-down holes.
- Each rack shall have double-sided tapped holes with standard EIA hole pattern.

Each rack will have an integral vertical cable channel with a minimum of 6.5" of channel space to facilitate the vertical cable management of the cables entering the rack from the under floor and above ceiling cable tray. Each rack will be supplied with a bag of bolts matching rack color and threading. 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, the anchoring will use Hilti ½" anchor bolts which 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).

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

- Shall be 20 amp, 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.
- Power switch will be lockable to prevent accidental power-down.
- Power cord shall be a minimum of 10 feet in length.
- Shall meet UL 1363 and 1449 requirements.

7.16 FLOOR MOUNTED CABINETS

When Information Technology rooms must coexist with infrastructure for other electrical or low voltage systems, the Information Technology infrastructure will be completely concealed in lockable telecommunication cabinets. Floor-mounted cabinets are preferred. These cabinets will 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.
- Contain knockouts for ceiling fans and cable routing. Any knockouts used for cable routing will be wrapped with a 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 clear access in front, back and sides of cabinets. All cabinets shall be properly anchored to the slab floor using manufacturer-provided seismic bracing kit. Per DSA approved design, the anchoring will use Hilti ½” anchor bolts which pass a 45 lb. torque test.

Per grounding described above, cabinets will be grounded to the TGB with a minimum #6 AWG copper wire.

7.17 CABLE WIRE MANAGEMENT

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

Vertical cable managers with covers are required on all racks and in between racks to facilitate cable management and routing between the racks. The vertical cable managers will be the finger-duct style with integrated cable guides. For single racks, a minimum size of a 4”Wx 8”D channel is required on each side of the rack. For multiple racks, a minimum 6”Wx 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 be opened in either direction or removed completely. Pass through slots will provide access from the front to rear cable channels. Vertical cable managers will be sized to extend the complete length of the relay rack. The covers will be one piece for the entire height of the rack.

Horizontal cable managers will be provided for every 48-port patch panel that is installed. The horizontal wire managers will be used to manage patch cord connections to the network switch equipment since the patch panels will have integrated cable management. The horizontal cable managers will be double-sided and 3.5" H. The covers will be hinged and can be opened up or down, or be completely removable as needed.

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

7.18 CABLE RUNWAY

All cabling run exposed horizontally in an Information Technology Room must be routed using cable runway (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.

7.19 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" of clearance is needed above the cable tray and the cable tray must have a minimum clearance of 12"-18" 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 12" 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 overfilled beyond their specified capacity. Where dense cable runs create large bundles of cables and cable runway is not available, the cable bundles will be split and supported on multiple J-hook routes. Cable bundles will not exceed 50 cables. Bundles of cable will 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 work of the cable installation contractor.

7.20 CABLE INSTALLATION METHODS

The Contractor shall adhere to cable installation methods that will ensure that the cabling transmission is not adversely effected in any possible manner. This includes strictly adhering to the manufacturer's installation methods and workmanship described as follows:

1. When placing cable, the contractor shall maintain the following clearances from sources of electro-mechanical interference (EMI):
   - Main Power panel - 6 feet
   - Power cable - 12 inches
   - Fluorescent Lights - 12 inches
   - Heat source - 30 inches
   - Transformers - 6 feet
2. All power feeds crossing the path of the UTP cables at right angles must be a minimum of 12 inches in distance from the UTP cables.
3. The cables shall be placed at a minimum of 18 inches above the ceiling.
4. The cables are to 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.) will not be 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 is allowed to 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 will 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 EIA/TIA 568B/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 will 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.

7.21 FIBER OPTIC CABLE TESTING AND TEST RESULTS

General Test Requirements:

- The tester shall be capable of performing the tests required by ANSI/TIA/EIA-568-B, ANSI/TIA/EIA-526-14A, and ANSI/TIA/EIA-526-7.
- 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/EIA 568-B.
- End-to-end attenuation testing using an approved Power Meter and Light Source per ANSI/EIA/TIA 455-53A.
- Backbone multimode fiber shall be tested in one direction at both 850nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A method B.
- Backbone single mode fiber shall be tested at both 1310nm and 1550 nm in accordance with ANSI/EIA/TIA-526-14A method A.1.
- The acceptable link attenuation for backbone 62.5/125 multimode fiber based on distance shall be 3.4 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 will be tested and results will be submitted for all fibers in an electronic format on CD-ROM and 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.

7.22 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). The 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 will NOT be acceptable, but must be provided in the native format of the tester. The Contractor shall submit (1) copy of software capable of viewing the electronic test result files with each set of as-built that are delivered with the close-out documents. Test results shall be provided with warranty registration no later than 14 days after completion of approved test results.

7.23 UTP HORIZONTAL CABLE TESTING AND TEST RESULTS

General Test Requirements:
All horizontal UTP cabling will be tested and certified to meet CommScope Systimax standards when all pairs are terminated on a patch panel port and at 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, then a patch cable must be added to the link to achieve the desired minimum length of 50 feet in order to verify Category 6A testing parameters.

- Testing shall conform to ANSI/TIA/EIA-568-B.2.
- 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 will NOT be acceptable, but must be provided in the native format of the tester. 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-builds that are delivered with the closeout documents. Test results shall be provided with warranty registration no later than 14 days after completion of approved test results

7.24 CABLE TESTING VALIDATION

After installation is completed and the Telecommunication Contractor has completed testing, District IS and Campus ACT reserve the right to separately test the installed cables, up to 100% using the Telecommunication Contractor testing equipment or with NOCCCD-provided computer/network equipment. Cables that have been tested and 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 test results.

7.25 IDENTIFICATION AND LABELING

District IS and Campus ACT will work with the Telecommunications Consultant to implement a consistent and unique labeling scheme across all buildings. All labels shall:

- Horizontal cables shall be marked at each end, on the sheath 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. Label 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 District IS and Campus ACT prior to cable installation or termination.
- Labeling will include site notations as follows: C for Cypress campus, F for Fullerton campus and A for the Anaheim campus.

<u>Information Technology Room Naming</u>

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 also correlates to the floor and building number. For example, in Building 300 at Fullerton College, the second floor TC is in room 307, indicating that it is in Building 300.

<u>Fiber Backbone Cable Labels</u>

All backbone fiber cables (riser cables) will 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 and riser openings, they will be labeled at each opening.

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

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

- The origination point
- The destination point
- The type of cable (SMF, 50MMF)
- The fiber strand count

Example: The-48 strand single mode backbone cable that runs between the 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 Spaces 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 EIA/TIA 606A standard. This shall include:

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

Riser/Backbone Copper Cable Labels

All riser copper cables will 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 and riser openings, the cables will be labeled at each opening.

All outside plant backbone copper cables will be labeled at each end and in each handhole/maintenance hole that they pass through. Labels will be heat and water-proof so 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-A standard. This shall include:

- The origination point
- The destination point
- The type of cable
- 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 Spaces and the pair count.

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

- The origination point
- The destination point
- 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 will be clearly and discretely labeled.

Faceplate/Outlet Labels

All faceplates/outlets for station cable terminations will 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:

- Name of Telecommunication Space the cable routes to.
- Unique faceplate/outlet number, incrementing numerically.

Station Cable Labels

All station cables will 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 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 Space where the cables terminate.
- Faceplate/outlet number
- Jack label – numeric (1, 2, 3, and 4) labeled left to right, top to bottom.

If in overhead cable trays or J-hooks, large bundles of Category 6A cables (up to 50 max) must each be independently labeled every 50 feet. Bundle labels must state the type of cable and the Information Technology Space where that cable bundle will terminate.

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:

- The origination point
- The destination point
- The type of cable

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

7.26 ROLE OF DISTRICT IS

As described at the beginning of section 2.0, District IS will take an active role in all aspects of the design, construction and acceptance of the network infrastructure. District IS will involve Campus ACT in all meetings, inspections and reviews as need be.

7.27 INSPECTION

District IS 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

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

8. REFERENCES, STANDARDS AND CODES

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

American National Standards Institute (ANSI)/Telecommunications ANSI/TIA/EIA 526-7

Industry Association (TIA)/ Electronic Industries Alliance (EIA), Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant.

American National Standards Institute (ANSI)/Telecommunications ANSI/TIA/EIA 526-14A Industry Association (TIA)/ Electronic Industries Alliance (EIA), Measurement of Optical Power Loss of Installed Multimode Fiber Cable Plant

American National Standards Institute (ANSI)/Telecommunications ANSI/TIA/EIA 568-B.1, Industry Association (TIA)/ Electronic Industries Alliance (EIA), Commercial and Building Telecommunications Cabling Standard Part 1 General Requirements

American National Standards Institute (ANSI)/Telecommunications ANSI/TIA/EIA 568-B.1-1 Industry Association (TIA)/ Electronic Industries Alliance (EIA), Commercial and Building Telecommunications Cabling Standard Part 1 General Requirements Addendum 1 Minimum 4-Pair UTP and 4-Pair ScTP patch cable Bend Radius

American National Standards Institute (ANSI)/Telecommunications ANSI/TIA/EIA 568-B.2 Industry Association (TIA)/ Electronic Industries Alliance (EIA), Commercial and Building Telecommunications Cabling Standard Part 2 Balanced Twisted-Pair Cabling Components

American National Standards Institute (ANSI)/Telecommunications ANSI/TIA/EIA 568-B.3 Industry Association (TIA)/ Electronic Industries Alliance (EIA), Commercial and Building Telecommunications Cabling Standard Part 3 Optical Fiber Cabling Components Standard

American National Standards Institute (ANSI)/Telecommunications ANSI/EIA/TIA 569 A Industry Association (TIA)/ Electronic Industries Alliance (EIA) Commercial Building Standard for Telecommunications Pathways and Spaces

American National Standards Institute (ANSI)/Telecommunications ANSI/EIA/TIA 569 A -1 Industry Association (TIA)/ Electronic Industries Alliance (EIA) Commercial Building Standard for Telecommunications Pathways and Spaces Addendum 1 Surface Raceways

American National Standards Institute (ANSI)/Telecommunications ANSI/EIA/TIA 569 A -2 Industry Association (TIA)/ Electronic Industries Alliance (EIA) Commercial Building Standard for Telecommunications Pathways and Spaces Addendum 2 Furniture Pathways

American National Standards Institute (ANSI)/Telecommunications ANSI/EIA/TIA 569 A -3 Industry Association (TIA)/ Electronic Industries Alliance (EIA) Commercial Building Standard for Telecommunications Pathways and Spaces Addendum 3 Access Floors

American National Standards Institute (ANSI)/Telecommunications ANSI/EIA/TIA 569 A -4 Industry Association (TIA)/ Electronic Industries Alliance (EIA) Commercial Building Standard for Telecommunications Pathways and Spaces Addendum 4 Poke-Thru Fittings

American National Standards Institute (ANSI)/Telecommunications ANSI/EIA/TIA 569 A -5 Industry Association (TIA)/ Electronic Industries Alliance (EIA) Commercial Building Standard for Telecommunications Pathways and Spaces Addendum 5 In Floor Systems

American National Standards Institute (ANSI)/Telecommunications Industry Association (TIA)/ Electronic Industries Alliance (EIA) ANSI/EIA/TIA 569 A -6 Commercial Building Standard for Telecommunications Pathways and Spaces Addendum 6 Multi-Tenant Pathways and Spaces

American National Standards Institute (ANSI)/Telecommunications Industry Association (TIA)/ Electronic Industries Alliance (EIA) ANSI/EIA/TIA 569 A -7 Commercial Building Standard for Telecommunications Pathways and Spaces Addendum 7 Cable Trays and Wireways

American National Standards Institute (ANSI)/Telecommunications Industry Association (TIA)/ Electronic Industries Alliance (EIA), ANSI/EIA/TIA 570-A Residential Telecommunications Cabling Standard.

American National Standards Institute (ANSI)/Telecommunications Industry Association (TIA)/ Electronic Industries Alliance (EIA), ANSI/EIA/TIA 570-A-1 Residential Telecommunications Cabling Standard. Addendum 1 Security Cabling for Residences

American National Standards Institute (ANSI)/Telecommunications Industry Association (TIA)/ Electronic Industries Alliance (EIA), ANSI/EIA/TIA 570-A-2 Residential Telecommunications Cabling Standard. Addendum 2 Control Cabling for Residences

American National Standards Institute (ANSI)/Telecommunications Industry Association (TIA)/ Electronic Industries Alliance (EIA), ANSI/EIA/TIA 598-A Optical Fiber Cable Color Coding

American National Standards Institute (ANSI)/Telecommunications Industry Association (TIA)/ Electronic Industries Alliance (EIA), ANSI/TIA/EIA 607 Commercial Building Grounding and Bonding Requirements for Telecommunications - August 1994

American National Standards Institute (ANSI)/Telecommunications Industry Association (TIA)/ Electronic Industries Alliance (EIA), ANSI/TIA/EIA 758 ANSI/TIA/EIA 758 Customer-Owned Outside Plant Telecommunication Cabling Standard

American National Standards Institute (ANSI)/Telecommunications Industry Association (TIA)/ Electronic Industries Alliance (EIA), ANSI/TIA/EIA 758-1 ANSI/TIA/EIA 758 Customer-Owned Outside Plant Telecommunication Cabling Standard Addendum 1

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

Building Industry Consulting Service International (BICSI) Customer-2nd Owned Outside Plant Design Manual, (Latest Edition)

Most current California Electrical Code

Most current National Electrical Code

Most current California Building Code

9. 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.