Computer and Information Systems
Policies, Procedures, Plans and Standards

Network and Telecommunications Design and Construction Standards

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Contents:

CHAPTER 1 - INTRODUCTION

1. About This Documentation

A. This standards manual contains the policies and procedures for architects, contractors, and telecommunications design professionals who are involved in Seattle Pacific University projects that include communications installation. The documentation should be used as a guide for projects providing communications cabling, to include Outside Plant Cable, Voice communications, Wireless Data Network, Network Systems, Inter/Intra Building Life Safety Circuits, and Facility Circuits. Work may include new or renovated buildings and may consist of upgrading or adding cabling infrastructures, cable and network electronics equipment.

B. This documentation assumes that the architect is familiar with communication distribution systems, associated cables and hardware, the cabling pathways and support structures, and the installation of cabling, wireless radio, and network systems in buildings and campus environments. It is not intended to be a training manual in telecommunication distribution systems or to replace existing industry standards.

C. Terminology used throughout this document to identify building termination locations is unique only to Seattle Pacific University campus. Terms such as Building Distribution Frame (BDF) and Intermediate Distribution Frame (IDF) are used in lieu of Industry Standard terms, such as Horizontal Cross-Connect (HC) and Intermediate Cross-Connect (IC). The requirements for these locations still adhered to the American National Standards Institute (ANSI), Telecommunications Industry Association (TIA) and Electronic Industries Alliance (EIA) standards.

D. The Computer and Information Systems department (hereafter “CIS”) must approve all communication designs no matter the size of the project.

E. CIS shall be included in all capital projects for budget and scheduling coordination.

F. Request for waivers or clarification of specific design issues must be forwarded to the directors of CIS and Facilities Management.

2. Network and Communication Services “Responsibilities for Projects”

A. CIS is responsible for Seattle Pacific University’s inside and outside communications system facilities, network connectivity, and the associated backbone equipment.

B. These responsibilities include the review of all project plans that include communications and to include the following review items:

1. CIS shall be provided a full set of drawings, which should include title Sheet, Architectural drawings, demolition drawings, single line diagrams, details, site plans, HVAC, Plumbing, Fire Protection and Electrical drawings.
2. CIS and Facilities Management shall be provided copies of the Project Planning Guide (PPG), Capital Improvement Budget (CIB), Detailed Project Program (DPP), Design Guide or other such documents describing the University approved program. These documents shall be provided to CIS upon approval of the governing agency, responsible for managing that project.
3. CIS shall be provided schematic design (SD) documents and Specification Documents for each stage of the schematic design process, and provided a minimum of ten workdays from date documents are received by CIS for review and return of comments.
4. CIS shall be provided Design Development (DD) documents and Specification Documents for each stage of the Design Development process, and be allowed a minimum of ten workdays from date documents are received by CIS for review and return of comments.
5. CIS shall be provided Construction Documents (CD) and Design Specification Documents for review at each stage of the Construction Document process, and be allowed a minimum of ten workdays from date documents are received by CIS for review and return of comments.

C. When a new building or a building renovation is planned, architectural drawings should be released for review by CIS in the following order:

1. Schematic – These are the initial planning documents and design drawings which assist departments in the early stage of the project. The Schematic Design documents shall consist of System Narrative, including locations for Building Distribution Frame (BDF), Intermediate Distribution Frame(s) (IDF), Shallow Closet information, Critical Pathways and Campus Connection Points.
2. Design Development—As the architectural design process progresses, overlays are developed to show the enhanced structures and systems planned for the building. Design Development documents shall consist of outline specifications, in the CSI model. Drawings should include title Sheet, line diagrams, site plans, “D” sized floor plans to show placement of BDF, IDF, Shallow Closets, Critical Pathways and communication outlet locations.
3. Construction Documents—These documents depict the final design before bid submittal is undertaken. The Construction Documents shall consist of completed Drawing to include:

a) BDF & IDF and Shallow Closet locations with specific details including floor plan.
b) C/U Facilities assigned room numbers.
c) Communication outlet locations and designations.
d) Critical pathway entry including fire stopping.
e) Cable tray placement.
f) Rack locations, & rack layout.
g) Labeling for communications racks, & patch panels.
h) Electrical feed, deployment & lighting.
i) Amperage requirements for electrical panel & outlets.
j) HVAC.
k) Fire protection.

4. As-built Drawings – These drawings and documents represent the project as it is finally constructed and are deliverable prior to final inspection of the project.

Note: CIS comments and requests must be incorporated into the reviewed documents in full for the next review of documents, or a written explanation must be provided to CIS regarding the status of comments and requests.

D. Architects, contractors, and telecommunications design professionals must indicate on the design drawings and in the design specifications, the location and specification of the physical infrastructure required for a complete communications cabling pathway and distribution system. Also, the date and revision number of the Seattle Pacific University Network/Telecommunications Design and Construction Standards document used at the time of this design. This physical infrastructure shall include:

1. Outlet (jack groups). Reference Chapter 2 for a complete description of an outlet.
2. Cabling and wiring for a complete telecommunications system.
3. The infrastructure necessary to support the horizontal, riser and campus cable plants.
4. The BDF and IDF locations.
5. The infrastructure necessary to interconnect buildings, to include conduit, maintenance holes, hand holes, pull boxes, building entrances, and connection to the nearest serving facility.
6. Grounding and bonding requirement and points.
7. Electrical service requirements and service points for BDFs and IDFs, as well as, any necessary ancillary electrical work as part of the project.

E. All materials specifically for voice and data services will be supplied through CIS Department. CIS must approve any substitutions or items that cannot be obtained.

3. The Telecommunications Distribution System Design Process

A. The Seattle Pacific University telecommunications distribution design system is divided into six segments:

1) The Horizontal Segment, Chapter 2, consists of the outlets, cabling to the BDF or IDF, and the associated pathways.
2) The Telecommunication Rooms , Chapter 3, describes the BDF and IDF, as well as the hardware for terminating the horizontal cable along with riser and campus cables. The BDF and IDF are rooms that house common equipment, such as switches and hubs.
3) The Riser Segment, Chapter 4, refers to the riser cable, and the sleeves, slots, and conduits that enable the cable to pass from floor to floor, BDF to IDF.
4) The Campus OSP Segment, Chapter 5, refers to the cabling and infrastructure that interconnect buildings or systems on a campus.
5) The Emergency, Inter/Intra Building Life Safety and Facility Circuits, Chapter 6, refers to the requirements for installation of special circuits.
6) The Wireless Network Systems, Chapter 7, refers to the requirements for installation of wireless devices.

B. The network electronic equipment, to include design, engineering and configuration of the facility's network system is accomplished by CIS Network/Telecommunications team.

4. Regulations and Code Compliance

A. All work specified within this document shall comply with the applicable requirements of:

1) ANSI/TIA/EIA-568-B. (Except as noted)
2) ANSI/TIA/EIA-569-A.
3) ANSI/TIA/EIA-606-A.
4) TIA/EIA-J-STD-037.
5) TIA/EIA-758.
6) Underwriters Laboratory.
7) Federal Communications Commission.
8) Federal Occupational Safety and Health Administration.
9) OSHA (Standards-29 CRF) Telecommunications –1910.268
10) BICSI Telecommunications Distribution Manual.
11) BICSI Customer-Owned Outside Plant Design Manual.
12) NFPA-National Fire Protection Association
13) Washington State Department of Labor and Industries Rules and Regulations.
14) Washington State Department of Health.

15) National Life Safety Code, NFPA 101.
16) ISO/IEC 11801-International Organization for Standardization.
17) IEEE - Institute of Electrical and Electronics Engineers, Inc.
18) NESC - National Electrical Safety Code.
19) NEC - National Electrical Code.

B. National Electrical Safety Code Board of Fire Underwriters inspection is required for all new electrical construction work. Specific Seattle Pacific University Fire and Safety requirements must be met. In the event of conflict between or among such codes/requirements, the more stringent will apply.

C. US Dept of Agriculture Rural Utilities Service – Formerly REA

CHAPTER 2: THE HORIZONTAL SEGMENT

1. The Design Process

A. The horizontal segment consists of two elements:

1) The horizontal cable and connecting hardware that provide the means for transporting the telecommunications signals between the outlet in the work area and the Intermediate Distribution Frame (IDF) or the Building Distribution Frame (BDF).
2) The horizontal cabling pathways and spaces that distribute and support the horizontal cable and connecting hardware between the outlet and the IDF or BDF.

B. This section describes the policies and procedures for the following design activities:

1) Determining the type and number of outlets in the work area.
2) Identifying the types and lengths of cable used in the horizontal segment.
3) Determining termination hardware requirements.
4) Designing the structures needed to support the horizontal cabling.
5) Assigning the outlet numbers to the appropriate locations.
6) Cable testing procedures.

C. Additional variables to adhere to:

1) All communication cabling is to be completed prior to placement of suspended ceiling tiles.
2) All cables must be installed in a neat and workman like fashion.
3) All cables in walls or soffits shall be installed in electrical metallic tubing (EMT).
4) All cables must be in an enclosed pathway.
5) All cables above ceilings should be installed in cable tray or conduit.
6) Cables shall not be installed directly on ceiling tiles.
7) Cables that have been kinked, chaffed, or burned shall be replaced.
8) All cabling will be installed according to manufactures recommendations, EIA/TIA Standards, and Seattle Pacific University Design and Construction Standards.
9) Maintain the following distances from EMI sources:
    a) Fluorescent Lights – 12 inches
    b) Power cables – 6 inches
    c) Transformers – 36 inches

D. Cables in common conduit or cable tray shall not be installed with other types of cables such as alarm circuits, speaker wires, or audio video cables not maintained by CIS.

E. All openings for cable tray, pull boxes, or any other fixture that gains access to cables must be properly closed after entry.

F. All pull strings in cable tray or conduits must be replaced when cables are installed.

G. An outlet location will not serve as a feed for another outlet location, otherwise known as “Piggy-Backing”.

H. An outlet location will not serve as a feed for another outlet location that is directly behind (opposite wall locations), otherwise known as “Back-to-Back”.

I. All pull boxes and/or junction boxes shall have an adequate access space provided to ensure the contractor/installer a safe means of entry. Cable trays shall maintain a 12” clearance from other utilities to assure assess.

J. All conduits shall enter a TR in a configuration that is in a grouped fashion and can be routed within industry standard for pull points, bend radius considerations and NEC fill ratio guidelines to their termination locations.

K. The use of ty-wraps or other cable ties shall not be used in pathways.

L. The accessible portion of abandoned communication cabling that is not terminated, labeled or intended for future use shall be removed as part of any renovation or upgrade.

2. ADA Requirements

A. Installed wall, counter-top, emergency and weatherproof telephones, speakerphones and outlets shall meet the requirements of the Americans with Disabilities Act (ADA) as referenced in ANSI/TIA/EIA 568-B.1.

Note: Wall telephones shall not be installed above or over Laboratory countertops. A standard desktop telephone shall be installed in these unique locations, if required.

B. ADA height requirements for side reach of devices.
   1) The maximum high side reach allowed is 54 inches (1370 mm).
   2) If side reach occurs over an obstruction 24 inches (610 mm) wide and 34 inches (865 mm) high, the maximum height allowed is 46 inches (1170 mm).

C. ADA height requirements for forward reach of devices.
   1) The maximum high forward allowed is 48 inches (1220 mm).
   2) If forward reach occurs over an obstruction 20 inches to 25 inches (510 mm to 635 mm), the maximum height must be 44 inches (1120 mm).

3. Cable Types and Lengths

A. CIS recognizes two types of cables for use in the horizontal segment: UTP (unshielded twisted pair) cable, and fiber optic cable.

   1) UTP cable will be 4-pair, 24 AWG, solid conductor cabling that meets ANSI/TIA/EIA-568-B.2-1 cabling specifications for Category 6 cable, to include any/all Amendments and Bulletins, and must meet specified specifications and performance requirements. Performance testing shall be conducted at the component level by a UL certified testing laboratory, and include Active Live Channel Testing to insure manufacture and performance quality.
   2) Fiber optic cable will be a minimum of 4-strands, Multimode, 62.5/125µm graded index, tight-buffered, indoor cable, or 4-strand, Single mode, 8.3/125µm, tight-buffered, indoor cable. Corning Cable Systems MIC type cable is the preferred and recommended manufacture. If substitutions are requested by the consultant/contractor, then demonstrated equivalency must be provided. Reference Corning Cable Systems web site for additional information. (http://www.corning.com/cablesystems)

B. All conductive cabling and associated components must comply with Article 800 of the NEC (2002). Furthermore, all fiber optic cabling must comply with Article 770 of the NEC (2002), OFN-FT4 (Non-plenum) and OFN-FT6 (Plenum).

C. Horizontal UTP and fiber optic cables will not be spliced, nor will these cables contain manufactured splices.

D. Horizontal cables will not be connected directly to communications equipment. Suitable connecting hardware (i.e. patch panels and punch-down blocks) and factory-manufactured patch cords must be used to make the connection. Cross-connect jumper wire shall be used for voice and fire circuits only.

E. The maximum total length of horizontal cable from the telecommunication room to the outlets (link) is 295 feet (90 meters). Including patch cords (channel), these circuits shall not exceed 328 feet (100 meters).

F. Cable slack must be provided at both ends of cable runs to accommodate future cabling system changes.

   1) The minimum amount of slack shall be 1 foot for UTP cables and fiber optic cables at the outlet. In the IDF or BDF, UTP horizontal cables shall meet manufactures procedures for slack, patch panels, and 110 type blocks.
   2) Service Loops placed during installation of 4-pair horizontal cable were tested and determined to cause Return Loss and NEXT problems on the order of 2-3dB. When creating service loops, they should be coiled in a Figure-Eight configuration to eliminate this effect. The fiber optic cable must have a 20-foot service loop at the BDF and IDF locations.
   3) The slack must be included in all length calculations to ensure that the horizontal cable does not exceed 295 feet.

   Note: These limits apply to all types of horizontal cables. In establishing these limits, a 33-foot (10 meter) allowance was made for the combined length of the manufactured patch cords used to connect equipment at the outlet and IDF or BDF locations.

4. Termination Hardware Requirements at the Outlet

A. Each UTP cable will be terminated at the outlet with a coded Category 6 RJ45 (CJ688TPEI) jack. Performance testing shall be conducted at the component level by a UL certified testing laboratory, and include Active Live Channel Testing to insure manufacture and performance quality. Panduit is the preferred and recommended manufacture. If substitutions are requested by the consultant/contractor, then demonstrated equivalency must be provided. Reference Panduit's web site for additional information. (http://www.panduit.com/)

B. Each fiber optic cable will be terminated at the outlet using a LC style connector mounted in an LC type outlet insert module. All strands shall be terminated at the outlet and IDF or BDF locations for testing and verification purposes. The MT-RJ fiber optic connector shall be from the same manufacture as the fiber optic cable to insure manufacture compatibility, performance and warranty. Corning Cable System is the recommended manufacture. If substitutions are requested by the consultant/contractor, then demonstrated equivalency must be provided. (http://www.corning.com/cablesystems)

C. Outlets for the designated modules must be from the same manufacture as the RJ45 connector type. The preferred and recommended for the outlet is the mini-com executive series double gang electric ivory bezel (CBEEI-2G) that is manufactured by Panduit. If substitutions are requested by the consultant/contractor, then demonstrated equivalency must be provided. (http://www.panduit.com/)

D. All outlets in a wall jack are to be populated with the appropriate connector and terminated back to the upstream IDF panel.

5. Termination Hardware Requirement at the TR

A. Termination hardware required to terminate the horizontal copper UTP and fiber optic cables at the BDF and IDF are covered in Chapter 3, The Telecommunication Rooms.

6. Assigning the Outlet Numbers

A. The outlet designations are used by CIS in the application of operational databases, for assignment of services to departments, and for other service related purposes. They are crucial to the implementation of service to the project.

B. The Contractors/Installers shall obtain outlet number configuration for room layouts from CIS and Facilities Management. Typically the outlet designations are assigned in a clock-wise orientation from the left of the primary entrance of the room.

C. The Contractor/Installer is responsible for the issuing of accurate outlet designations and as-built drawings.

D. After outlet numbers have been assigned to the floor plans, the Contractor/Installer will complete the outlet designations. A hardcopy (as-built) of outlet designations per level (floor) shall be provided to CIS for close out.

7. Structures to Support the Horizontal Cabling

A. Special attention must be provided when selecting and designing the type and layout of structures to support the horizontal cabling. The design must accommodate cabling changes with minimal disruptions to building occupants.

Note: Seattle Pacific University requires that the space above the ceiling grid be used, whenever possible, to route the support structure that will contain the horizontal cabling.

B. Listed below are the steps needed to complete this phase of the design process:

1) Obtain an accurate set of floor plans.
2) Annotate, on the floor plan, the locations and types of outlets.
3) Verify that the distance from each outlet to the patch panel does not exceed 295 feet. This distance must include the planned cable path as well as any vertical transitions. NOTE: The physical pathway should not exceed 275 feet.

Note: If there are horizontal cable lengths that exceed 295 feet, the TR must be relocated to a more centralized location or another TR must be added.

4) The proposed route of the conduit and the cable tray must be drawn on the floor plan and CIS must approve the design.

Note: The preferred method of routing the horizontal cabling is to run conduit from the outlet to a cable tray placed along natural building corridors. The cable tray then channels the cabling to the TR.

5) Cable trays are the most preferred structure to support the horizontal cabling in buildings due to their design and flexibility of accommodating future growth and installations for horizontal applications.
   a) All cable trays must be installed per manufacturer's specifications.
   b) The cable tray should have a smooth solid flanged cover that is composed of equal sections with a maximum length of 5 feet.
   c) The cable tray cover should not be screwed or hinged down.
   d) The cable tray should be constructed as a continuous support structure with all bonding elements in place.
   e) Conduits that attach to the cable tray should enter from the side, located 2 inches from the bottom of the tray, and should be fitted with plastic bushings.
   f) Cable tray trays must be installed to allow technicians/installers adequate access space above and to the side of the structure.

1. The minimum recommended height above the cable tray is 12 inches.
2. The minimum recommended side clearance is 18 inches.

g) The cable tray should not extend more than 12 inches inside of the TR.
h) The cable tray dimensions will vary according to number and type of outlets it supports. A 30% fill ratio shall be used when determining cable tray sizing.
i) All cable trays should be cleaned and free from derbis.

6) A 1-inch or larger EMT conduit must be used from each outlet to the cable tray.
   a) All conduits will be shall be appropriately fire stopped in accordance wit TIA/EIA 569-A, Annex A, and any/all local fire codes.
   b) Conduit will be installed with a pull string with a minimum test rating of 200 pounds.
   c) The ends of conduits will be reamed and bushed to eliminate sharp edges that can damage cables during installation or service.

7) Raceways may be used for horizontal outlet locations.
   a) All raceways shall be sized with the equivalent cross sectional capaCISy as the specified conduit.
   b) 4000 raceway shall be served with a minimum 1.25" EMT. Additional conduits will be considered when the raceway routes around the perimeter of the room.

8) Conduit must extend through the fire rated barrier when a fire rated barrier exists between the outlet and cable tray.

   Note: All horizontal pathways that penetrate fire rated barriers must be fire stopped in accordance with TIA/EIA 569-A, Annex A and local fire codes.

9) Identify hard ceiling or ceilings with restricted access that must be traversed during cable installation.
   a) Multiple metallic conduits will be used in these areas.
   b) Conduits will be of a size that will ensure that a 40% fill ratio is not exceeded.
   c) The ends of the conduit will be bonded and grounded. Conduit will be grounded to Main Terminal Grounding Busbar (MTGB).

10) Minimum cable bend radii and conduit capaCISy must be considered when using a modular furniture system.

11) The minimum bend radius for 4-pair UTP cable, no load, is 6 times the outside diameter.

12) The minimum bend radius for a conduit that is 2 inches or less in diameter should be 6 times the internal conduit diameter. If the conduit is larger than 2 inches the bend radius should be 10 times the internal diameter of the conduit.

13) LB-type fittings shall not be used.

14) NMT or seal-tight conduit shall not be used.

15) Flexible metallic conduit may be used in existing walls and shall be approved by CIS, in writing, prior to placement. A 1-inch EMT conduit or 2400 Wiremold raceway is the minimal size that is used for all administrative, laboratory and classroom outlet boxes to the cable tray. A larger EMT conduit must be used if the bulk of the cables to be supported exceed the recommended 40% fill ratio.

16) Basic outlets may be installed with 1" EMT to the cable tray to a single gang outlet box near the user device. A raceway with the same cross sectional capacity may be used. Routing conduits directly to the TR is the preferred method for distribution of emergency reporting devices.

This configuration is most common for:

- Wall phones.
- Wireless access points.
- Fire alarm panels.
- Courtesy phones.
- Utility circuits (chill water, card readers, time clocks and customer owned equipment)

17) The following chart is used to determine the recommended 40 % fill conduit capacity.

Number of cables

Inside Diameter mm	Trade Size	Cable Outside Diameter mm (in)									
		3.3 (0.13)	4.6 (0.18)	5.6 (0.22)	6.1 (0.24)	7.4 (0.29)	7.9 (0.31)	9.4 (0.37)	13.5 (0.53)	15.8 (0.62)	17.8 (0.70)
27	1	8	8	7	6	3	3	2	1	0	0
35	1-1/4	16	14	12	10	6	4	3	1	1	1
41	1-1/2	20	18	16	15	7	6	4	2	1	1
53	2	30	26	22	20	14	12	7	4	3	2
63	2-1/2	45	40	36	30	17	14	12	6	3	3
78	3	70	60	50	40	20	20	17	7	6	6
91	3-1/2							22	12	7	6
103	4							30	14	12	7

1 outlet = 1 inch EMT
2 outlets = 1.5" EMT
3 outlets = 2" EMT

18) The maximum pulling tension on each 4-pair UTP cable is 25 lbs.

19) A metal pull box shall be installed if any of these conditions exist:
-The length of the pathway is over 100 feet.
-Quantity of more than two 90-degree bends.
-There is a reverse bend in the run.

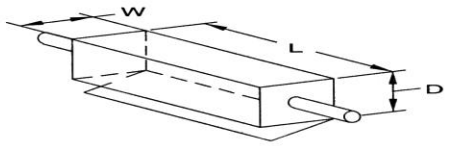
20) Pull boxes or junction boxes should be located in an area that is readily accessible and is immediately above a suitably marked panel.

21) Velcro cable ties shall be used to secure cable bundles and patch cords, where required. Plastic Ty-wraps will only be used with the Infrastructure Engineer's approval and must meet installation requirements per TIA/EIA specifications.

22) Installation should not allow cables to load up at the corners of the cable tray.

23) The following chart is used to determine recommended pull box or junction box size.

Maximum Trade Size of Conduit	Size of Box			For Each Additional Conduit Increase Width
	Width	Length	Depth	
21 mm (3/4)	100 mm (4 in)	300 mm (12 in)	75 mm (3 in)	50 mm (2 in)
27 mm (1)	100 mm (4 in)	400 mm (16 in)	75 mm (3 in)	50 mm (2 in)
35 mm (1-1/4)	150 mm (6 in)	500 mm (20 in)	75 mm (3 in)	75 mm (3 in)
41 mm (1-1/2)	200 mm (8 in)	675 mm (27 in)	100 mm (4 in)	100 mm (4 in)
53 mm (2)	200 mm (8 in)	900 mm (36 in)	100 mm (4 in)	125 mm (5 in)
63 mm (2-1/2)	250 mm (10 in)	1050 mm (42 in)	125 mm (5 in)	150 mm (6 in)
78 mm (3)	300 mm (12 in)	1200 mm (48 in)	125 mm (5 in)	150 mm (6 in)
91 mm (3-1/2)	300 mm (12 in)	1350 mm (54 in)	150 mm (6 in)	150 mm (6 in)
103 mm (4)	375 mm (15 in)	1520 mm (60 in)	200 mm (8 in)	200 mm (8 in)



8. Cable Testing Procedures

A. Testing shall conform to ANSI/TIA/EIA-568-B Cabling Transmission Performance and Test Requirements

B. Horizontal UTP Cable Testing

1) CIS requires that all horizontal UTP cable pairs be Category 6 Permanent Link tested with a Level IIIe tester or equivalent for full compliance with ANSI/TIA/EIA 568-B and addenda regardless of intended use.

2) Test results must be provided for all conductor pairs of each cable.

3) The test results must be provided on a MS-Windows formatted CD in an MS Excel worksheet and tester manufacturer's application format.

4) Test parameters should include:
a) Length
b) Wire map (continuity, polarity, parity)
c) NEXT
d) ELFEXT for Category 6 and higher
e) Attenuation
f) Delay and delay skew for Category 6 and higher
g) Return loss for Category 6 and higher
h) Power sum crosstalk (PSNEXT and PSELFEXT) for Category and higher

C. Horizontal Fiber Cable Testing

1) The horizontal fiber optic cable must be tested for link attenuation as referenced in TIA/EIA-568-B.1, Section 11.3. See Table 2-2 for proper fiber testing measures. All strands will be tested in a bi-directional method, using both an OTDR and Power Meter.

2) The horizontal cable, to include connectors, must be tested in-line between two reference cables. One cable will be attached to the light source and the other to the power meter to measure the dB loss from both connectors, as well as any dB loss associated with the cable between the connectors.

3) The dB loss for a horizontal segment must not exceed 2.0dB. TIA/EIA 568-B.1 and 526-14A outlines the steps required to test multimode horizontal fiber optic cabling. TIA/EIA 526-7 outline the steps required to test Single mode fiber optic cable. Horizontal multimode cable only needs to be tested at 850 or 1300µm.

4) Field-testing instruments for multimode fiber optic cabling shall meet the requirements of ANSI/TIA/EIA-526-14-A. The light source shall meet the launch requirements of ANSI/TIA/EIA-455-50B, Method A. Reference TIA/EIA-568-B.3 for additional information. Per ANSI/TIA/EIA 526-14A, Annex B, Test Method B shall be accomplished.

5) Field-testing instruments for Single mode fiber optic cabling shall meet the requirements of ANSI/TIA/EIA-526-7. Testing Method A and B shall be accomplished. Reference TIA/EIA-568-B.3 for additional information.

6) All field tests findings-of-fact will be clearly documented and provided to CIS in writing.

Note: Because of the relatively short cable lengths within the horizontal segment (less than 295 feet), the main loss will be connector loss.

CHAPTER 3: THE TELECOMMUNICATION ROOMS

1. General

A. ANSI/TIA/EIA-568-B.1 has replaced the term Communications Closet with the term Telecommunication Room (TR).

B. On the Seattle Pacific University campus, TR(s) define the Building Distribution Frame (BDF) and when necessary, an Intermediate Distribution Frame(s) (IDF). TRs house communications equipment to serve the voice, data, and wireless requirements for an entire building. The term BDF refers to a cross-connect point for both copper and fiber optic cable serving a single building. This cross connect hardware is physically located within a TR, and can vary in size depending upon termination space requirements, (i.e. equipment cabinets, equipment racks or backboard space).

C. The term IDF refers to a termination point for riser copper and fiber cables, horizontal copper and fiber optic cables, and data distribution equipment. The primary function of an IDF is to provide voice and data beyond the limits of the BDF, which allows for the installation of station copper to meet industry and manufacturers standards. Operating outside those standards eliminates the ability to provide the full potential for data speed to the user. This would apply to the horizontal copper cabling from the outlet to a RJ-45 patch panel for voice and data applications. The horizontal fiber cabling from the outlet to a fiber-housing unit is for data applications. These media types are mounted within an equipment rack, cabinet or mounted to a wall. This termination hardware is located within a TR and can vary in size depending upon termination space requirements and quantities.

D. A TR provides a secure controlled environment in which CIS installs equipment racks, communications voice and data equipment, terminating hardware, splice closures, and protection apparatuses where applicable. This equipment may also include Private Branch Exchange (PBX) equipment, switching nodes; IP based video distribution equipment, network routers, wireless equipment and uninterruptible power sources (up to 100kVA).

E. TRs are considered secure spaces due to the nature and complexity of the equipment they contain. CIS is responsible for providing reliable service through physical security to the voice and data infrastructure as well as electronic security for the voice and data networks. As a result, these spaces are uniquely keyed and should contain only that equipment directly under the control of CIS.

F. Because technology limits the distances between termination points of horizontal distribution media, the location of these facilities is important. In order to make the most effective use of the TRs, they should be vertically aligned and placed in a central location within the building. Another important consideration is that it be in close proximity to a path to the floor above and or below.

2. The Design Process

A. TRs shall be designed and provisioned according to the requirements in ANSI/TIA/EIA-569-A. Modifications to the design can only be made with the approval of CIS.

B. The primary use of the TR is to provide a secure, centralized distribution room for technology. This may require space for equipment racks in which to place fiber terminations, voice patch panels, data electronics, and patch panels for station media (copper or fiber).

C. The BDF requires additional space for terminating and circuit protection of feed copper and additional rack space for terminating and housing feed fiber.

D. The size and quantity of the TRs will be influenced by the serving distance per floor and the number and type of outlets to be served from them. Also consideration for growth should be calculated into the dimensions.

3. General Requirements

A. Telecommunication rooms shall be unshared, secure, environmentally controlled spaces. They shall be provided with locks according to specifications obtained from CIS and FM. Only facilities administered by CIS are to be installed in them and they shall not be accessible to building occupants or to any personnel other than those authorized by CIS, and those with life-safety access requirement. No other utilities shall share or pass through these rooms.

B. Equipment not related to the support of the communications facilities (e.g. sprinkler, steam, chilled water, supply and waste piping, ductwork, pneumatic tubing, Life Safety, Facilities monitoring, CATV etc) shall not be installed in, pass through or enter the TR.

C. In any multi-level structure, communications rooms should be designed so they are vertically aligned. The size and number of conduits used between rooms depends on the usable floor space of the building, however riser conduit and/or sleeves between closets should consist of a minimum of 3 - 4" conduits or sleeves. CIS shall specify and approve all designs in regards to the size and placement of the conduits or sleeves. These riser conduits or sleeves should have bushings attached at both ends. Conduits or sleeves in the room below should extend only far enough below the ceiling to permit installation of a bushing and a cap. In the room above, this conduit or sleeves should extend 3" above the finished floor and also have bushings attached. All conduits or sleeves should be installed at a minimum of 2 inches and no more than 6” inches from the adjacent wall.

D. A single 36” wide by 80” height solid door should be provided for the BDF and IDFs and mounted to swing outside the room. A shallow room should have two 36” wide by 80” height solid doors installed without a center post and should swing outside of the room. Door(s) shall be fire rated for a minimum of one hour, or more as required by local code requirements

E. Space and configuration requirements for communications rooms are described below with general notes to be taken into account during design.

F. Horizontal pathways should terminate in the TR located on the same floor as the area being served. However in an effort to provide the most cost effective communications solution, a TR located on one floor and serving the floor above and below is acceptable practice. In this instance, the space must be sized accordingly.

G. Shallow riser rooms are used only as splice points for fiber or pass-through for Category 6 copper cables from outlets and shall not house electronics.

H. The main TR shall be large enough to accommodate lightning protectors, cross-connects, wall and rack mounted data equipment, data equipment racks, and the main telecommunications grounding bussbar (TMGB)

4. The Size of the TR

A. The size of the TR depends upon the size of the area that the room will serve and the quantity and variety of the equipment to be installed.

1) The TR must provide enough space for all planned cable terminations and electronic equipment, including any environmental control equipment, power distribution/conditioners, and uninterrupted power supply systems that will be installed to serve the telecommunications equipment.

2) The TR must provide adequate space for safe access to the equipment for maintenance and administration purposes, and for equipment changes with minimal disruptions.

3) The minimum size of the TR is based on providing communications service over a Category 6 or fiber optic cable plant.

4) Multiple TRs are required if the usable floor space to be served exceeds 10,000 square feet or the cable length between the outlet and the patch panel in the TR exceeds 295 cable/feet.

5. The Location of the TR

A. The TR must not be located in any place that may be subject to water, steam, humidity, heat, and any other corrosive atmospheric or environmental substance.

B. The TR must not be located near electrical power supply transformers, elevator or pump motors, generators, x-ray equipment, radio and radar transmitters, induction heating devices, and any other potential sources of electromagnetic interference (EMI).

C. The TR must not share space in or be located near electrical closets, boiler rooms, washrooms, janitorial closets, and storage rooms.

D. The TR must not be located near sources of mechanical vibration that could be conveyed to the room through the building structure.

E. The TR shall not be located below water level unless preventive measures against water infiltration are implemented. 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 the risk of water ingress exists.

F. TRs should be vertical aligned in multi-story buildings to minimize construction and material costs.

G. Access to the TR should be directly from hallways or service corridors; not through classrooms, offices, or spaces not accessible by maintenance level keys.

H. The location of the TR must be submitted to CIS for approval via the construction drawings, and it must be annotated on the floor plan.

I. The TR shall be located in an accessible area on each floor (e.g. a common hallway).

6. Design Requirements

A. The major factors that must be considered when designing the TR are as follows:

1) Ceiling:
a) The minimum ceiling height must be 9 feet.
b) Ceiling protrusions must be placed to assure a minimum clear height of 8 feet, 6 inches to provide space over the equipment facilities for cables and suspended racks.
c) For maximum flexibility, ceilings should be left bare to the deck.
d) Ceiling shall be treated to eliminate dust.

2) Entrance Doors:
a) The door shall be a minimum of 36 inches wide and 80 inches high, without including doorsill measurements. Door shall be fire rated for a minimum of one hour, or more as required by local code requirements.
b) Doors must open outward (code permitting).
c) The keying of doors for all TRs shall be keyed to CIS and Safety/Security specifications. Locks should have a storeroom function cylinder, which should always require a key for access.
d) For security purposes, the room signage should be consistent with the Facility room numbering scheme.

3) Walls:
a) Interior finishes shall be in a light color (linen) to enhance room lighting.
b) All walls must be lined with Trade Size, void free, ¾-inch AC-grade plywood, 8 feet high.

c) The plywood must be securely fastened to the wall-framing members, and painted with two coats of light gray fire-retardant paint.
d) Plywood will be mounted vertically starting at 3 inches above the finished floor.

4) Floors:
a) Floors must be sealed concrete to minimize dust and static electricity. Removable computer floor tiles shall be of a tile type surface.
b) If vinyl tiles are required, then **anti-static** vinyl tiles shall be used to avoid damage to the electronics located in the room.
c) Floor loading capacity in the TR shall be designed for a minimum distributed load rating of 100 lbf/ft² and a minimum concentrated load rating of at least 2000 lbf. The floor loading for a TR shall be designed for a minimum load rating of 50 lbf/ft². It shall be verified that concentrations of proposed equipment do not exceed the floor limit.

B. Environmental Controls

1) The following environmental requirements should be taken into account when creating a design for a TR.

2) The current Hewlett Packard network electronic device generates about 2100BTU/hr. Cooling capacity should anticipate double that number in the event a second unit is required. Consult with NCS for considerations of anticipated network electronics to be installed.

3) The recommended operating temperature should be set between 60 degrees F. to 80 degrees F.

4) In situations where the daily temperature within a TR will exceed 80 degrees F., or if ventilation is not possible within code, then an HVAC source must be considered. This may be accomplished by:
- Dedicated HVAC equipment.
- Access to the main HVAC delivery system.
- Wet cooling can be a fan coil unit with chilled water.
- Cooling may also be obtained with an AC unit and a remote condenser.

5) The most cost-effective method for the given environmental circumstances should be implemented to attain the correct operating levels and be approved by CIS.

6) Where the daily temperature in the surrounding area does not exceed 80 degrees, building ventilation can be used to cool the room under the following conditions.
a) The intake must be filtered.
b) The exhaust cannot be vented in a manner that will violate code.
c) Fire dampers will be installed to comply with code.
d) Air within the room is exchanged at a rate, which will keep the room temperature within limits from the finished floor to a height of 5-feet.
e) Ventilation return and supply ducts should be terminated with a flushed mounted grid in the TR.

7) The recommended humidity level should fall between 30% and 65%. Humidity should be a concern if it is anticipated that normal level within the TR would fall outside these parameters.

8) The air handling system and environment controls for TRs must be continuous and dedicated, and designed to provide positive airflow and cooling even during times when the main building systems are shut down. This may require separate air handlers and/or small stand-alone cooling systems that are thermostatically controlled in this space. If this room is to be used as a switch room, and or data node room the air handling system should be connected to the building's backup power generation system. Whether this space is separated or combined with the building service entrance, it is, by almost every definition, a specialized area. The room will house sensitive electronic components that will generate heat 24 hours a day, 365 days a year and must be cooled to maintain operating performance.

9) Heating, ventilation, and air-conditioning sensors and control equipment related to the environment within the TR must be located in the TR.

10) The TR shall be protected from contaminates and pollutants that could affect operation and material integrity of the installed equipment. When contaminates are present in concentrations greater than indicated in ANSI/TIA/EIA 569-A, Table 8.2-2, vapor barriers, positive room pressure or absolute filters shall be provided.

C. Lighting

1) Lighting must provide a minimum equivalent of 50 foot-candles when measured three feet above the finished floor.

2) Suspended light fixtures should be mounted at 8 feet, 6 inches above the finished floor. Position the light fixture(s) above an aisle area front and back only, and not directly over equipment racks or cabinets. Wall mounted fixtures are permissible if lighting standards are met. Wall mounts should be placed in such a manner that they will not interfere with infrastructure pathways, protective equipment, and cables.

3) The light switch must be located near the entrance of the TR. Dimmer switches are not permitted.

4) Power for the lighting must come from the sub-panel within the communications room.

5) Emergency lighting and signs should be properly placed such that an absence of light will not hamper an emergency exit.

D. Electrical

1) TRs shall contain electrical service fed by a dedicated 50 Amp sub-panel or load panel located within the TR.

2) Sub-panels shall be located near the room entrance door, whenever possible, to conserve wall space. Placement of the sub-panel should take into consideration allotted space for an additional rack or device.

3) The TR must be equipped with a minimum of five dedicated 3-wire 120V AC nominal receptacle circuits. These shall be 20- ampere rated, non-switched, quad electrical receptacles on separate branch circuits. There should be two primary circuits for data electronics. These should reside on duplex outlets, one dedicated circuit on each, in one 4-inch utility box.

4) All circuits should be labeled on the box as well as in the panel.

5) Receptacles are not to be located on active equipment racks but may be installed on overhead ladder racking as designed and approved by CIS.

6) Electrical service may be connected to an emergency power source if available.

E. Grounding

1) Grounding shall conform to TIA/EIA-J-STD-037- Commercial Building Grounding and Bonding Requirements for Telecommunications, National Electrical Code® and manufacturer's grounding requirements as minimum.

2) The TR must be provided with a Main Telecommunications Grounding Busbar (MTGB) (electrical ground) on a 4-inch or larger bus bar as defined by NEC Article 250- 71(b) and TIA/EIA-J-STD-037. The ground wire shall consist of a green insulated #6 AWG copper-grounding conductor.

3) The bus bar must be mounted on the plywood and placed so as not to interfere with the installation of the communications equipment or infrastructure pathways.

4) This grounding bar must be connected to a main building ground electrode, reference NEC Article 250 and TIA/EIA-J-STD-037.

5) Bonding conductors placed in ferrous metal conduit over 3-feet in length shall be bonded to the conduit per NEC Article 250.

6) All metallic conduits, racks, cabinets, patch panel, fiber housing units, and any other associated devices located in the TR must be bonded to the ground busbar (TGB).

7) In the event an IDF is required, a #6 ground shall be installed as a communications grounding backbone interconnecting the TMGB “Telecommunications Main Grounding Busbar” to a TGB “Telecommunications Grounding Busbar” in the IDF(s)

F. Security and Fire Protection

1) If sprinklers are required within the TR, wall mounts above the plywood backboard are preferred. Should overhead sprinklers be required, the heads shall be provided with wire cages to prevent accidental operation.

2) When possible by code, arrange sprinkler system in TRs to be on a separate zone from other spaces.

3) Consideration should be given to the installation of alternate fire-suppression systems.

4) Additional equipment such as fire alarm panels and/or building monitoring devices must not be housed in the TR. Separate space for these services can be provided as part of the electrical room or in a separate space.

7. Cable Pathways Entering/Exiting the TR

A. Sleeves, conduits and cable trays are used to route the cables entering and exiting the TR.

B. A sleeve is a circular opening through the ceiling or floor of a TR that allows the passage of cables.

C. TRs that are vertically aligned must be connected with sleeves.

1) Sleeves and conduits must be positioned near a wall on which the cables can be supported.
2) They must be located where pulling and termination can be done so as not to interfere with other equipment within the room.
3) Sleeves and conduits must not be placed directly above or below the wall space that is used for termination fields.
4) Sleeves and conduits must conform to the fire stopping requirements as established by the National Electrical Code (NEC) and local fire codes.
5) They must not be left open after cable installation and they must be properly fire stopped in accordance with TIA/EIA 569-A, Annex A, and any/all local fire codes.
6) Sleeves and conduits must extend a maximum of 3-inches above the finished floor level.
7) Sleeves and conduits must be fitted with plastic bushings on both ends.

8) All unused sleeves must be appropriately fire stopped in accordance with TIA/EIA 569-A, Annex A, and any/all local fire codes.
9) A minimum number of 4–5 inch conduits must be installed to support the technologies entering the BDF room.
10) A minimum number of 3 - 4-inch sleeves or conduits must be installed to support the technologies located within the IDFs or Shallow rooms.
11) The conduit, sleeves, and cable trays will be grounded on both ends.
12) All conduits and cable trays will be equipped with a pull string.

Note: The number of sleeves and/or sizes of conduits must be specified prior to construction and approved by CIS.

8. Termination Hardware Requirements for the BDF, IDF, and Shallow Rooms

A. Patch Panels for Copper Horizontal Cabling.
1) The cabling in the horizontal segment shall be terminated on patch panels designed for high speed cabling in the BDF or IDF. UTP cables supporting data outlets must be terminated on high density patch panels which are mounted in a free standing equipment rack, wall rack or in an enclosed data cabinet. All structures must be standard industry enclosures in installed according to manufacturer specifications.
2) Product testing shall be conducted at the component level by a UL certified testing laboratory and will include Active Live Channel Testing to insure manufacture and performance quality.
3) Patch panels and active equipment in the BDF and IDF must be placed to allow interconnections via jumpers, patch cords, and equipment cables.

B. Cable Management Panel for Data Horizontal Copper Cabling.
1) Horizontal and vertical cable management panels shall be installed with data patch panels in all rack and cabinet installations. Two horizontal cable management panels are recommended for every data patch panel and will be configured so that one is above the patch panel and one is below it.
2) Vertical cable management will be located on both sides of the rack or cabinet.
3) Sizing of cable management shall be coordinated with CIS and FM.

C. Patch Panels for Fiber Optic Cabling.
1) Fiber optic cable for Outside Plant and Riser/Backbone installations shall be terminated on LST1U-072/7 connectors at the TRs.
2) All loose-tube Outside Plant fiber optic cables shall have a Buffer Tube Fan Out kit installed prior to the installation of fiber connectors.
3) Fiber optic cable for horizontal installations shall be terminated on LC type connectors at the TR and outlet locations.
4) Fiber optic termination cabinets/terminals shall be rack mounted in either equipment racks or enclosed data cabinets.

D. Patch Panels for Voice Connections/Activations
1) The cabling for the voice connections/activations shall be terminated on patch panels to 110 type termination blocks in the BDF or IDF. A 25 pair copper cable will be used to connect the two wiring devices. The patch panel will be positioned within the rack or cabinet and the 110 type termination block will be positioned on the wall below the building feed or riser termination points (A 188 backboard shall be located between the two fields).
2) The 25 pair cable will be terminated on the 110 type hardware in chronological order via the color code and sequential numbering on the back of the patch panel.
3) The 25 pair will be terminated on the 110-style patch panel in a fashion that allows two pairs to accommodate three positions on the device (sometimes called the “Seattle Pacific Loop”). Two pair should be dedicated per position on the patch panel and terminated in chronological order via the color code. The following two illustrations provide detail to this procedure (Note this configuration is used for Universal or T568B wire mapped devices).
4) Cross-connect fields, patch panels, and active equipment in the BDF and IDF must be placed to allow cross-connections and interconnections via jumpers, patch cords, and equipment cables.

9. Structures to Support the Cabling in the TRs

A. Wire tray, ladder racking, equipment racks, plywood backboards, data equipment racks, and wire management brackets for the BDF and IDF equipment must be used to keep the cabling and equipment organized, and to allow the cable plant to be installed to TIA/EIA 569-A specifications. Wire tray or ladder racking must be used to route bulk communications cables within the TR.

1) Wire tray must be at least 12 inches wide and be installed a minimum of 7’6” above the finished floor to allow adequate clearance at the top of the equipment racks and cabinets.

2) Provide proper clearance between the top of cable tray and any obstacle that may be encountered.

3) All trays used to support cables, to include splice points and T-sections, must be bonded and grounded to the busbar located within the TR.

4) Free standing equipment racks must have equipment mounting holes19 inches apart (19” relay racks). The floor to top dimension should be 84 inches, with ANSI/EIA-310D spacing and 12-24 threads. Enclosed cabinets shall be ordered with the same ANSI/EIA-310D spacing and 12-24 threads to insure consistency.

a) Metric threaded screws and cage nuts will not be used.
b) A minimum working clearance of 3 feet must be maintained in the front and behind each equipment rack and at one end of the equipment rack or multiple rack assemblies. The front and rear clearance must be measured from the outermost surface of the electronic equipment and connecting hardware rather than from the equipment rack itself since some of these devices may extend beyond the equipment rack.
c) The equipment racks must be bonded and grounded to the MTGB/TGB in the TR in accordance with TIA/EIA-J-STD-037.
d) Vertical cabling management sections, single or doubled sided shall be installed with each freestanding rack.

B. In limited applications, equipment and connecting hardware may be wall mounted using wood screws on rigid plywood backboard. Installed plywood backboard shall meet all requirements as listed in this chapter (Sub-Section 3 of Section 5), and ANSI/TIA/EIA 569-A. This practice may be used when the outlet density is minimal and when limited expansion space is available. A floor mount rack design should be considered first.

1) Horizontal and vertical wire management brackets must be used to manage cables and jumpers. Velcro cable ties will be used to secure cable bundles where required. Plastic Ty-Raps will only be used with CIS' approval, and if used, must meet installation requirements per TIA/EIA specifications.

2) The cross-connect points must be located near the end of the riser pathways to minimize the need for cable routing in the TR.

3) The equipment racks or cabinets must be configured with wire management to aid in jumper and/or patch cord routing. The fiber housing units must be wall mounted or mounted in equipment racks or enclosed data cabinets.

4) In very small buildings (fewer than 24 outlets), fiber, voice patch panels, and UTP, can be located in the same equipment rack/cabinet.

C. Equipment Wire Rack Layout

1) Fiber housing is always located at the top of the equipment rack. Electronics shall be mounted 40-inches AFF. This will allow for future installation of equipment if necessary. Open wire management allow for a path across the rack without cluttering the jumpers housed in the closed management. Voice patch panels are installed as required for the area being served.

D. Station Wire Rack

1) Station wire racks should consist of open wire management, station wire or fiber patch panels, and closed wire management. These should be installed from the top down in quantities necessary to support the needs of the area being served.

CHAPTER 4: THE RISER SEGMENT

1. The Design Process

A. The riser segment consists of the Copper and Fiber optic riser cable and the supporting infrastructure within a building. This pathway and cabling connects the TRs vertically (the BDF to the IDFs).

B. This section describes the policies and procedures for the following design activities:

1) The sizing, type, and termination of copper and fiber optic riser cables.

2) Designing the structures to support a vertically aligned riser segment.

3) Designing the structures to support a horizontally offset riser segment.

4) When fiber optic cable passes through a vertical riser closet, secure fiber to the wall vertically every 48 inches or according to manufacturers recommendations.

5) All fiber optic cables should be installed in an inner-duct and/or EMT from termination point to termination point.

6) Contractors/Installers shall adhere to all manufacture's requirements in regards to pulling tension and allowable pulling lubricants when installing riser cables.

2. The Size, Type and Termination of Copper Riser Cable

A. The size of the riser cable is a function of the number of administrative and higher density communication outlets supported by the TR.

1) A minimum of two copper cable pairs is required for each administrative outlet.

2) Commonly available copper cable sizes are 50 (min), 100, 200, 300, 600, 900 and 1200 pairs.

B. The type of riser cable shall meet the following requirements:

1) Conform to NEC Article 800-51(B) and comply with the State of Washington fire codes.

2) The type of riser cable will be ARMM, UL listed CMR rated. Filled-core Outside Plant cable shall not be used for interior backbone cable.

3) The riser cable is labeled based on a cable number assigned by CIS.

4) ARMM riser cables shall be grounded and bonded in accordance with TIA/EIA-J-STD-037 requirements, as applicable.

C. The method of termination of the copper riser cable will conform to the requirements in Chapter 3.

3. The Size, Type, and Termination of Fiber Optic Riser Cable.

A. The standard strand count of the riser fiber optic cable is 12 single mode and 12 multimode.

B. Riser fiber optic cables shall be terminated on LC type terminations. All fiber strands shall be terminated and tested in accordance with this standard, with complete documentation/results provided to CIS and Facility Management.

C. The type of riser cable shall meet the following requirements:

1) Conform to NEC Article 770, and comply with the State of Washington fire codes as interpreted by the State Fire Marshal's department.

2) The type of riser cable will be UL listed OFNR rated. Filled-core Outside Plant cable shall not be used for interior backbone cable.

3) The riser cable is labeled based on a cable number assigned by CIS.

4) All riser cable (fiber optic) should be of a tight buffer design.

5) The fiber optic components shall be manufactured by the same vendor to insure compatibility, performance and warranty. Corning Cable Systems shall be the preferred manufacturer.

6) The method of termination of the fiber optic riser cable will conform to the requirements in Chapter 3.

4. Testing Requirements for Copper and Fiber Optic Riser Cables

A. Copper and fiber riser cables shall be meet the performance criteria in accordance with TIA/EIA 568-B.1.

B. Fiber riser cables shall be tested in accordance with TIA-526.

C. Copper cable binders will tested individually with a VOM for loop continuity.

D. Fiber optic link segments shall be tested in one direction at 1310 and 1550 nm.

E. All test results will be provided to CIS in writing.

5. Structures to Support Vertically Aligned IDFs

A. TRs that are aligned vertically will utilize sleeves and slots as identified in Chapter 3, Telecommunications Rooms.

B. In a multi-story building, grip brackets must be specified to support the riser cable's weight as it passes through the TR.

6. Structures to Support Horizontally Offset TRs

A. TRs that are not vertically aligned must be connected with conduits and pull boxes.

B. Conduit will be used to route the riser cables between the BDFs and the IDFs. Conduit paths are tightly controlled pathways that must be coordinated with other trades during construction or remodeling.

1) The conduit will be Electrical Metallic Tubing (EMT) 4 inches in diameter.

2) The conduit will be bonded to the electrical ground at each end.

3) The conduit will be installed with a pull string and the ends will be bushed to protect the cable.

4) Conduits that enter the TR must be placed near the corner and as close as possible to the wall where the backboard is mounted to allow for proper cable racking and to minimize the cable route inside the TR.

5) Conduit located in the ceiling must protrude into the ER/TR 1 to 2 inches and a minimum 7½ feet above the finished floor. Conduit will not turn down.

6) Sketch the proposed route of the conduit on the floor plan.

CHAPTER 5: THE OUTSIDE PLANT SEGMENT

1. The Design Process

A. All new communications cabling on the Seattle Pacific University Campus is to be installed in underground ducts encased in concrete. Direct burial or aerial cable may only be used under exceptional circumstances and if prior written approval is obtained from the CIS. Existing telephone lines may be found in ducts, or may be direct buried depending on locations and age of cable. These are legacy installations that will be grandfathered. During the process of Schematic and Design drawings, CIS will identify the routes, cable types, and the building cable entrance locations.

B. Where the entrance conduits penetrate the foundation, footings or outside walls, rigid metallic conduit will be used. At the point of exit, a minimum of 2' ground covers at 5% grade shall be maintained. If existing conditions should alter this, Facilities Management and CIS must be notified.

C. The campus segment consists of the Outside Plant (OSP) cables and structures needed to inter-connect the Campus Buildings, and Building Distribution Frame (BDF) for facilities associated with Seattle Pacific University.

D. The supporting structure includes underground (in conduit) cables, direct buried cables, maintenance holes (MH), hand holes/pull boxes (HH/PB), aerial cables, pole lines, pedestals and outside terminals. The campus segment must be designed and installed to the NESC and ANSI/EIA/TIA-758 and 758-1 requirements and standards for outside plant construction. The HH/PB's shall not be considered for splice points.

E. This section describes the policies and procedures for the following design activities:
1) Identifying cable routes from the maintenance hole to a building or building-to-building.
2) Selecting cable distribution methods.
3) Determining the aerial, underground and direct buried cable requirements.
4) Identifying the types of cable used in the campus segment.
5) Determining maintenance hole, hand hole, and pull box requirements.
6) Determining electrical protection and bonding/grounding requirements.

2. Cable Routes

A. The following steps must be taken to identify the cable routes between new buildings and major building renovations.

1) Provide an as-built of the campus utilities map for the specified area.

2) Determine where the cable entrance point is for each building.

3) Provide a drawing of the intended path for the cables from building entrance to the nearest serving facility.

4) Note any obstacles, existing cable facilities, or other underground utilities on the campus map.

5) Note if right-of-way permits or easements are required (off campus locations).

3. Cable Distribution Methods

A. CIS must be contacted during the schematic design phase of the project to determine the best distribution method for the routing of the feed cables.

B. An underground duct system consists of cables placed in buried conduits encased in concrete (duct bank) that is connected to maintenance holes (MH); hand holes/pull boxes (HH/PB) and serving building.

1) If new conduits (ducts) are required, a minimum of four 5-inch (4-5 inch) ducts will be required. Minimum top cover for the encased duct bank is two feet. Conduit material will be of schedule 40 PVC Carlon Type EB, or other duct material approved by CIS. Coordinate design with Facilities Management in case additional ducts are needed for other purposes.

2) Concrete for encapsulating duct-bank should be 3/8 inch aggregate, with a nominal compressive strength of 4000 pounds per square inch. It should have just enough consistency to flow to the bottom of the formation, but not as wet to cause the ducts to float.

3) Where practical, avoid locating duct banks adjacent to steam lines. If this is not possible, contact Facilities Management and CIS for special design specifications.

4) If telephone and electric duct-bank share a common trench, the following clearance requirements must be adhered to:
   - When in concrete a minimum of 6 inches should be observed.
   - When in masonry a minimum of 8 inches should be observed.
   - When in well-tamped soil a minimum of 12 to 18 inches should be observed.

5) Where duct banks will be exposed (e.g., bridge crossings, etc.), a transition to rigid steel must be made. Expansion joints are required in conjunction with the steel conduit and the transition will be made no less than 10 feet from the point of exposure.

6) Where road crossings are needed, transition must be made to steel pipe or schedule 80 PVC Carlon Type EB if the cover will be less than four (4) feet.

7) A duct-bank that has a downhill grade prior to entry of a building, a maintenance hole should be installed to protect against flooding.

8) Metallic locating tape labeled "telephone cable" must be placed approximately 6 inches below grade and immediately above duct banks.

C. An aerial cable system consists of cables installed on aerial supporting structures such as poles, sides of buildings, and other above ground structures.

4. Underground Cable Requirements

A. All underground conduit and OSP construction and installation at Seattle Pacific University must conform to Division 27 Design and Construction Standards.

B. Underground and OSP cable projects must be designed and approved by CIS. These drawings must include the following information:

1) Details showing duct locations in regards to, clearances from final grade, backfill materials, depths, and cross sections of the duct configuration, including entries into the selected building and maintenance holes.

2) Construction notes applicable to the work being performed.

3) 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 Seattle Pacific University.

4) A legend explaining symbols of all relevant structures and work operations.

5) Cable types, counts, and directions of feed.

6) Conduit types, dimensions, and wall-to-wall measurements when used with MH, HH/PB, and TRs.

7) MH drawings showing cable-racking information, applicable cable counts, conduit assignments, splicing details, north point arrows, and street outlets. MH drawings must be consistent with CIS standards.

a) All maintenance holes and hand holes will be pre-cast or cast-in-place reinforced concrete designed for a minimum H-20 loading.

b) Maintenance holes should be located so as to avoid unnecessary hazards and cause minimum interference with normal traffic flow. Communications maintenance holes should be located outside the traveled portion of the roadway or sidewalk whenever possible.

c) Pulling irons are required in every manhole and vault. In general irons are to be placed in the wall opposite each duct entrance at a point from six to twelve inches below the ducts with which they are associated and in line with the center line of the duct.

d) Service structures will be designed to meet the needs of each project.

e) Maintenance hole covers and frames will be cast iron and conform to Seattle Pacific Specifications. Covers will be labeled “SPU Communications”.

f) All MH's and HH/PB's will be equipped with a storm drain located at the bottom with positive drainage. Sump pumps shall not be used as an alternate.

g) Access ladders must be provided in all new manholes; such ladders must be galvanized steel or other non-corrosive metal with non-slip rungs.

h) A ground lug will be provided in all manholes and connected to a grounding rod at length and size that is compliant with code (NEC).

i) Pulling irons will be located on the opposite wall, and one (1) foot below the horizontal projection of the lowest duct, for each duct bank entering the manhole.

j) A maintenance hole is the preferred service device to be installed for Campus communications needs. A HH/PB is limited to future accommodations to growth and configurations. Splices are not allowed in HH/PB's.

C. All cables entering a building must conform to the bonding and grounding requirements listed in the NEC, Articles 250, 770 and 800.

D. Warning tape containing metallic tracings must be placed a minimum of 12 inches above the underground conduit/duct structure and direct buried cable to minimize any chance of an accidental dig-up. The American Public Works Association has adopted the color orange for identifying the telecommunication cables and structures.

E. The minimum depth of a trench must allow 24 inches of cover from the top of the conduit/cable to final grade. All underground utilities must be located and marked prior to any excavation or trenching.

F. All OSP conduits shall be strung with a mule line rated at a minimum of 1,250 lbs.

5. Cable Types

A. CIS recognizes two types of cable for outside use in the campus OSP segment, copper cable and fiber optic cable.

1) Outside Plant copper cable:

a) Filled core, (waterproofing compound) cable must be used for underground and direct buried cable installations. Filled cable preserves the integrity of the cable by providing physical protection against moisture penetration and seepage.

b) Direct buried cable may require an armored sheath to resist rodent and penetration type damage.

c) Plastic Insulated Cable (PIC) cables must be marked with cable length, cable code, date and manufacturer.

d) The following standard designations for copper exchange cable have been assigned by the Rural Utilities Services (RUS):

1. PE-39 refers to filled cable with solid polyolefin insulation, and is suitable for both conduit and direct-buried applications. Cable must meet ANSI ICEA 7CFR-1755-039/390 specifications.
2. PE-89 refers to filled cable with formed polyolefin insulation for conduit and direct-buried applications. Cable must meet ANSI ICEA 7CFR-1755-089 and 890 specifications.

2) Outside Plant Fiber Optic cable:

a) Loose Tube, filled core, (waterproofing compound) cable must be used for underground and direct buried fiber optic cable installations. Filled cable preserves the integrity of the cable by providing physical protection against moisture penetration and seepage. Loose tube fiber optic cable is the preferred and recommended cable for Outside Plant applications at Seattle Pacific University.

b) Corning Cable Systems shall manufacture all OSP fiber optic cable used for Seattle Pacific University's Facilities.

6. Maintenance Holes (MH) and Hand Holes/Pull Boxes (HH/PB).

A. MH's or HH/PB's are required where maximum cable reel lengths are exceeded, at the intersection of main and branch conduit runs, and at other locations where access to the cable in a conduit system is required. Splices will not be located in HH/PB's.

1) CIS has accepted the general sizing guidelines for MH's and HH/PB's.

2) Pre-cast MH/HH/PB's must be used whenever possible. Site-cast MH/HH/PB's may be used when the size required exceeds pre-cast sizes, obstructions prohibit placing pre-cast MH/HH/PB's must be rebuilt, or a custom design is required.

3) MH's must be sized to meet the maximum conduit requirements and be located to optimize the use of the associated conduit routes.

4) All conduits must be sealed in a MH/HH/PB system to prevent water entry.

5) The strength of concrete used for MH's must be at least 3,500 psi.

6) All hardware in maintenance holes will be galvanized. Maintenance holes must be equipped with:
   a) Bonding and grounding attachments and Uni-struts for racking.
   b) Pulling eyes at least 7/8 inches in diameter and, at a minimum, should be located opposite of each conduit entrance point.
   c) A positive drain of at least 8 inches in diameter.
   d) An entry ladder.

7) Conduit entry points:
   a) Should be located at opposite ends of the MH/HH/PB and the conduit formations shall enter the walls at a point approximately halfway between the floor and the ceiling.
   b) For wall racking considerations, design splayed duct bank entrances at the end walls rather than center placement to ease in the racking of the cables and splices.
   c) Lateral conduits entering MH/HH/PB's should be avoided.
   d) If the total number of conduits being placed is significantly less than the capacity of the termination MH or cable entrance, conduit should enter at the lower level. The upper space should be reserved for future additions.
   e) Conduits installed between MH/HH/PB's and Buildings, and between other MH/HH/PB's will be sloped per ANSI/TIA/EIA 758 to insure proper drainage of water.
   f) All conduits in buildings and MH/HH/PB's shall be plugged (Waterplug Quick-Setting Hydraulic Cement) to prevent the entrance of water and gases.

8) Cores into existing MH's can only be done via shop drawings clearly identify the methods and procedures to be used in the coring process. Cores into any MH must have approval from CIS. Personnel from CIS should be on-site during the boring to ensure a safe entry into the MH.

9) The maximum distance allowed between buildings and MH/HH/PB's and between MH/HH/PB's is 400 feet.

10) No more than two 90º sweeps or bends will be allowed between buildings, MH/HH/PB's, and MH/HH/PB to MH/HH/PB's. 45º conduit angles are preferred.

B. Hand holes/Pull Boxes (HH/PB) must be placed at strategic locations in a conduit system to allow installers to pull cable through the conduit with minimum difficulty and to protect the cable from excess tension.

1) Conduit entry points must be at opposite ends of the HH/PB.

2) HH/PB's will shall be sized at a minimum of 4 ft x 4 ft x 4 ft.

3) All HH/PB covers must be 36 inches in diameter and marked for easy identification (CU Communications).

4) All HH/PB covers will be secured with a minimum of two lugs per cover.

5) All HH/PB covers will be rated for the area in which they are installed (i.e. sidewalks, traffic lanes, etc).

6) HH/PB's will not be used as a splice points.

7. Splicing Methods and Splice Closures

A. Copper Cable Splices

1) Copper telephone cables will be spliced using a 3M 4000-D/TR Super Mini Splice Connector for underground, direct buried, aerial and building terminal splices.

2) All splices will be accomplished using the conductor fold-back method to ease future splicing and maintenance efforts.

3) CIS will specify the size and type of splice closure.

4) CIS shall inspect all splices prior to enclosing.

5) All splice closures shall be labeled, to include serving locations, size and designator.

6) All splice closures shall be properly racked and lashed to the MH/HH/PB racks.

7) All splice closures shall be properly grounded to the MH/HH/PB grounding and bonding system.

8) All OSP copper slice closures shall be encapsulated to protect from water damage.

Fiber Optic Cable Splices

1) All fiber optic cables on the Seattle Pacific University campus will be installed as either a home run or be spliced within the MH.

2) Should field splices be required, both multimode and single mode OSP fiber cables will be spliced using an approved fusion splicing machine only. Mechanical splices will not be allowed for permanent splices. Heat shrink type fusion protectors with a strength member shall be used for all fusion splices.

3) The splice trays shall contain 12 inches of slack for each strand of fiber that is spliced. A minimum of 24 inches of slack shall be allocated for each buffer tube and the correct bend radius must be maintained.

4) A minimum of 30 ft of slack fiber optic cable will be provided in the MH/HH/PB. This slack is required to allow splicing activities to take place outside of the MH/HH/PB and in a controlled environment (e.g. splicing trailer/van). This slack shall be properly stored and lashed to the MH/HH/PB racks, and will not interfere with existing cables and splice closures.

5) All splice closures shall be properly racked and lashed to the MH/HH/PB racks.

6) All splice closures shall be properly grounded to the MH/HH/PB grounding system, when applicable.

7) CIS shall inspect all splices prior to enclosing.

8. Building Entrance Facilities

A. Outside Plant copper cables entering the BDF shall be terminated on wall-mounted building entrance protector terminal(s) equipped with solid state protector modules.

If point of entrance for the building is not within the BDF, a continuous rigid metallic or EMT conduit must be provided.

Protector terminals shall be mounted in a location on the backboard that will allow sufficient space for future cable and cross-connect installations.

Copper cables up to and including 100 pairs shall be terminated on protected terminals.

Copper cables over 100 pairs shall be terminated on individual 100 pair protected terminals equipped with a factory installed, 26AWG swivel cable stub on the In-side (field side), and 110 type terminations on the Out-side (equipment side). Cable stubs shall be no shorter than 2 feet in length after installation.

Factory cable stubs shall be spliced with 3M 4000-D/TR Super Mini Splice Connectors to the Outside Plant copper cable, using the fold-back splice method. An indoor rated splice closure and 3M 4000-D/TR Super Mini Splice Connectors shall be installed and securely mounted to the plywood backboard or existing cable ladder. Indoor closures will not be encapsulated.

CIS shall approve all substitution prior to material ordering or placement.

9. Electrical Protection and Bonding/Grounding Requirements

A. Any system installed on the Seattle Pacific University campus must conform to the NEC for electrical and bonding/grounding requirements. Also, buildings shall meet TIA/EIA-J-STD-037 Commercial Building Grounding and Bonding Requirements for Telecommunications.

All underground, direct buried and aerial cables (copper and fiber) shall be properly grounded and bonded at each end, and in each MH/HH/PB, where applicable.

10. Testing Requirements for OSP Campus Cables

A. Copper and fiber optic OSP backbone cables shall be meet the performance criteria in accordance with TIA/EIA 568-B.1 and TIA/EIA-758.

Fiber optic OSP backbone cables shall be tested in accordance with TIA-526.

Copper cable binders will tested individually with a VOM for loop continuity.

Fiber optic link segments shall be tested in one direction at 1310 and 1550 nm.

CHAPTER 6: ACTIVE ELECTRONICS

1. Notice of Responsibility and Inclusion

This chapter provides specific requirements that apply to the devices comprising the physical and logical layers of the SPU campus network.

A. The physical and logical layers of the campus network are interconnected in a complex array of dependencies, all of which vie for communications channels within a shared medium. Computer and Information Systems is responsible for maintaining the confidentiality, integrity and availability of this resource.

B. Because of the interconnected and interdependent nature of the physical and logical network, all devices connecting to this resource impact the performance and security of the resource as a whole. Consequently, and in measure due to the responsibility CIS holds in maintaining network functionality, all devices and active electronics that comprise the physical and logical layers of the network fall within the domain of CIS standards and governance. These devices include, but are not limited to:

1) Core network switching, routing, and management components;

2) BDF and IDF active electronics, such as switches and media converters;

3) Physical connection points such as punch down panels and building uplink/termination points;

4) Other devices that connect to the campus network infrastructure, including:
   a. Energy management system electronics
   b. Webcams
   c. Security components
   d. Wireless access points
   e. Downstream (station electronics) such as mini-hubs and unmanaged switches.

2. Active Electronic Component Standards

A. CIS recognizes the following active electronics to be in compliance with acceptable standards for network security (confidentiality, integrity, availability):

1) Layer 2, managed switches that are fully compatible with 802.1Q VLAN specifications.

   a. Switches must be manageable via HP Procurve Management software;
   b. Switches must be configured according to CIS specifications for Vlan tagging, logging, and security settings.
   c. CIS only recognizes Hewlett Packard Procurve series switching components. Switch models to be detailed/specified by CIS at the time of purchase.
   d. Specification of such devices shall be coordinated under the direction of CIS in advance of procurement/purchase

2) Layer 2, unmanaged switches may be installed only as the last drop within a station location that otherwise would not have adequate connectivity due to constraints imposed by inadequate physical wiring. Such switches must be configured according to the requirements set forth in section 2.A.1 of this chapter.

3) Wireless access points as specified in Chapter 7 of this document

4) Layer 1 media converters, as specified in Chapters 2, 3, and 4 of this the document.

B. The following devices are NOT permitted within the administrative core of the campus network (including all campus locations not part of the residential network – a.k.a. ResNet).

1) Physical layer (Layer 1) hubs

2) Layer 3 devices such as routers or layer 3 switches that may be used to spoof or mask the MAC or IP address of the originating device.

C. Privately owned/maintained hubs and access pointsare permitted within the ResNet, provided such devices do not extend connectivity to anyone other than the device owner, that the device is not disruptive to the campus network, that all connections established from the hub pass through the Cisco Clean Access system, that the device's MAC and IP addresses are not spoofed or masked, and that use is in compliance with the University's Acceptable Use Policies.

D. Devices that serve to capture and analyze traffic within the logical or physical segments, wired or wireless, and that are not under the direct control of CIS, are expressly prohibited throughout the campus network.

CHAPTER 7: WIRELESS NETWORK SYSTEMS

1. The Design Process

This chapter provides general requirements that apply to the design and acceptance for wireless network access point installation.

E. Determine the coverage area:

1) Generally, the desired areas will be where users tend to assemble and use laptops or other handheld-networked devices. Examples include libraries, lounges, and public study areas. Provide markings on the associated facility floor plan to indicate the areas to be covered.

2) An RF site survey should be executed to ensure adequate IEEE 802.11a/b/g coverage.

3) Locate the single gang box supporting the access point so that a line of site can be established to the computing devices that will utilize the wireless network. This location should be as central as possible to the coverage area. The wireless access point is placed on vertical surface; the standard installation height should be 90 inches above the floor and at least 6 inches from the ceiling, cornices or molding and should adhere to the installations requirements found in Chapter 2, Section 8 (Structures to Support the Horizontal Cabling).

4) Avoid close proximity to other electronics that emit strong signals, i.e. microwaves, TVs, monitors, satellite dishes, etc., also avoid elevator shafts and large pipe chases and other similar building components that will have the tendency to block the RF signal of the access point. Preferably mount in higher locations out of casual reach in ceilings or against walls and ceilings.

5) Indicate location of jack in prints and cable records, including height of jack.

6) The pathway for the wireless media should adhere to the specifications and support structures found in Chapter 2, Section 8 (Structures to Support the Horizontal Cabling).

7) CIS must approve all designs.

F. Install in accordance with SPU security and encryption standards.

1) Installation and configuration of the electronics will be completed by CIS.

2) Wireless access points shall be assigned to the appropriate vlan to secure and restrict access through the Perfigo authentication/encryption system.

3) SSIDs shall bear the name “SPU-Wireless.”

4) Proxim AP-4000s (tri-mode) are the preferred access point.

5) Access points must support management by the Wavelink Manager system.

CHAPTER 8: DRAWINGS

1. Standards

A. Drawings shall be created utilizing ANSI and Architectural sized drawings:

1) ANSI A size on 8 1/2 inch by 11 inch paper.

2) ANSI B size on 11 inch by 17 inch paper.

3) Architectural C size on 18 inch by 24 inch paper.

4) Architectural D size on 24 inch by 36 inch paper.

5) Architectural E1 size on 30 inch by 42 inch paper.

B. Drawings plots (hard copies) may be produced in all colors with exception of yellow or any other light color that will not reproduce easily.

C. Electronic drawing files are to be in AutoCAD 2002 (.dwg) format or later.

D. Electronic drawing files are to consist of TIA/EIA 606-A standards for layer names, colors, and line types, for technology related material.

E. Electronic drawing files are to consist of AIA standards for layer names, colors, and line types, for Architectural, mechanical, and civil related material.

F. Electronic drawing file names are to be based upon TIA/EIA 606-A standards.

G. Electronic drawing files may contain no fonts which are not included in with the standard installation of Autodesk AutoCAD 2002 or later versions, or with standard Windows XP Professional operating system software.

H. All electronic drawing files given to Seattle Pacific shall be in an editable format with all associated files necessary for proper reproduction.

Acknowledgements and Salutations:

We acknowledge and give appreciation to Cornell University in modeling much of the standards documentation herein. Our work was made easier in adapted document: *Cornell Division 27 Design and Construction Standards* – to suite SPU's specific needs and specifications.