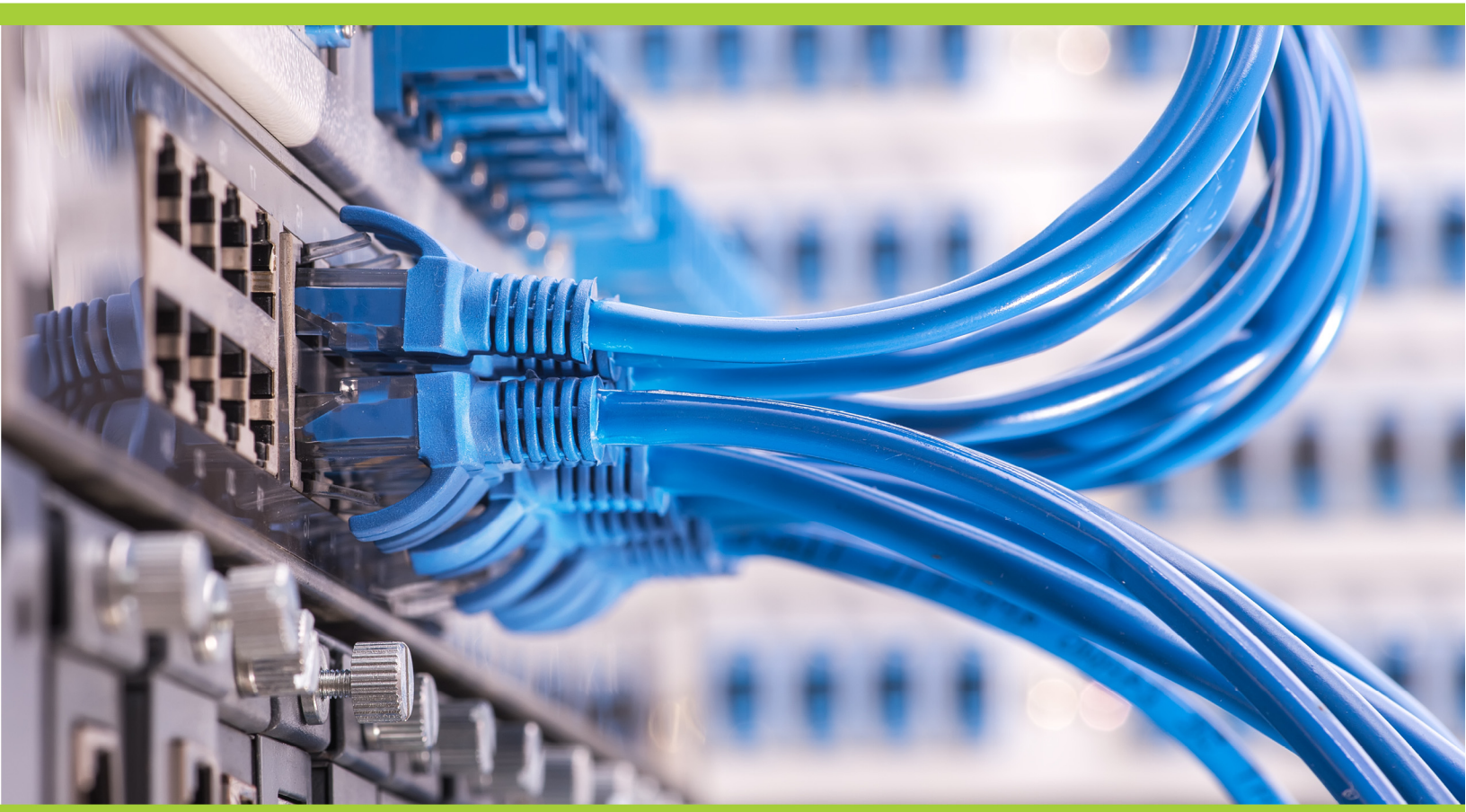
U.S. General Services Administration | GSA IT

Telecommunications
Distribution Design Guide

Telecommunications and Infrastructure Standards
Version 8

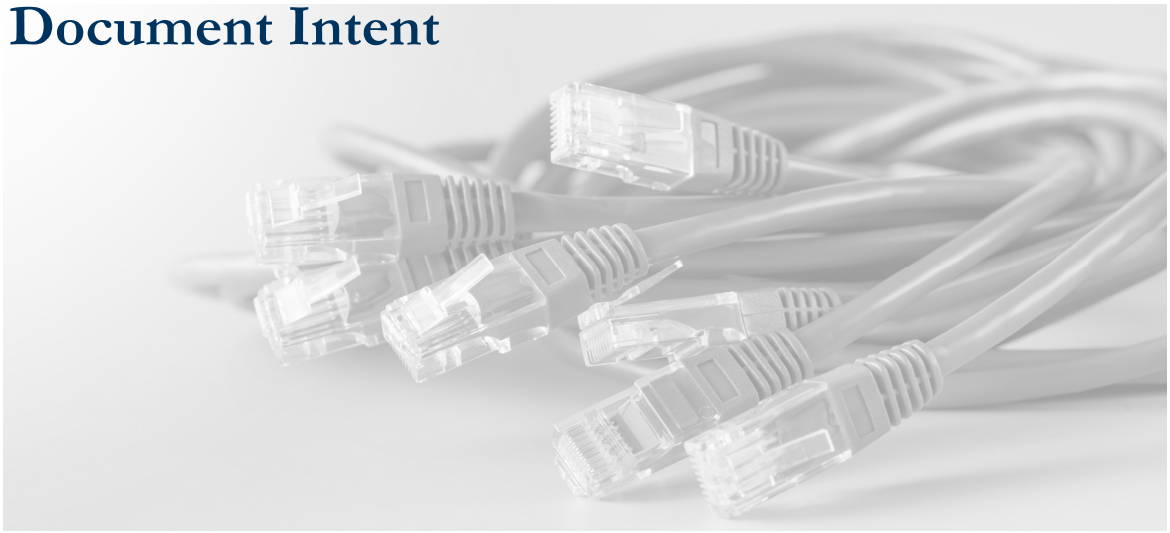







This page intentionally left blank.

Document Intent



Please be advised that this document is intended to serve only the purposes of GSA. It does not apply to non-GSA tenants.

The requirements described in this document apply only to spaces and systems for which the GSA IT has stewardship. Some departments within GSA may have their own telecommunications standards. The Designer shall communicate with each GSA department that will occupy space in the building to obtain their potentially unique requirements for telecommunications infrastructure for spaces and systems under their stewardship.

Other non-GSA tenants may also occupy space in a building. The Designer shall inquire whether a facility will serve non-GSA tenants, and if so will work with the GSA PBS PM to obtain tenant-specific telecommunications infrastructure requirements for non-GSA tenants.

Other building tenants (both within GSA and non-GSA) may choose to adopt these standards for their purposes on a given project. However, this document does not require that they do so.

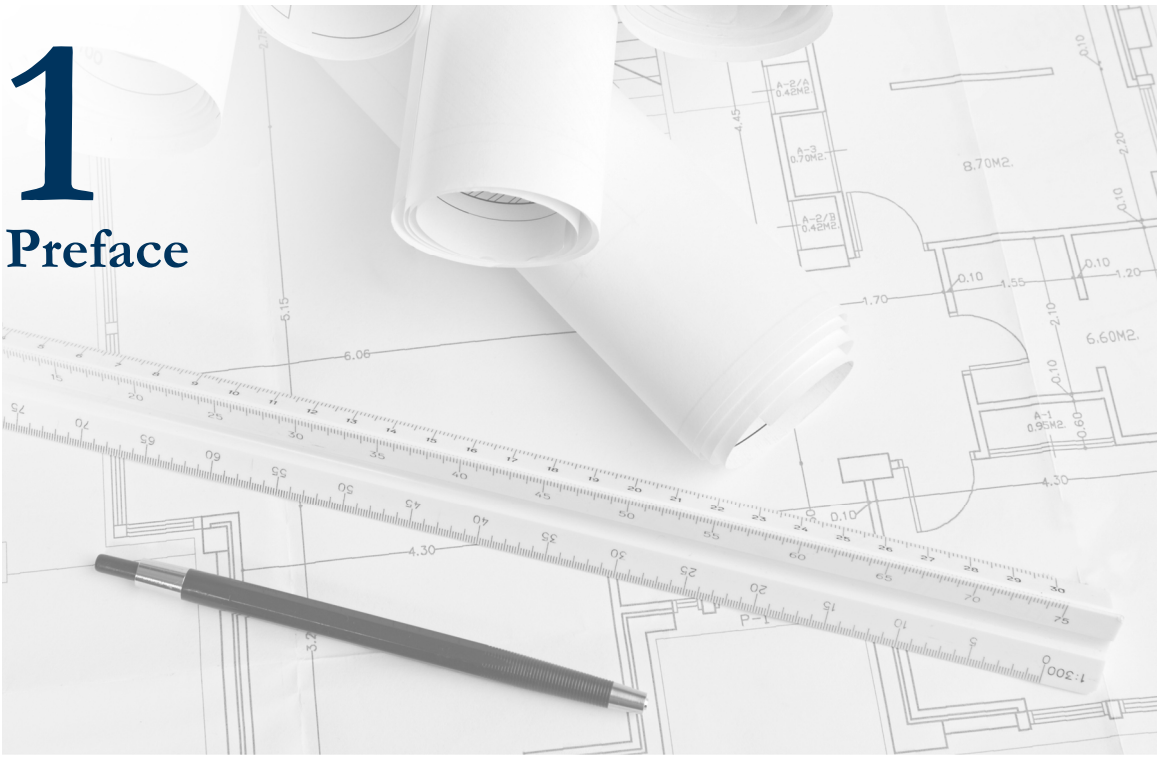
This document describes contractually binding requirements with which technology infrastructure designers, architects, engineers, and design-build contractors/installers must comply.

Table of Contents

Table of Figures

This page intentionally left blank.

1 Preface



A. The Telecommunications Distribution Design Guide (TDDG) is written to communicate the requirements of U.S. General Services Administration (GSA) for the design and installation of telecommunications distribution systems at GSA facilities.

   - The TDDG is written for the following audiences:
     + Architects, Engineers, and Designers who are responsible for the design of new or remodeled facilities for GSA, where telecommunications infrastructure currently exists or will be installed.
     + Telecommunications contractors (and other low voltage contractors) installing telecommunications infrastructure at GSA facilities.
     + GSA personnel who are involved in the construction of projects with technology infrastructure, regardless of the size or scope. This may include personnel from GSA IT, GSA FAS, and GSA PBS, or their representatives.

B. Telecommunications distribution systems designed for GSA are expected to support and integrate telecommunications of voice, data, video, and other low voltage systems with common media; for example, fiber optic and unshielded twisted pair (UTP) copper cable.

C. Telecommunications distribution designers shall be responsible to apply the guidelines, instructions, and requirements in this document while designing telecommunications distribution infrastructure at GSA facilities.

D. It is the responsibility of telecommunications distribution designers to coordinate with the other designers on a project (architectural, electrical, mechanical, etc.) to determine whether other systems are both compatible with and complementary to the telecommunications cabling system. It is critical to coordinate between disciplines during the design phase of a project, rather than making adjustments in the field during construction.

E. Contractors and cabling installers involved in projects without a formal engineering and design process shall be fluent with and adhere to the requirements of this document in the course of their work at GSA facilities.

F. This document was prepared by GSA IT. It is updated periodically by GSA IT to reflect changes in technology and policy. The revision history is as follows:

August 9, 2010	Originally published
September 30, 2010	Updated
July 27, 2011	Updated
April 16, 2014	Updated, Version 7 published
August 6, 2016	Updated, Version 8 published

G. For inquiries about this document, please email **infrastructure@gsa.gov**.

1.1 Low Voltage Systems

A. Wherever practical, telecommunications pathway and cabling systems designed for GSA facilities are expected to support and integrate with the complete set of building automation systems and other low voltage systems that convey information and operate facilities. Telecommunications infrastructure shall be designed in accordance with the requirements in ANSI/TIA/EIA 862-A – *Building Automation Systems Cabling Standard*, and the requirements in this document, to support the Ethernet telecommunications channels on low voltage devices. Throughout this document, references to “low voltage systems” shall include those referenced in ANSI/TIA/EIA 862-A, and shall be subject to specific requirements in that standard and as discussed below.

B. Wherever possible, cabling supporting building automation systems and other low voltage systems shall be either 24 AWG UTP copper cable (Category 5e-rated or better) or 50/125 micron multimode fiber optic cable. Backbone cabling is permitted to be shared among systems; however, horizontal cabling serving these systems shall be dedicated to each system.

C. The common inside plant (ISP) telecommunications pathway is intended for shared use by these systems.

D. The following is a non-exclusive list of building automation systems and other low voltage systems that use telecommunications infrastructure. Other similar systems may also require the support of telecommunications infrastructure.

- Voice-Over-IP (VOIP) Telephone Systems
- Data Networks (wired and wireless)
- Building Automation Systems
- Video Surveillance Systems (IP-based)
- Energy Management Systems
- Environmental Control Systems
- Video Systems (Digital)
- Fire Alarm Systems
- Security Systems
  - Access Control Systems
  - Alarm Systems
- PLC Control Systems

E. Inside plant telecommunications infrastructure intended to support Ethernet telecommunications (or other similar protocols for security and fire alarm systems) shall be designed in accordance with the inside plant telecommunications infrastructure requirements in this document. However, due to the critical nature of these systems, inside plant pathway and cabling serving these systems shall typically homerun to a Mechanical Room or other Low Voltage Electronics Room rather than to a common shared telecommunications room.

F. Where low voltage systems require different media (other than fiber optic cabling and 24 AWG UTP), the systems shall be designed to comply with the pathway and space requirements of this document wherever practical.

G. The Designer shall design pathways and cabling to serve these systems, in cooperation with the other design disciplines on a project.

1.2 Outside Plant Infrastructure

A. The majority of GSA facilities are stand-alone buildings that are not networked directly with other buildings in a campus-like environment. Interconnections between buildings are typically accomplished using third-party service providers.

B. The installation of GSA-owned outside plant telecommunications infrastructure is rare. In such cases the Designer shall design outside plant spaces, pathways and cabling to meet the requirements of the project, under the direction of GSA IT IT-Specialists.

C. Where outside plant telecommunications infrastructure is required for a project, the services of an engineering firm specializing in OSP will be necessary to design standards-compliant underground ductbanks, maintenance holes, aerial pathways, and outdoor-rated cabling.

1.3 Document Context

A. GSA has standardized on the ANSI/TIA/EIA – *Commercial Building Telecommunications Standards* series and has adopted the following BICSI[1] design guide documents as the basis for telecommunications distribution design in GSA facilities:

- *Telecommunications Distribution Methods Manual* (TDMM), 13th Edition
- *Information Transport Systems Installation Methods Manual* (ITSIMM)

The GSA TDDG is the guide to the application of the ANSI/TIA/EIA Standards, the BICSI TDMM, the BICSI OSP Design Reference Manual (OSPDRM), and the BICSI ITSIMM to the unique circumstances present in GSA facilities and projects. See Figure 1 below for further information.

B. The TDDG is intended to be used in conjunction with the TDMM to reinforce selected TDMM content. It is also used to highlight any restrictions and/or limitations on TDMM content to meet the specific requirements of GSA facilities. The TDDG is not intended to detract from or replace the TDMM.

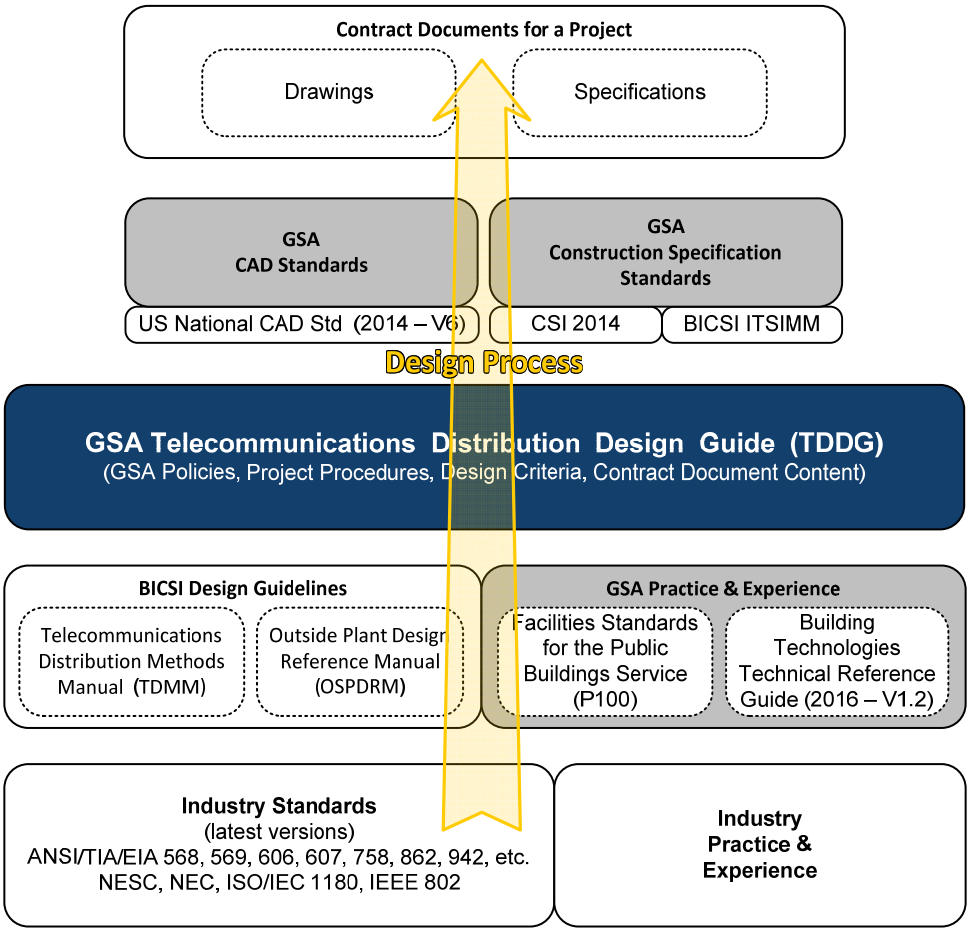
C. The TDDG is not intended to serve as a master specification nor for stand-alone use on design-build projects. This document is a guide for making standards-compliant design decisions that will in due course be reflected in a project specification.

D. In addition to the telecommunications specifications for a project, plan drawings, schematic diagrams, and details shall also be produced by the Designer, in conformity with the guidelines contained in the TDDG.

E. The following diagram (Figure 1) depicts the relationships between the ANSI/TIA/EIA Standards, the BICSI Design Guidelines, the GSA TDDG, and the project-specific Construction Documents. Telecommunications distribution infrastructure at GSA facilities shall be designed based on the BICSI design guidelines (the TDMM, the OSPDRM, and the ITSIMM) and compliant with the ANSI/TIA/EIA Standards as applied by and illustrated in the GSA TDDG.

[1]The BICSI TDMM is widely considered to be the industry reference text for the design of standards-compliant telecommunications distribution systems (see http://www.bicsi.org/manuals.htm). BICSI, 8610 Hidden River Pkwy, Tampa, FL 33637-1000 USA; 1-800-242-7405; http://www.bicsi.org

FIGURE 1: THE DESIGN PROCESS



F. The TDDG provides guidelines for telecommunications distribution system design for use within a building for all telecommunications, low voltage, and signal systems as related to:

- Telecommunications Spaces – Entrance facilities, equipment rooms, and telecommunications rooms
- Intra-building Backbone Distribution – Pathway and raceway requirements, telecommunications media requirements
- Horizontal Distribution – Pathway and raceway requirements, telecommunications and low voltage media requirements, requirements for special work areas

G. This document provides directions for making standards-compliant design decisions that will ultimately be reflected in Construction Documents. The Construction Documents for a project will be comprised of drawings and a specification that properly incorporates telecommunications infrastructure within

a project. The TDDG shall be used to guide the development of content in project-specific Drawings Specifications.

H. Adherence to and compliance with the latest versions and addenda of the codes, standards, and industry practices listed below, along with the GSA requirements contained in this document, is mandatory. Please note that when new versions of industry standards are released (independent of GSA's actions), conflicts between the TDDG and the new standards version may result. It will require some time for GSA IT to review the new standards and update the TDDG. Therefore, when conflicts are discovered, please seek guidance from the GSA IT ITS.

- *National Electrical Safety Code*, American National Standards Institute C2
- *National Electrical Code* (NEC), National Fire Protection Association (NFPA 70)
- *Manual of Practice*, Firestop Contractors International Association (FCIA)
- ANSI/TIA/EIA 568-C series – *Commercial Building Telecommunications Standards*
- ANSI/TIA/EIA 569-C series – *Telecommunications Pathways and Spaces*
- ANSI/TIA/EIA 606-B series – *Administration Standard for Telecommunications Infrastructure*
- ANSI/TIA/EIA 607-B series – *Generic Telecommunications Grounding (Earthing) and Bonding Requirements for Customer Premises*
- ANSI/TIA/EIA 758-B series – *Customer-Owned Outside Plant Telecommunications Infrastructure Standard*
- ANSI/TIA/EIA 862-A – *Building Automation Systems Cabling Standard*
- NISTIR 6392 – *GSA Guide to Specifying Interoperable Building Automation and Control Systems Using ANSI/ASHRAE Standard 135-1995*, BACnet
- ANSI/TIA/EIA 942-A – *Telecommunications Infrastructure Standard For Data Centers*
- ANSI/BICSI 005-2013 – *Electronic Safety and Security (ESS) System Design and Implementation Best Practices*
- TIA/EIA 455 (Series) – *Standard Test Procedures for Fiber Optic Systems*
- TIA/EIA 526 (Series) – *Optical Fiber Systems Test Procedures*
- IEEE 802.3 (Series) – *Ethernet*
- IEEE 802.11 (Series) – *Wireless LANs*

I. All references to the following manuals within the TDDG shall specifically address only the editions specified below. Newer editions shall be used "for reference only" until authorized by GSA in writing or through a revised edition of the TDDG:

- *BICSI Telecommunications Distribution Methods Manual* (13th Edition)
- *BICSI Outside Plant Design Reference Manual* (5th Edition)
- *BICSI Information Transport Systems Installation Methods Manual* (6th Edition)

J. Requests to deviate from the GSA requirements may be submitted on a case-by-case basis. No deviation from the requirements of the National Electrical Code

will be allowed. For further information regarding codes and standards, please refer to Appendix A in the BICSI TDMM as well as the BICSI OSPDRM Bibliography.

K. Where conflicts may arise between industry standards, Codes, GSA's standards, and the requirements of the local Authority Having Jurisdiction, the most stringent requirements shall apply.

L. The requirements contained in the TDDG are considered to be in addition to the requirements in the *Facilities Standards for the Public Buildings Service* (PBS P100-2016). Where a specific requirement differs, the conflict shall be brought to the attention of the GSA PBS Project Manager for resolution.

- While the entire P100-2016 document has important content, Sections 6.5.8 through 6.5.11 contain content specifically related to telecommunications.

1.4 Document Structure

The TDDG is organized in six sections:

1. Preface
2. GSA Telecommunications Policies
3. Project Procedures
4. Design Criteria
5. Construction Document Content
6. Appendices

A. The **Preface** (this section) describes this document, its intent, and its relationship to industry standards, practices and the various audiences affected by the document. It also describes how to use this document.

B. The **GSA Telecommunications Policies** section applies specifically to GSA personnel. It describes internal GSA telecommunications policies, requirements, standard practices, and processes for designing, installing, and operating telecommunications infrastructure. GSA personnel should also be aware of the instructions, requirements, and guidelines for Designers contained in the other sections of this document, with respect to their application on both large-scale telecommunications distribution projects and small-scale "moves/adds/changes" (MAC) projects. In addition, these requirements apply to in-house operations and maintenance of existing telecommunications distribution systems.

C. The **Project Procedures** section describes the required qualifications for telecommunications Designers, as well as the procedures that Designers must follow when working on telecommunications infrastructure projects at GSA facilities. It includes activities that are required throughout the project as well as phase-specific requirements.

D. The **Design Criteria** section serves two purposes. The first is to describe the general requirements for GSA telecommunications infrastructure, along with the typical features required for different categories of building spaces and construction types. The second purpose is to place limitations on the materials and methods described in the BICSI TDMM. While the TDMM describes many materials and methods that are generally accepted in the industry for providing telecommunications infrastructure, GSA facilities have some unique characteristics that impose limitations on some of the materials and methods that otherwise might be acceptable. Some of the practices discussed in the TDMM are expressly prohibited in GSA facilities.

   Generally speaking, if the BICSI TDMM does not describe a particular material or method for use with telecommunications distribution infrastructure, it will not be allowed for GSA facilities unless specifically requested and pre-approved. In addition, the GSA TDDG places further restrictions on the use of some materials and methods that the BICSI design guidelines support.

E. The **Construction Document Content** section defines the minimum level of detail that GSA requires to be present in the telecommunications portion of the Construction Documents for a project. In this section, the required types of details, as well as the content in the details, are both described. This section also briefly describes the specifications that are required for a project.

F. The **Appendices** section provides example forms and diagrams that are required for GSA telecommunications infrastructure designs.

1.5 Construction Type

For the purposes of this document, construction projects are categorized by the extent of the construction work, as follows:

Construction Type	Definition
New Construction	A new building
Modernization	An existing building undergoing extensive remodeling, frequently including reallocation of internal spaces
Minor Remodel (workspace remodel)	An existing building undergoing adjustments to office/work spaces. The project typically does not include changes to building systems (HVAC, electrical, etc.).
Telecommunications-only	Projects involving minor remodeling to create telecommunications spaces and the installation of telecommunications infrastructure
Moves, Adds, and Changes	Projects involving very limited adjustments to the telecommunications infrastructure
Historical Building Remodel	Changes made to buildings that are designated as historical properties.

Unless otherwise stated, the guidelines defined in the TDDG apply to all five types of construction and to areas that GSA occupies within GSA-owned and leased facilities.

Historical Building Remodel projects will qualify as multiple construction types, for example:

- Historical Building Remodel + Modernization
- Historical Building Remodel + Minor Remodel
- Historical Building Remodel + Telecommunications-only

The Designer shall assume that adherence is required to BICSI guidelines, referenced industry standards, and the TDDG (unless specifically indicated otherwise) for all facility types and for all extents-of-construction. Where exceptions are permitted, this document will specifically highlight the construction type where GSA's requirements may differ from generally applicable practices and standards.

Adherence to applicable code is always required.

1.6 Building Types

The requirements described in this document apply to all building types. Where specifically noted for Warehousing/Stores facilities, some of the requirements may be relaxed.

1.7 Tenant Specific Requirements

The requirements described in this document apply only to spaces and systems for which the GSA IT has stewardship. Some departments within GSA may have their own telecommunications standards. The Designer shall communicate with each GSA department that will occupy space in the building to request and receive the requirements for telecommunications infrastructure in spaces and for systems under their stewardship.

Other non-GSA tenants may also occupy space in a building. The Designer shall inquire whether a facility will serve non-GSA tenants, and if so, shall work with the GSA PBS PM to obtain tenant-specific telecommunications infrastructure requirements for non-GSA tenants.

1.8 GSA Departments

The following is a partial list of the departments within the General Services Administration (GSA) with which the Designer may be required to communicate and for whom telecommunications infrastructure may need to be designed:

- Office of the Chief Information Officer (GSA IT)
- Federal Acquisition Services (FAS)
- Public Building Services (PBS)
- Inspector General (IG)
- Office of General Counsel (OGC)

1.9 GSA Personnel

The following is a list of the GSA personnel who have authority over or responsibility for the telecommunications infrastructure in GSA facilities:

A. GSA PBS PM: Public Building Services Project Manager

- Responsible for the overall project, as it relates to the structure and serviceability of the building as a whole.
- Authorized to make final decisions for project-related issues related to the structure and serviceability of the building as a whole.

B. GSA PBS Building Manager:

- Responsible for the operation and maintenance of an existing building.
- The Designer may need to obtain as-built information from this individual regarding an existing building that will be remodeled or will receive new telecommunications infrastructure.

C. GSA IT ITS: GSA IT Information Technology Specialist

- Assigned on a project-by-project basis.
- Serves as the local IT specialist, having familiarity with the building, its resources, history, and operations.

D. GSA IT Tech PM: GSA IT Technology Project Manager

- Serves as the Designer's main point of contact within GSA for telecommunications infrastructure guidance.
- Responsible for the telecommunications aspects of a project.
- Authorized to interpret the TDDG and to make decisions affecting the telecommunications infrastructure on a project.
- Coordinates with the GSA IT ITS infrastructure-related communication on capital projects.

- Ensures that relevant GSA management and specialized technical staff are kept informed and involved in all telecommunications-related aspects of a project (design, construction, support, and maintenance).
- Ensures that the installed telecommunications infrastructure meets GSA standards and that the requirements of the TDDG are enforced.

E. GSA IT TD: GSA IT Telecommunications Designer

- Designs smaller telecommunications projects without the involvement of a consultant.

F. GSA Network Operations Branch Manager:

- Responsible to participate in the specification process (types, quantities, styles, makes-and-models) for network electronics and wireless networking required for internal GSA operations. This in turn will guide the decisions affecting the telecommunications infrastructure that will be required for specific application objectives. Quantity, type (pizza box, chassis switch), WAPs, style, make/model, etc. Aids in the design process to help create a cooperative infrastructure.

G. GSA Circuits Management Branch:

- Responsible to participate in the specification process (types, quantities, bandwidths, protocols) for wide area network (WAN) circuits required for internal GSA operations. This in turn will influence the network electronics specifications and will guide the decisions affecting the telecommunications infrastructure that will be required for specific application objectives.

1.10 Key Terms and Abbreviations

The TDDG uses many terms and abbreviations that are common in the telecommunications industry. While a glossary is included in Appendix 6.8 at the end of this document, please refer also to the Glossary in the BICSI TDMM for further information.

A/E Architect/Engineering design team

FAR Federal Acquisition Regulation http://www.gsa.gov/far

POE Power over Ethernet

RCDD Registered Communications Distribution Designer http://www.bicsi.org

RITP Registered Information Technology Professional http://www.bicsi.org

SCS Structured Cabling System: telecommunications cabling, connectors, patch panels, etc., which, when installed in a building, constitute its structured cabling system.

This page intentionally left blank

2 GSA Telecommunications Policies

This section describes internal GSA telecommunications policies, requirements, standard practices, and processes associated with designing, installing, maintaining, and operating telecommunications infrastructure. It is directed toward an audience of GSA personnel, including GSA IT personnel, PBS personnel, building maintenance personnel, and any others that may be involved in these activities at a GSA facility.

A. GSA personnel designing telecommunications infrastructure for GSA facilities shall follow the requirements in this document.

B. Input from the GSA IT Tech PM must be incorporated when developing the initial and ongoing construction schedules. This input is especially important when an early or phased turn-up of buildings is required, but is also vital for the initial startup of a new facility. The telecommunications rooms, Regional Information Centers, backbone pathways and cabling are all critical path items required for bringing buildings online within schedule.

C. Management of GSA's Enterprise Network is the responsibility of the GSA IT Network Operations (NetOps) personnel, who cooperate in the specification process (types, quantities, styles, makes-and-models) for network electronics and wireless networking required for internal GSA operations at all GSA facilities. NetOps works in conjunction with the Circuits Management Branch.

- At some GSA facilities, network documentation does not exist, is incomplete, or has not yet been updated to reflect recent changes. While GSA IT is currently working to improve the library of network documentation at each

facility, anyone relying upon this documentation for a project shall be responsible to verify that it is sufficiently accurate for their purposes.

- When using GSA IT's existing network documentation for a new project, there is no guarantee that the documentation will (in its current condition) be suitable for that project. Users of GSA IT network documentation shall be responsible to investigate and update the documentation to meet their needs. Project Managers shall include scope in their projects to prepare or update the documentation to meet the needs of their projects.

D. GSA's GSA IT Information Technology Specialists are responsible for the installation and support of LAN hardware, data telecommunications, and VOIP network systems, as well as certain enterprise network hardware and software.

E. The responsibility for provision and procurement of IT services, hardware, software, and related products is project-dependent. The responsible Department or Division will be accountable for ensuring that the procurements meet GSA technology standards and that the procurement process is conducted in compliance with federal procurement guidelines, GSA policy, delegated authority, and statutory requirements. The Designer shall inquire on each project to determine who has this responsibility.

2.1 GSA Personnel

2.1.1 GSA Personnel Installations

A. GSA personnel (or representatives) who install telecommunications pathway and cabling infrastructure at GSA facilities must be familiar with the requirements of this document. They should also have a current copy of, be familiar with, and adhere to the guidelines in the BICSI TDMM and this document.

B. Telecommunications pathway work shall be done in accordance with the requirements of the NEC. Prior to constructing telecommunications pathways, a Registered Communications Distribution Designer (RCDD) shall be contracted to prepare drawings and specifications for the project. The RCDD shall also be contracted to periodically observe the work while in progress and upon completion, providing written observation reports following each visit. The RCDD shall also be contracted to produce as-built drawings bearing the RCDD's stamp and signature. (For more information, see Section 2.7.7 – *Telecommunications Administration*, below.) GSA's objective is that telecommunications infrastructure be:

   + Properly installed
   + Properly tested
   + Properly documented

C. Cabling system manufacturers may provide training for GSA personnel who will install or modify telecommunications infrastructure. In addition, GSA strongly encourages GSA personnel to obtain training in telecommunications

fundamentals from BICSI prior to installing or modifying telecommunications infrastructure. GSA personnel should inquire whether a given manufacturer offers this training.

D. Any penetration created by a telecommunication pathway through fire walls, fire barriers, fire partitions, smoke barriers, and smoke partitions shall meet the requirements in the International Building Code (IBC) and any applicable requirements in the PBS-100, which may exceed the IBC requirements.

E. At the commencement of each project, it is suggested as a good practice that project managers coordinate with the PBS Building Manager responsible for that building. The PBS Building Manager may be aware of other projects that are underway, and might offer helpful logistical insights or identify other building conditions that can affect choices and decisions.

2.2 Initiating New Projects – General

The following information is provided as guidance to any GSA department desiring telecommunications or low voltage additions to facilities, or who will be involved in projects requiring such infrastructure.

2.2.1 New Construction

New construction projects shall include telecommunications infrastructure designed and installed in accordance with the requirements of this document.

2.2.2 Modernization of Existing Structures

GSA facilities undergoing modernization projects shall incorporate telecommunications infrastructure in the project, designed and installed in accordance with the requirements of this document. A GSA IT ITS shall be included in the initial development of the project scope to determine the extent of any required telecommunications infrastructure upgrades.

2.2.3 Minor Remodel (workspace remodel)

GSA facilities undergoing minor remodel projects (typically to make adjustments to accommodate workspace/office arrangements) shall incorporate telecommunications infrastructure in the project, designed and installed in accordance with the requirements of this document. A GSA IT ITS shall be included in the initial development of the project scope to determine the extent of any required telecommunications infrastructure upgrades.

2.2.4 Upgrading Telecommunications Infrastructure to Support New Technology

GSA will occasionally install new systems (voice, data, video, etc.) at a facility where the existing telecommunications infrastructure may be inadequate for the new application.

GSA IT will verify whether the existing infrastructure is adequate to support the new system(s) and will make recommendations for upgrading the infrastructure where necessary. Any upgrades made to the telecommunications infrastructure shall meet the requirements of the TDDG.

2.2.5 Upgrading Telecommunications Infrastructure to Meet New Standards

There is not a requirement to upgrade existing telecommunications infrastructure at any GSA facility simply to meet industry standards or the requirements of this document. However, infrastructure upgrades may be required to correct code violations or to meet system performance requirements.

2.2.6 Infrastructure to Support Other Tenants at GSA Facilities

Most GSA facilities host tenants that are not GSA operations. The GSA TDDG does not address telecommunications cabling infrastructure to support other tenants. It is possible that other tenants may wish to adopt GSA's TDDG (this document). Otherwise, the tenants will need to provide guidance regarding the telecommunications infrastructure required to meet their needs.

2.2.7 Damage to Existing Telecommunications Infrastructure

A. Construction, maintenance, and other activities may result in damage to existing telecommunications infrastructure, including cabling.

B. In the event of damage to telecommunications infrastructure, regardless of the cause or party responsible, GSA personnel shall immediately contact GSA IT, who will determine the repair or replacement strategy for the damaged infrastructure.

C. The GSA IT ITS shall:

- Work with GSA staff to identify any potential methods of temporary/interim repairs.
- Identify the steps necessary to assess whether the damaged infrastructure can be repaired or whether it must be replaced.

D. The party responsible for the damage to the telecommunications infrastructure shall be responsible for the total cost of all temporary/interim repairs and all replacement costs.

All damaged infrastructure shall be restored so as to be within the scope of the original design/installation parameters. This shall include (but not be limited to) all repair or replacement work performed by certified contractors of GSA's choosing, and all testing and recertification of the infrastructure for full compliance with GSA's Telecommunications Standards and applicable SCS warranty.

2.3 Initiating New Projects – Specific

All telecommunications infrastructure activity, regardless of the size or scope of the project or quantity of cable involved, must have either prior written approval from, or include prior notification to, the GSA IT ITS to proceed with the design and/or installation. The requirement to contact the GSA IT ITS applies even to small projects, so that the documentation can be updated to reflect the work being done. This includes the following types of projects:

- New construction.
- Renovation of existing structures.
- Upgrading telecommunications infrastructure to support new technology.
- Upgrading telecommunications infrastructure to meet new standards.
- Infrastructure to support other agencies or tenants at GSA facilities.
- All moves, adds, and changes (MACs) at GSA facilities, including MAC work performed by GSA personnel.
- Low voltage cabling to support proprietary systems that will use the telecommunications infrastructure (pathways and spaces) as identified in *Building Automation Systems Cabling Standard* (ANSI/TIA/EIA-862-A).

It is required that the GSA IT ITS be consulted prior to any planned infrastructure moves, adds, or changes to determine if existing infrastructure may be adequate, or if efforts can be coordinated with other planned or proposed work. Please initiate contact by emailing infrastructure@gsa.gov. The following specific requirements apply:

2.3.1 Telecommunications Room Work

Any GSA department that is planning the installation of cabling or equipment in any Telecommunications Room must coordinate the installation with the GSA IT ITS prior to commencing work, regardless of the type of cabling or equipment to be installed. This coordination is intended to assure efficient use of existing space, and to ensure that resources/spaces planned for future projects are not inadvertently lost due to other uncoordinated equipment.

2.3.1.1 Telecommunications Room Design Parameters

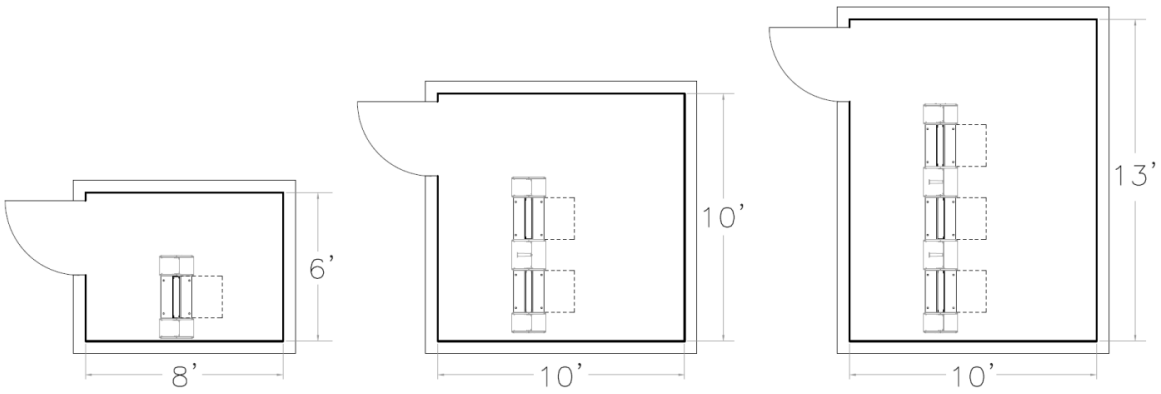
When considering the budgeting requirements for a new project, the following items shall be included for each telecommunications room (TR):

- TRs should be located centrically within the areas they serve.
- Each rack in a TR will support a maximum of 384 cables. Typically, modular furniture offices (cubicles) require an average of 1.25 cables each, and hardwall offices require 4 cables (2 outlets with 2 cables each). TRs shall be sized to hold the required rack space and provide appropriate accessibility. See TDDG Section 4.5 – *Horizontal Distribution Systems* for further information.

- TR doors shall swing out of the room.
- For some new construction projects, a TR often requires its own technical power panel inside the telecommunications room. The technical power panel should be fed from a centralized uninterruptible power supply.
- For remodel projects where work on the electrical power distribution system may be limited, it may be sufficient to supply power to the TRs from dedicated circuits out of panels that do not serve loads that are electrically noisy. The electrical engineer shall evaluate the appropriate solution for this situation.
- TRs should be designed such that the environmental conditions are kept within a temperature range of 64 to 81 degrees, in compliance with ANSI/TIA-569-C. Achieving this requirement commonly requires air conditioning systems, although in some cases an exhaust fan might be adequate. In cooler climates, cooling with outside air is encouraged. Since this is a year-round requirement, it may not be sufficient to rely upon building cooling systems that operate only during the summer. Wherever heat loads are relatively small, it is often sufficient to ventilate the room without providing mechanical refrigeration.
    - RICs require humidity control. Humidity is not typically controlled in a TR.
    - The desirable range is between 45% and 55% relative humidity.
- Environmental monitoring and real-time reporting shall be incorporated in all telecommunications rooms, in accordance with the *Environmental Monitoring for IT Spaces (EMITS)*.
- All telecommunication rooms and technical spaces defined in this document shall be protected by a wet-pipe sprinkler system that is designed and installed in accordance with the requirements in PBS P100-2016 Section 7.8, including the use of sprinkler guards.
- Backbone cabling shall be 50-micron multimode fiber optic cabling and copper backbone cabling.

Example telecommunications room floor plan sizing:

FIGURE 2: TELECOMMUNICATIONS ROOM FLOOR PLAN SIZING



For more detailed examples of telecommunications room arrangements, please see Appendix 6.2.

2.3.2 Horizontal Cabling

Any GSA department requiring changes or additions to horizontal infrastructure shall contact the GSA IT ITS. No horizontal infrastructure shall be installed in any GSA facility without the GSA IT ITS approval. This includes the installation of any other low voltage infrastructure using the telecommunications pathway/media.

2.3.3 Regional Information Center (RIC)

Regional office buildings shall be designed to include a "Regional Information Center" (RIC) to support local operations and field offices in that region. A RIC is essentially an upsized main telecommunications room (MDF) with support functions that wouldn't exist in a regular MDF. Power and cooling requirements are more demanding in RICs.

See Section 4.18 – *Regional Information Centers and Data Centers* for further information.

2.4 Procurement and Installation Policy

A. The primary responsibility for the management and use of information systems, telecommunications, and information technology equipment, software, and services rests with each Department head. Equipment is defined as machines, devices, and transmission facilities used in information processing, such as computers, VOIP telephones, and cables. This section highlights certain procurement policies applicable to the telecommunications infrastructure. Readers shall consult the FAR for further information.

B. There are two general methods used for the procurement and installation of the telecommunications infrastructure. In larger construction projects, the telecommunications infrastructure installation might either be part of the general construction contract or it could be a separate contract.

C. Use of a GSA IT Blanket Purchase Agreement (BPA) may apply to a given project. Contact GSA IT for further information.

The following policies and procedures apply to the planning and management of telecommunications infrastructure installation as a separate project (apart from other remodeling or new construction work):

2.4.1 Procurement Policy for Information Technology Infrastructure

2.4.1.1 GSA Information Technology Services Approval

GSA procurement and installation of telecommunications infrastructure must have the prior approval of GSA IT to achieve consistent and competent technical design in compliance with the TDDG and with federal procurement requirements. Requests for approval shall be submitted to the GSA IT Department and will be forwarded to the appropriate internal division for action. Requests for approval must include a description of the procurement and installation procedures and must also identify the following:

- Source of funding.
- RCDD Designer for design services (if appropriate).
- RCDD for construction observation services (optional).
- Structured Cabling System (SCS) cable installer (typically known after bid selection).

The procurement process itself is governed by the FAR.

2.4.1.2 Cabling Infrastructure Materials

Standardization on a cabling infrastructure product line permits GSA personnel to be familiar with the installed infrastructure components at all facilities, and helps them to be prepared to handle moves, adds, and changes to the infrastructure in an efficient manner. Standardization also ensures that there will be performance compatibility with

the installed base when additions are made to the infrastructure, and that spare parts and components from one facility can be used at other facilities as needed. Finally, product standardization allows GSA to manage and benefit from consistent warranty coverage at all GSA facilities.

2.4.1.2.1 Structured Cabling System

A. Where additions are made to **existing** facilities, the design shall specify the use of cabling materials from the same manufacturer whose cabling exists in the building, as long as the existing cabling was produced by an approvable manufacturer.

B. The telecommunications infrastructure design for **new** facilities shall be based upon the SCS products from an approvable manufacturer.

2.4.1.2.2 Approvable SCS Manufacturers

GSA only accepts cabling materials from manufacturers that are approved through the GSA contracting process. The following criteria are key factors in designating approvable manufacturers and materials:

A. The materials shall be UL Listed.

B. The materials shall comply with Industry Standards.

C. The materials shall be compliant with the Federal Acquisition Regulation (FAR).

D. The company shall manufacture its own products (cabling and connecting hardware). Using cabling from one manufacturer and connectors or patch panels from a different manufacturer is not approvable, unless the manufacturers have established a publicly recognized cooperative alliance and offer a joint warranty.

2.4.1.2.3 Approvable SCS Materials

GSA only accepts cabling materials that meet the following criteria:

A. The materials shall be manufactured by an Approvable Manufacturer (see above).

B. The materials shall be in new, original-manufacturer packaging.

C. The materials shall not be remanufactured, refurbished, recertified, or reused in any way.

D. The materials shall not be “gray-market,” meaning that they shall be procured via the manufacturer-intended distribution channels.

2.4.1.2.4 Manufacturer 20-Year Warranty

A. The structured cabling system manufacturer must provide a 20-year (minimum) warranty and must require contractor certification under stringent requirements that will ensure a high quality installation. The manufacturer must honor the warranty regardless of the longevity of the installation contractor. In the event that warranted cabling or terminations fail to perform as warranted, the

manufacturer must replace underperforming portions of the cabling system at no charge to the Owner for either materials or labor.

B. Where multiple manufacturers have established a publicly recognized cooperative alliance for the purpose of using cabling from one manufacturer and termination materials from another manufacturer, the manufacturers shall demonstrate that their materials cooperatively comply with Industry Standards. The entire system shall be warranted by the manufacturers under a joint warranty (as if the materials were provided by a single entity) subject to the requirements discussed above.

2.4.1.2.5 Installation Contractor 1-Year Warranty

A. In addition to the twenty-year minimum warranty required of all involved manufacturers, the installation contractor shall be required to provide a 1-year warranty covering workmanship and craftsmanship, ensuring that the system is installed in compliance with Industry Standards, manufacturer requirements, and the requirements of the construction contract.

2.5 Telecommunications Projects

Depending on the size and scope of a project, the GSA IT Telecom Project Manager, working with GSA PBS, will determine whether an engineering firm or contractor is required to develop a telecommunications distribution design.

2.5.1 Externally Designed

Externally designed telecommunications infrastructure installation may be handled as stand-alone projects to prepare for the installation of new technology. They may also be accomplished as separate projects, running concurrently with another capital project.

2.5.1.1 Design Philosophy

A. An engineered telecommunications design is required for all new construction, modernization, or minor remodeling, including technical specifications and drawings to be used as the basis for competitive bidding for the construction contract.

B. GSA requires the use of a Registered Communications Distribution Designer (RCDD) to design the telecommunications distribution infrastructure for all new construction, modernization, and major telecommunications upgrades at GSA facilities. The RCDD designation is recognized worldwide as indicating a design professional that has met specific professional design experience requirements and has successfully completed an extensive examination on the subject of telecommunications distribution design. RCDDs are employed by architectural and engineering firms, and also by telecommunications infrastructure installation Contractors.

C. Telecommunications infrastructure shall be designed and installed in accordance with applicable codes and industry standards. Due to the unique physical characteristics of many GSA facilities, some technical design solutions are better suited than others. This document identifies which design solutions are appropriate for, as well as approved for, common types of buildings and areas at GSA facilities.

D. Telecommunications infrastructure design shall be incorporated during the preliminary design phase of each project. This will provide GSA IT the opportunity to influence the design from the start and address telecommunications requirements at appropriate points in the design process. It is imperative that the A/E firm and their RCDD work closely with the GSA IT ITS, the GSA IT Technology Project Manager, and the GSA PBS Project Manager from the start of each project.

2.5.2 Internally Designed Telecommunications Projects

A. For small projects, a GSA IT Telecommunications Designer may be selected to prepare a design internally (without the use of outside engineering).

B. For small projects or installation of additional cabling, a manufacturer-certified installation contractor may be hired for a limited-scope installation. The contractor must be currently in good standing with the manufacturer, with the ability to provide the required warranties.

   The alternative to using a certified contractor (for copper cabling installation only) is to use BICSI-trained GSA personnel. (See Section 2.7.3 – *Manufacturer-Certified Installation* below for further information.) There shall be no exceptions to this requirement.

2.6 Reviewing Telecommunications Designs

2.6.1 Standards Variance Requests (SVR)

A. Requests to deviate from industry standards or GSA design solutions will be considered on a case-by-case basis. Any request to deviate from the requirements of the National Electrical Code will not be accepted.

B. Requests to apply alternative design solutions shall be submitted to the GSA IT Tech PM for consideration. The SVR will follow the review process as shown in the flow chart in Appendix 6.7. Approval will only be granted in writing, and must be authorized by the GSA IT Tech PM, or GSA IT ITS. Approval must also be authorized by the GSA PBS Project Manager if capital funding is involved.

C. For more information, see Section 3.3.2 – *Standards Variance Request (SVR)* in this document.

2.6.2 Design Review

A. Project milestones will be designated by GSA for each project and in some cases may not follow conventional patterns. The GSA IT Design Review process will mirror the milestones established for the project. For the purposes of describing the Design Review Process, a common project structure is used in TDDG Section 3.5 – *Design Review Process*. The process should be adapted to reflect the milestones established by GSA for each specific project.

B. The following is a partial list of the people who should participate in the Design Review Process:

- GSA IT Tech PM
- GSA IT ITS
- GSA-selected RCDD Review Consultant (optional)
- Architect/Engineer (Prime Consultant)
- Designer
- GSA PBS PM
- GSA PBS Fire Protection Engineer
- GSA PBS Building Manager

C. For more information, see TDDG Section 3.5 – *Design Review Process*.

2.7 Telecommunications Operation and Maintenance

2.7.1 GSA Telecommunications Infrastructure Responsibilities

A. GSA IT is responsible for defining the requirements for a cable pathway between the Entrance Facility and each telecommunications room in a building, as well as the pathway, cabling and outlets served by those telecommunications rooms.

B. GSA IT is responsible for providing the network equipment and installing it in racks in its telecommunications rooms.

C. The design of the Entrance Facility (EF) is not under the stewardship of GSA IT, and therefore the TDDG does not contain guidelines concerning the EF. Contact GSA PBS on a case-by-case basis to identify who will provide EF design guidance.

D. It may also be necessary to provide telecommunications infrastructure to serve other (non-GSA) tenants. The Designer shall contact each tenant and request the requirements that will meet the telecommunications infrastructure needs of each individual tenant.

2.7.2 Service Provider Responsibilities

The service provider is responsible for providing and installing the entrance cable up to the demarcation point, as well as the termination hardware at the demarcation point. In some cases, GSA contracts with the service provider to extend the demarcation point from the EF to another location at the facility. In such cases, the service provider is also responsible for maintenance and troubleshooting of the extended portion of the cabling and termination hardware.

2.7.3 Manufacturer-Certified Installation

A. GSA telecommunications cabling systems are covered by a 20-year (minimum) warranty from the cabling system manufacturer and a 1-year warranty from the installation contractor. If any portion of the warranted cabling system fails to perform at its original capacity, the manufacturer shall provide both labor and materials to restore its performance.

B. To obtain this warranty coverage, the contractors who perform the installation must be fully certified by the cabling system manufacturer. Contractors who are manufacturer-certified will have met certain requirements established by the manufacturer (including copper and fiber optic cabling installation) giving the manufacturer confidence as it endorses the cabling installation work of the contractor.

2.7.4 GSA Telecommunications Technicians

A. To preserve the 20-year (minimum) manufacturer warranty, GSA personnel who may be modifying warranted telecommunications cabling systems shall also be certified by the manufacturer, through training courses and working with a local manufacturer's representative.

In addition to cabling manufacturer training, GSA also strongly encourages GSA personnel or their designated representatives who install, move, or make changes to telecommunications cabling to receive ITS Installer 1 (IN101), ITS Installer 2 Copper (IN225), and ITS Installer 2 Optical Fiber (IN250) training from BICSI[2]. Cabling installations performed by GSA personnel must be tested in accordance with manufacturer requirements, and may also be inspected by an RCDD as discussed in Section 3.4.5 – *Construction Observation*.

2.7.5 Moves, Adds, and Changes

A. Moves, adds, and changes (MACs) to the telecommunications infrastructure shall be performed in accordance with the requirements of this document. This includes (but is not limited to) all copper or fiber optic cables for the LAN, VOIP telephones, workstation area outlets, patch panels, patch cords, etc. All MACs must be coordinated with the GSA IT ITS.

B. Whenever moves, adds, or changes (MAC) are made, the new cabling shall follow the routes of existing established (properly installed) telecommunications cabling pathways. Where existing pathways are not properly installed, new cabling shall be routed in a manner compliant with Industry Standards and GSA Standards.

2.7.5.1 Splitting of Cable Pairs

A. In certain situations, it may be necessary to use one or two pairs of a four (4)-pair cable to support one telephone device, and to use the remaining pairs to support a different telephone device. In these situations, the splitting of the pairs shall be accomplished with a line-splitting device installed on the outside of the Work Area Outlet faceplate. In the telecommunications room, a similar line-splitting device may be installed at the patch panel.

B. Under no circumstances will cable pairs be split or removed from the back of a modular jack or patch panel. All four pairs of each horizontal distribution cable must be terminated to a single eight-position, eight-conductor jack.

C. Under no circumstances will the splitting of data cable pairs be allowed. The integrity of all four-pair cable (all eight wires) must be maintained end-to-end for the LAN equipment.

[2] As of the date of this writing, information about the ITS Installer 1 training course is available from BICSI's website at: https://www.bicsi.org/credential_programs.aspx This address is subject to change without notice.

2.7.6 Electrical Power in Telecommunications Rooms

A. Each telecommunications room (TR) shall be equipped with technical power outlets that are dedicated for use by telecommunications equipment. Technical power outlets shall be labeled and used exclusively for telecommunications equipment and shall not be used for general-purpose or utility devices such as electric drills, vacuum cleaners, coffee pots, etc.

B. Each TR will also be equipped with white, gray, or beige-colored convenience power outlets that are available for use with non-telecommunications equipment (one convenience power outlet per wall).

2.7.7 Telecommunications Administration

A. GSA's telecommunications administration system is based on "records" and "identifiers." It documents cabling, termination hardware, patching and cross-connection facilities, conduits, cable pathways, telecommunications rooms, and other telecommunications spaces. ANSI/TIA/EIA-606-B – *Administration Standard for the Telecommunications Infrastructure* is the industry standard for administering and documenting the telecommunications infrastructure. The purpose of this industry standard is to provide a uniform administration scheme that is independent of applications, because applications may change several times throughout the life of a building. The TDDG establishes guidelines for GSA personnel, end users, manufacturers, installers, and facilities administrators involved in the administration of the telecommunications infrastructure at GSA facilities.

B. "Records" are a collection of information about each specific component of the telecommunications infrastructure. Drawings, details, diagrams, specifications, spreadsheets, and databases are all examples of telecommunications records.

C. Telecommunications records show unique "identifiers" for each component of the telecommunications infrastructure. For more information about identifiers, see TDDG Section 4.10 – *Telecommunications Administration*.

D. Records shall be maintained electronically in their native formats using AutoCAD and/or MS Visio. Drawings shall be saved as AutoCAD 2015 and MS Visio 2010 version files, regardless of the version of the software that is used (newer program versions are acceptable). Whenever AutoCAD or Visio files are submitted, a parallel set of files printed to Portable Document Format (PDF) shall also be submitted, as a snapshot record of the original state of those files.

   "As-Built Drawings" (typically prepared by installers) and "Record Drawings" (initially prepared by Designers based on the installer's as-built drawings) are a vital component of the telecommunications administration system, and must be kept current as moves, adds, and changes take place.

   See Section 5.3 – *Record Drawings and Documentation* for more information.

E. All GSA facilities shall maintain a system for documenting and administering the telecommunications infrastructure. The administration system shall include cable

records, equipment records, as-built drawings, and record drawings (including installation dates) for all information technology systems. The administration system shall follow the ANSI/TIA/EIA-606-B standard.

- While the GSA IT is responsible to verify that the cable and equipment records, record drawings, and as-built drawings are kept up to date, it is the responsibility of the local GSA PBS representatives (using local facility personnel) to maintain/update the telecommunications record drawings for each facility after any construction project and to provide electronic copies to GSA IT for storage, as well as hardcopy documents if they have been printed.
- Regional GSA IT personnel shall be responsible for storing the telecommunications-related documentation.

3 Project Procedures

A. The Project Procedures section contains guidelines for architects, engineers, and telecommunications distribution designers regarding the procedures that GSA requires for projects that include telecommunications distribution systems. This applies both to projects that entail primarily telecommunications distribution work (such as telecommunications infrastructure replacement projects) as well as to architectural projects and other work (such as a new building or a remodel/renovation) involving telecommunications design.

B. This section is not intended to supersede the requirements in the *Facilities Standards for the Public Buildings Service* document (PBS P100-2016), but rather to complement them, providing additional requirements that apply specifically to telecommunications distribution design projects at GSA facilities.

C. It is intended that the requirements in this section be considered contractually binding for design professional firms and design/installation contractors providing telecommunications distribution design services.

3.1 Designer Qualifications

A. For the purposes of this document, the term “Designer” shall mean a Registered Communications Distribution Designer (RCDD) who is currently in good standing with BICSI. This means that the telecommunications design shall be produced by the RCDD. GSA’s communications with the telecommunications consultant

shall be mainly through the RCDD. On projects where the RCDD is not the prime consultant, the RCDD shall keep the prime consultant, the Architect/Engineer (A/E), informed of all direct communications with GSA.

- The Registered Information Technology Professional (RITP) certification from BICSI is not an acceptable substitute for the RCDD.

B. In addition to the RCDD certification, it is desirable that the RCDD have one or more of the following qualifications:

- Professional Engineer (P.E.) in the electrical engineering field
- CCNA certification from Cisco
- CCNA Wireless certification from Cisco
- CTS certification from InfoComm

C. In addition, the RCDD shall have the following qualifications:

- The RCDD shall demonstrate a minimum of 5 years of experience in the design of inside plant telecommunications distribution systems. Experience designing telecommunications infrastructure on Federal Government projects is desirable but not required.
- Experience not directly related to the design of inside plant telecommunications distribution systems, such as sales and/or marketing, project management, or installation experience, is not acceptable.
- The RCDD shall demonstrate that he/she has:
  + personally designed, or
  + personally overseen the design of a minimum of five projects similar in size and construction cost to the current GSA project.
- The RCDD shall be independent from and unaffiliated with any manufacturer associated with the telecommunications distribution system industry. Manufacturers' representatives are not considered independent or unaffiliated.
- The RCDD shall be completely familiar and conversant with industry and GSA telecommunications standards (this document).

D. The RCDD shall affix his/her RCDD logo stamp (showing the registration number and expiration date) and signature to the final Construction Documents (drawings and specifications) pertaining to the telecommunications distribution design.

E. The services of a professional engineer shall be required to design the following aspects of a complete telecommunications infrastructure:

- Grounding and bonding
- Firestopping
- Electrical power distribution in telecommunications spaces
- Telecommunications room cooling systems

F. Under the direction of PBS, the services of a licensed fire protection engineer shall be required to design the fire protection and life safety systems in telecommunications rooms and technical spaces (e.g., fire suppression, fire alarm system, etc.).

3.2 Architect/Engineer Teams

It is imperative that the telecommunications design be incorporated during the preliminary architectural design phase. To accomplish this, the architects and engineers on the design team shall work closely with the designated project RCDD, the GSA ITS Telecom Project Manager, and the GSA PBS Project Manager, beginning with the Schematic Design phase of the project.

3.2.1 Cross-Discipline Coordination

Successful telecommunications projects require frequent and thorough design coordination between the disciplines involved in the project. The Designer shall be primarily responsible to coordinate the telecommunications requirements and design features with the designs produced by the other Designers on the project.

At a minimum, the following aspects of the design shall be coordinated:

- HVAC requirements for telecommunications rooms (TR).
- HVAC ductwork routing (avoiding TR ceiling spaces).
- Plumbing routing (avoiding TR spaces).
- Lighting requirements for TRs.
- Power requirements for TRs.
- Power requirements for work areas (receptacle locations near telecommunications outlet locations).
- Proximity of cabling to sources of EMI.
- Routing of telecommunications conduits through and location of telecommunications pullboxes in congested areas (HVAC ductwork, plumbing, electrical, etc.).
- Floor treatments in TRs.

More information regarding the above requirements is available in Section 4 – *Design Criteria* in this document.

3.3 General Procedures

3.3.1 CAD Files

The Designer shall coordinate with the A/E team to determine that the electronic CAD files used as backgrounds for the telecommunications design are consistent with the CAD file backgrounds used by the other disciplines on the project.

GSA has adopted the National CAD Standards. Therefore, all drawings shall be numbered according to the National CAD Standards numbering scheme and all symbols

shall be National CAD Standards-compliant.

The Designer may wish to request copies of existing network documentation for use on a project. At some GSA facilities, network documentation does not exist, is incomplete, or has not yet been updated to reflect recent changes. If the documentation is available, GSA may provide it to the Designer as a courtesy; however, GSA is not obligated to do so. While GSA IT is currently working to improve the library of network documentation at each facility, anyone relying upon this documentation for a project shall be responsible to verify that it is sufficiently accurate for his or her purposes.

- When using GSA IT's existing network documentation for a new project, there is no guarantee that the documentation will be suitable for that project in its current condition. Users of GSA IT network documentation shall be responsible to investigate and update the documentation to meet their needs. Project Managers and Designers shall include scope in their projects to prepare or update the documentation to meet the needs of those projects.

3.3.2 Standards Variance Request (SVR)

A. It is not the intent of GSA to rigidly impose standards on every aspect of a telecommunications system design. Each design is unique, and special requirements may lead to situations in which deviations from the standards are warranted.

B. This document identifies specific design solutions that are intended to meet the technical requirements of GSA telecommunications and information technology systems at most GSA facilities. Design issues that are not consistent with the requirements in this document shall require prior approval through the GSA Standards Variance Requests (SVR) process. Requests to deviate from industry standards or GSA design solutions will be considered on a case-by-case basis. Any request to deviate from applicable Code requirements or to deviate from manufacturer's warranty requirements will not be approved.

C. If the Designer feels that deviation from a given standard is warranted, the Designer shall submit a written standards variance request to GSA. The Designer may, upon written approval from GSA, incorporate the design deviation into the overall design. GSA approval is required on a project-by-project basis – the Designer shall not assume that a deviation approval for one project means that the deviation will necessarily be approved for a subsequent project.

   SVR requests shall include a complete description of the proposed alternative design identifying:

   + The type of facility
   + The conditions at the facility
   + The approved design solution as described in this document, or as described in the standards referenced in this document
   + The proposed alternative design
   + A list of the guidelines and standards referenced in this document with which the alternative design will not be in compliance, and the effect of non-compliance, both short and long term

+ The reason for requesting the alternative design
+ The Contractor or personnel performing the construction

The Designer shall provide written comments indicating that the proposed alternative design will meet the applicable GSA system performance requirements, and identifying any performance limitations, drawbacks and benefits from using the alternative design.

D. The Designer shall be responsible to determine that the SVR process is properly conducted. For projects where the Designer is not the prime consultant, the prime consultant shall also be responsible to determine that the SVR process is properly conducted, and shall participate in the process (review, acknowledge and address issues) to determine that GSA's requirements are met.

E. The SVR will follow the review process as shown in the flow chart in Appendix 6.7.

3.4 Procedures Related to Project Phases

Telecommunications projects are typically conducted in phases. In addition to the requirements contained in the *Facilities Standards for the Public Buildings Service* document (PBS P100-2016), Designers of telecommunications distribution systems for GSA facilities have the following phase-related responsibilities:

3.4.1 Schematic Design and Fieldwork

A. Telecommunications projects at existing GSA facilities may require preliminary fieldwork to document the existing cabling and infrastructure systems into which the new cabling and infrastructure will integrate. GSA believes that this information is vital to a successful project.

B. For projects that involve modifications to existing buildings, the Designer shall visit the project site during the Schematic Design phase to perform preliminary field investigation of the horizontal and intra-building backbone telecommunications infrastructure. The Designer shall create the following types of documentation based on information gathered while onsite:

- Take digital photographs of existing telecommunications rooms and work areas that affect or are affected by the new project work.
- Verify existing or create a new riser diagram showing the existing intra-building backbone cabling associated with the new project and the existing cross-connection strategy.
- Investigate and document the routing of existing horizontal pathways and cabling that are affected by the project.
- Verify existing or create new elevation diagrams of each telecommunications rack and each wall within each TR affected by or affecting the new project work.
- Meet with local GSA IT staff to review and validate field investigation findings and also to gather undocumented legacy information from the experiential

knowledge of the local staff. This is not a substitute for a complete field investigation, but rather is intended to augment the field investigation effort.

C. The Designer shall also conduct a needs analysis (involving GSA personnel) to identify and describe the required features and functionality of the new telecommunications infrastructure.

D. The information gathered during the fieldwork, combined with the results of the needs analysis, shall be the starting point for Schematic Design of the proposed new work.

E. Schematic Design documents shall show the following information:

- Building and local distribution
- Telecommunications Room sizes and locations
- Major distribution pathways
- Telecommunications Room Backboard locations

F. Upon completion of the Schematic Design documents, the standard Design Review Process shall be conducted prior to progressing to the Design Development phase.

3.4.2 Design Development

A. The Designer shall modify the design documents to address the review comments received during the Schematic Design Phase.

B. During the Design Development phase, the Designer shall obtain the assistance of manufacturer product representatives to review the project specifications to determine that the correct part numbers have been included for each product in the specification.

C. In addition to the content shown on the Schematic Design documents, the Design Development documents shall show the following information:

- Schematic diagrams
- Data outlet locations and port counts for each outlet
- Power outlet types, quantities and locations

D. Upon completion of the Design Development documents, the standard Design Review Process shall be conducted prior to progressing to the Construction Document phase.

3.4.3 Construction Documents

A. The Designer shall modify the design documents to reflect the accepted review comments received during the Design Development Phase.

B. In addition to the content shown on the Schematic Design and Design Development documents, the Construction Documents shall show the following information:

- Raceway routing plans
- Telecommunications room wall elevation details
- Rack elevation details

The Construction Documents are also expected to contain the items discussed in Section 5 – *Construction Document Content* in this document.

C. It is expected that the Designer will expend considerable effort coordinating details between different disciplines during the design process. Non-coordinated pathway/raceway is not acceptable to GSA.

D. Upon completion of the Construction Documents, the standard Design Review Process shall be conducted. The Designer shall then modify the documents to reflect the accepted review comments associated with the Construction Documents prior to the Bidding Phase.

E. Upon completion of the Final Construction Documents, the standard Design Review Process shall be again conducted as described above. The Designer shall modify the documents to address the review comments associated with the Final Bid Documents prior to the bidding phase rather than “by addendum.”

3.4.4 Bidding

A. On projects where a pre-bid walkthrough is held, the Designer shall attend the walkthrough and shall provide the bidders with a written list of materials and practice requirements that the bidders might find peculiar and that might affect the bids if such requirements are overlooked. Noteworthy items would typically be requirements that are more restrictive than practices considered acceptable for other commercial projects. The Designer shall consider the following items for inclusion on such a list, as well as any other items applicable to the project:

- The use of flex-conduit is prohibited.
- In slab-on-grade situations, the installation of conduit under-slab or in-slab is prohibited, unless specifically noted.
- The requirement for no more than two 90-degree bends in any conduit run.
- The fact that telecommunications standards are more stringent than electrical installation requirements.

B. On projects where a cabling contractor will design the work, the Contractor shall submit the following documentation with the bid, depicting what will be installed by the Contractor:

- Material cut-sheets.
- Plan drawings of new outlets and cable routing.
- Drawings of the grounding/bonding plan (as appropriate, when required).

All drawings shall be prepared using professional design software. Drawings that are hand-drawn sketches or produced using bitmap graphics editors shall not be accepted.

C. During the bid evaluation process, GSA will consider the value and quality of the materials proposed. The selection will be based in part on the following criteria:

- Price.
- Whether the proposed SCS manufacturer is the manufacturer of existing cabling to remain in service.
- Terms and benefits of the manufacturer's 20-year (minimum) warranty.
- Manufacturer-guaranteed performance parameters that exceed Industry Standards.
- The perception of the SCS manufacturer's stability and longevity.

3.4.5 Construction Observation

A. The Designer shall review the Contractor's submittals that are required by the Construction Documents. When the Contractor's submittals include materials or methods that deviate from GSA standards, the Designer shall either:

- Reject the specific materials and methods that do not comply, when the Designer believes that they constitute undesirable solutions, or
- Pursue the Standards Variation Request process to seek separate approval for each specific material or method that the Designer believes would constitute a better solution, within the limitations described in the TDDG.

B. The Designer (RCDD) shall visit the construction site frequently to observe the construction quality and progress. The Designer shall confer with the GSA PBS Project Manager and the GSA IT PM prior to proposing services for the project to determine an appropriate site visit frequency for the project. On average, one site visit per week will typically be required. The site visit frequency will likely change during the construction as the telecommunications-related activity increases and decreases.

C. Accurate record drawings are considered critical for the efficient operation of GSA facilities. During these site visits, the Designer shall observe and report on the Contractor's progress toward keeping a set of As-Built drawings current with appropriate notations.

D. During the site visits, the Designer shall take digital photographs of existing and new telecommunications pathways, spaces, and cabling that are related to the project. In particular, the Designer shall photograph infrastructure that will later be concealed during the course of construction.

E. The Designer and GSA IT representatives shall use the Construction Observation Checklist as an aid during construction observation visits. (See Appendix 6.1.3.).

F. After each site visit, the Designer shall submit a written report describing the observed construction progress. Observations shall be documented in the report with annotated digital photographs and a written description of any problems, a

description of the requirements in the Construction Documents and the resolution to the issues. For each item requiring corrective attention, the report shall describe the following:

- A description of the issue
- Applicable requirements in the Construction Documents
- Applicable GSA standards, industry standards, and codes
- Corrective options available to GSA
- Designer's recommendation

G. The Designer shall submit the construction observation reports via email to the GSA PBS PM and the GSA IT Tech PM and to **infrastructure@gsa.gov** as soon as possible following each site visit. The reports shall also be reviewed at the next construction meeting. A timely report submission will aid the Designer and GSA in identifying potential problems early in the construction process.

H. Cable testing shall be performed after electrical systems have been powered on and after building operational conditions become similar to normal operations. Also, any dust-producing construction activities shall be completed prior to any cable testing. The intent is that testing not be done until normal operating conditions exist (and the associated electromagnetic interference is being generated by electrical systems in the building).

I. The Designer shall review the cable test reports produced by the Contractor for each cable installed during the project. The Designer shall verify that the test reports are complete and indicate passing results, as defined in TDDG Section 4.12 – *Field Testing*.

J. The Designer shall require that the Contractor submit weekly project progress status reports.

K. The Designer shall require that the Contractor submit formal requests for information (RFI) in written, electronic format.

L. The Designer shall require that the Installation Contractor's supervisor be certified as a BICSI ITS Installer Level 2 Copper/Fiber and also be fully certified by the SCS manufacturer. The supervisor shall be on site full time during construction to supervise contractor activities.

3.4.5.1 Construction Observation Checklist

A. During the Construction process, the Designer and GSA IT representatives should visit the construction site periodically to review the quality and completeness of the work.

B. The Designer shall use the Construction Observation Checklist during each site visit.

C. The GSA IT Tech PM and the GSA IT ITS shall use the Construction Observation Checklist during each site visit.

D. See Appendix 6.1.3.

3.4.6 Post-Construction

A. The Designer shall review the Operation and Maintenance information provided by the Contractor for the telecommunications distribution system. The Designer shall verify that information is included for each component in the telecommunications distribution system. Upon approval of the content in the Operation and Maintenance information, the Designer shall submit the information to local GSA ITS Staff with written documentation indicating that the Designer has reviewed the information and that it appears to meet the requirements in the Construction Documents.

B. The Designer shall provide complete, accurate record drawings and record documentation to GSA (based on as-built documents that have been "red-lined"/marked-up by the Contractor). Record documents shall be provided in electronic CAD format where applicable, in addition to requirements put forth by the Designer's contract with GSA.

- GSA IT Tech PM will review the record documents submitted by the Designer. Any inaccuracies or incompletions discovered by GSA shall be addressed by the Designer within 30 days of receiving review comments from GSA.

C. The Designer shall inquire with the GSA IT Tech PM whether it would be desirable to have a laminated set of record drawings to be stored in each TR. Where the GSA IT Tech PM feels it would be desirable, the Designer shall provide the laminated set of drawings as described in TDDG Section 5.3 – *Record Drawings and Documentation*.

D. The Designer shall require that the cabling contractor provide cable test reports immediately upon completion of the testing. The Designer shall review each individual report to verify that each test was correctly performed and that each cable passes. After the Designer reviews the reports, the Designer shall submit the cable test reports to GSA.

E. The Designer shall verify that the cabling contractor provides the appropriate manufacturer-backed, 20-year (minimum) warranty certification documentation to GSA within 30 days of completing the cable testing.

F. See TDDG Section 5.3 – *Record Drawings and Documentation* for further requirements.

3.5 Design Review Process

As noted in TDDG Section 3.4 – *Procedures Related to Project Phases*, the project documents will pass through the design review process at the end of each design phase plus follow-up reviews when necessary. These requirements are in addition to those contained in the *Facilities Standards for the Public Buildings Service* document *(*PBS P100-2016*)*.

The design review process involves two main objectives:

- Finding undesirable conditions that are visible among the content.
- Noticing content or features that should be included, but are lacking.

To help improve the quality and thoroughness of design review, a Design Review Checklist has been prepared (see Appendix 6.1.2). The checklist is not intended to be all-inclusive, comprehensive, or static. The reviewer using the Design Review Checklist is expected to draw upon his or her professional experience to completely review the document set considering any noteworthy applicable parameters, even if those parameters do not appear on the Design Review Checklist.

On some projects, GSA may hire an RCDD Review Consultant to act in the capacity of an independent reviewer and consultant to GSA. The RCDD Review Consultant will be responsible to review the overall design, paying particular attention to areas of the design that are related to the current or future operation and maintenance of the telecommunications system, and sometimes low voltage systems other than voice and data. The RCDD Review Consultant will identify issues that do not appear to be compliant with the requirements in the TDDG or other GSA Standards, appear to depart from industry best practices, or which conflict internally within the construction document set.

To avoid a conflict of interest in situations where GSA does not own the building, a Review Consultant cannot work for a building owner who leases to GSA. Instead, GSA shall contract directly with the Review Consultant so that the Review Consultant is independent of and not influenced by the building owner.

The following steps correspond to the numbered activities shown on the Design Review Process diagram below:

① Each time a review is required, the A/E shall provide copies of the complete project documents set (drawings and specifications for all disciplines involved in the project) for the following people:

- GSA PBS Project Manager (PM) (three sets)
  + GSA PBS Property Manager
  + GSA PBS Fire Protection Engineer
- GSA IT ITS (one set)
- RCDD Review Consultant (two sets)

ⒶⒷ The RCDD Review Consultant will have 3, 5, or 10 days (depending on the project phase) to review the design documents and provide written RCDD Review Comments to the GSA PBS PM and the GSA ITS Telecom Project Manager.

②③④ The GSA PBS PM and the GSA IT ITS will have 5, 8, or 10 days (depending on the project phase) to review the design documents and the RCDD Review Consultant's comments. The GSA IT ITS will create the GSA ITS Review Report, and incorporate the RCDD Review Comments into the report. Following their review, they will distribute the complete set of comments to the RCDD Review Consultant (if present on the project) and hold brief discussions about the comments. If there is no RCDD Review Consultant assigned to the project:

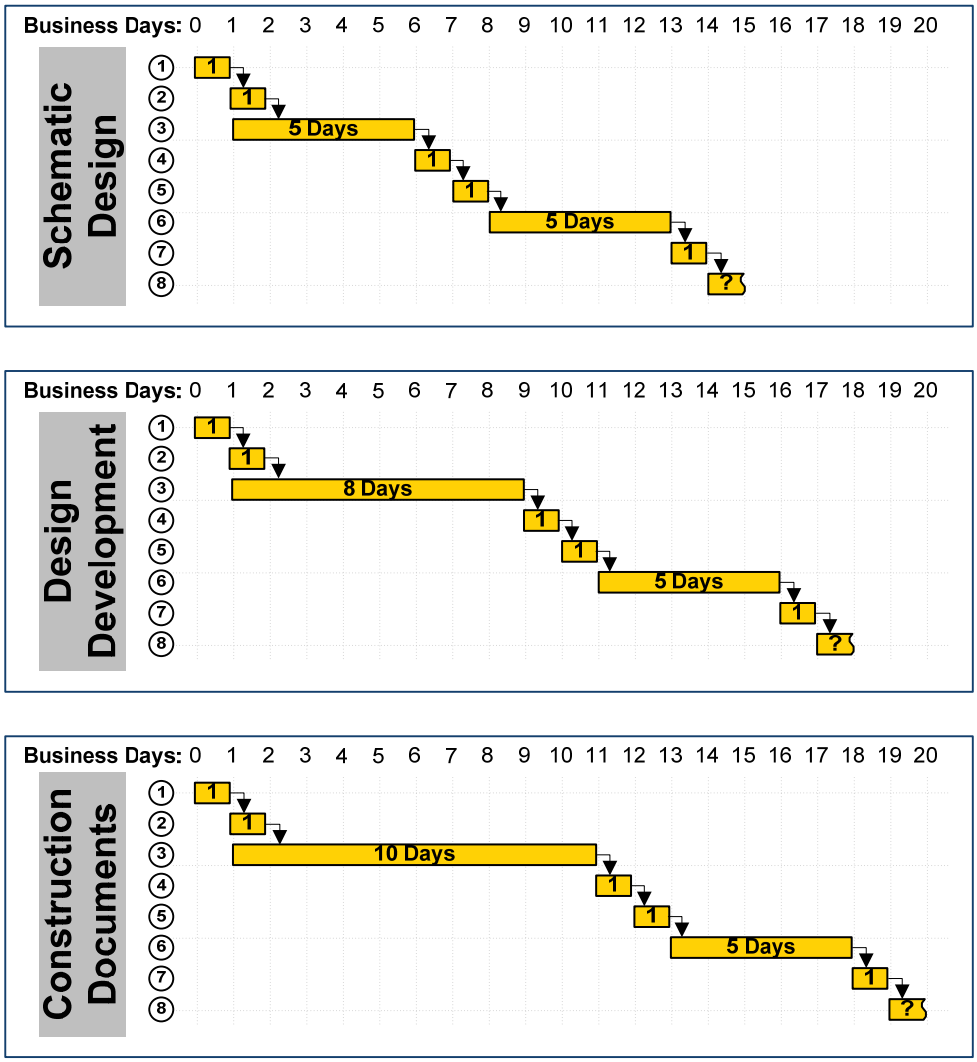
- The GSA IT ITS will create the GSA ITS Review Report without RCDD Review Comments.
- The GSA ITS Review Report will then be sent to the GSA PBS PM for review.

⑤⑥ The GSA PBS PM will submit the RCDD Review Report to the Designer. The Designer will then be given five days to review the comments and respond to them in writing. Negative responses to any comment shall include a discussion of the reasons for non-compliance.

⑦⑧ Finally, a meeting or teleconference will be held with the GSA PBS PM, the GSA IT ITS, the RCDD Review Consultant, and the Designer to discuss the review comments and the Designer's responses. Following the meeting, the Designer shall revise the design in accordance with the GSA's resolution for each comment.

The following diagram depicts a typical telecommunications design review process when an RCDD Review Consultant is not involved in the review process. The number of days listed for #3 and #6 may need to be adjusted based on the scope or depth of the telecommunications infrastructure on a project.

FIGURE 3: DESIGN REVIEW PROCESS



1. Designer sends Drawings and Specifications to GSA IT Technology Project Manager and GSA PBS Project Manager (PM).

2. GSA PBS PM reviews the drawings and the specifications.

3. GSA IT Technology Project Manager reviews the drawings and specifications and then produces the GSA IT Design Review Report.

4. GSA PBS PM and the GSA IT Technology Project Manager meet to discuss and finalize the GSA IT Design Review Report.

5. GSA PBS PM issues the GSA IT Design Review Report to the Designer for response.

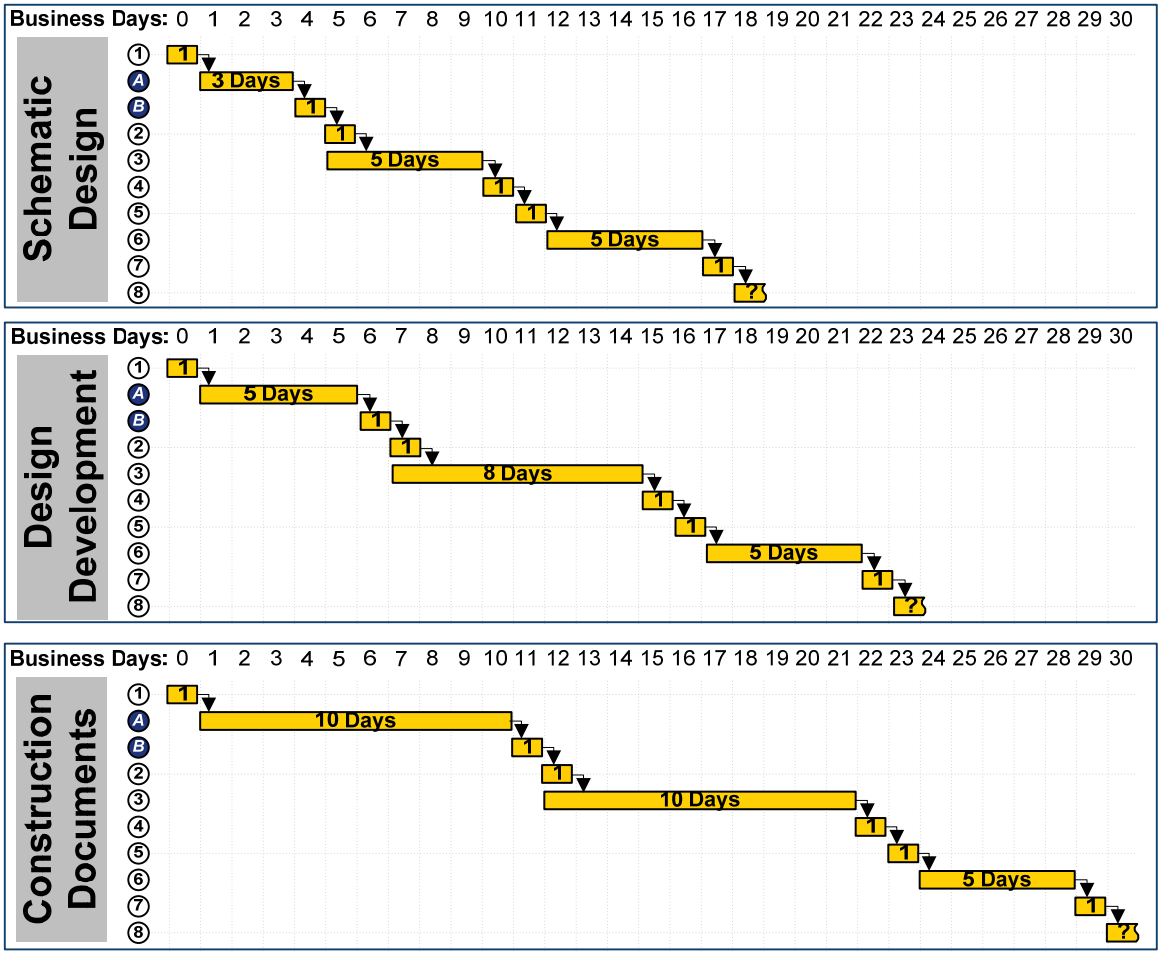
6. The Designer reviews the GSA ITS Review Report and provides a written response for each comment to the GSA IT Technology Project Manager and GSA PBS PM.

7. GSA PBS PM, GSA IT Technology Project Manager, and the Designer meet to discuss the Designer's responses to the GSA IT Design Review Report and determine a course of action for each item.

8. The Designer shall revise the design per the direction given in Step 7 (above). The Designer shall then submit a second written response to the GSA IT Design Review Report, indicating how each comment was resolved.

The following diagram depicts a typical telecommunications design review process, including the RCDD Review Consultant's role in the review process. The number of days listed for #A, #3 and #6 may need to be adjusted based on the scope or depth of the telecommunications infrastructure on a project.

FIGURE 4: DESIGN REVIEW PROCESS WITH CONSULTANT



1. Designer delivers Drawings and Specifications to RCDD Review Consultant, GSA IT Technology Project Manager, and GSA PBS Project Manager (PM).

A. RCDD Review Consultant reviews the drawings and specifications and produces RCDD Review Comments.

B. RCDD Review Consultant delivers the RCDD Review Comments to GSA PBS PM and GSA IT Technology Project Manager.

2. GSA PBS PM reviews the RCDD Review Comments, the drawings, and the specifications.

3. GSA IT Technology Project Manager reviews the RCDD Review Comments, drawings, and specifications and then produces the GSA IT Design Review Report, incorporating the RCDD Review Comments.

4. GSA PBS PM, the RCDD Review Consultant, and the GSA IT Technology Project Manager meet to discuss and finalize the GSA IT Design Review Report.

5. GSA PBS PM issues the GSA IT Review Report to the RCDD Review Consultant and the Designer for response.

6. The Designer reviews the GSA IT Design Review Report and provides a written response for each comment to the RCDD Review Consultant, GSA IT Technology Project Manager, and GSA PBS PM.

7. GSA PBS PM, GSA IT Technology Project Manager, the RCDD Review Consultant, and the Designer meet to discuss the Designer's responses to the GSA IT Design Review Report and determine a course of action for each item.

8. The Designer shall revise the design per the direction given in Step 7 (above). The Designer shall then submit a second written response to the GSA IT Design Review Report, indicating how each comment was resolved.

G. The Designer shall not proceed with the next phase of telecommunications design without receipt of written comments from the GSA IT Information Technology Specialist.

H. The Prime Consultant shall be responsible to determine that the review process is conducted in accordance with GSA's requirements, and shall participate in the review process to determine that the review comments are satisfactorily addressed.

3.5.1 RCDD Review Consultant

For projects where GSA hires an RCDD Review Consultant, the prime consultant (Designer or A/E) shall provide two sets of the drawings and specifications (from all disciplines involved in the project) for the RCDD Review Consultant. The RCDD Review Consultant will not perform any design services. The RCDD Review Consultant could be asked to do the following:

3.5.1.1 Typical Document Review Scope

A. Review telecommunications distribution system design:

- For compliance with the GSA TDDG and Industry standards.
- To identify apparent conflicts (routing, electromagnetic interference, etc.) with designs from other disciplines.
- To identify points of coordination between GSA and telephone service providers or Internet service providers.
- For general document clarity.

B. Review the completed needs analysis report.

C. Review the cutover plans.

D. Prepare a report consistent with the format shown in Appendix 6.1.1 of the TDDG that addresses at a minimum the items in the Design Review Checklist in Appendix 6.1.2.

3.5.1.2 Other Services (upon specific GSA request)

A. On some projects, GSA may also use an RCDD Review Consultant to provide services during the construction phase. These services may include submittal review and "big-picture" construction observation services. In these situations however, the Designer always remains responsible for submittal review, construction observation, punchlist management, and other standard services as indicated in the *Facilities Standards for the Public Buildings Service* document *(*PBS P100-2016*)*.

B. In these situations, the RCDD Review Consultant shall provide written comments to GSA and to the Designer. In turn, GSA will decide how to act on the written comments, and then direct the A/E, Designer, or Contractor accordingly. The RCDD Review Consultant shall not, under any circumstances, give direction to the A/E, Designer, or Contractor.

3.5.2 Design Review Checklist

A. The Designer shall use the Design Review Checklist prior to submitting drawings and specifications at each project milestone.

B. The GSA IT Tech PM, the GSA IT ITS, and the RCDD Review Consultant shall use the Design Review Checklist during the review process.

C. See Appendix 6.1.2.

3.6 Field Investigation Activities

Some projects may involve existing buildings where existing conduit pathways may be considered for reuse with new cabling.

Early in the design process, the Designer shall fully investigate the existing pathways, documenting the entire pathway, all changes in direction, all junction boxes, and pull points. This is an important task, because existing pathways in old buildings are commonly constructed without consideration of modern telecommunications standards. Without a complete investigation, the design may attempt to reuse conduits that have too many bends, have been constricted (flattened by bending) or have improperly installed junction boxes, all of which may damage new high-performance cabling which the conduits were not originally designed to support.

Conduits that are determined not to be compliant with GSA's standards shall be either de-rated (reduced cable carrying capacity or distance), modified (pull points added, bend radii increased) or not used.

3.7 Designing for Demolition

Some projects may involve existing buildings that require the demolition of existing telecommunications cabling and components.

3.7.1 Site Specific Code Requirements

The Designer shall clearly understand the site-specific, Code-based requirements for demolishing cabling and components that are no longer in use, and shall communicate these requirements to GSA.

3.7.2 Salvage Objectives

The Designer shall inquire with GSA on a project-by-project basis about equipment and materials that should be removed and salvaged to the Owner. The Designer shall also inquire how and where the salvaged materials will be delivered to the Owner, in compliance with any applicable "green" requirements.

3.7.3 Preservation Objectives

GSA may wish to preserve in operational condition some existing cables. Such existing cables may not be used immediately following the completion of the work, but GSA may have plans for future use of those cables. It may be required by Code that such cables be physically tagged for future use, or otherwise be subject to demolition.

4 Design Criteria

4.1 Principles of Transmission

Please refer to Chapter 1 – *Principles of Transmission* in the BICSI TDMM for general information regarding the design of telecommunications distribution infrastructure.

4.2 Electromagnetic Compatibility

Please refer to Chapter 2 – *Electromagnetic Compatibility* in the BICSI TDMM for general information regarding the electromagnetic interference with and clearance requirements for telecommunications infrastructure. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at GSA facilities:

A. The BICSI TDMM includes tables listing minimum separation distances from sources of electromagnetic interference (EMI). Telecommunications infrastructure shall not be installed closer than the minimum separation distances listed in the BICSI TDMM. Where the NEC or local codes require greater separation distances than those listed in the BICSI TDMM, the largest separation distance shall be maintained.

B. Separation distances apply equally to both copper cabling and fiber optic cabling. Even though fiber optic cabling is impervious to EMI, once a pathway is established for fiber it could later be used for copper cabling.

C. OSP telecommunications infrastructure designs shall adhere to the governing clearance requirements of the NEC and NESC.

4.3 Telecommunications Spaces

Please refer to Chapter 3 – *Telecommunications Spaces* in the BICSI TDMM for general information regarding the design of telecommunications rooms. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at GSA facilities:

A. In GSA facilities, the TRs in a building may also serve as low voltage systems equipment rooms, typically containing electronic equipment intended to serve the building or a portion of the building. The TR shall not be shared with electrical installations other than those necessary for telecommunications.

4.3.1 Telecommunications Room Location

A. The Designer shall be responsible to inform the Architect of the sizing and location requirements for Telecommunications Rooms during the Schematic Design phase of the project.

B. The most desirable location for telecommunications rooms is to be located as centrally as possible and as near as possible to the area being served. In addition, for multi-story buildings, telecommunications spaces shall be vertically aligned wherever possible. This allows for clean, vertical pathway to be easily provided to each space. It also reduces the number of bends and offsets that the intra-building backbone pathway must undergo as it connects each of the telecommunications rooms. Please see the discussion in TDDG Section 4.4.1 – *Intra-building Backbone Pathways* for further information.

   - In minor remodel projects, this requirement may be waived due to budget or space availability limitations.

C. There shall be a minimum of one TR per building. Additional TRs shall be added when the area to be served exceeds 10,000 square feet or where the cable lengths will exceed 295 feet between a TR and the work area telecommunications outlet, including allowance for cable slack loops. Generally, each floor of a building shall be served by a TR located on that floor.

   - When specifically approved by the GSA IT ITS, a TR may be designed to serve multiple floors of a building.

D. Field offices are generally smaller and can be supported with less infrastructure than what is required for regional office buildings. Some options that might be considered include:

- A one-rack solution for the headend equipment and remote wall-mounted cabinets serving other areas of the building may be sufficient for smaller Field Offices. The Designer shall work with GSA IT to obtain direction whether this solution or something similar would be appropriate for the application.

E. Telecommunications Rooms shall not be co-located with any type of electrical room or mechanical room. The TR location shall maintain the separation distances identified in the Electromagnetic Compatibility subsection of this document.

F. The telecommunications room shall not be constructed in any of the locations listed below:

- Areas subject to water or steam infiltration, particularly basements. Floor drains (with trap primers) are required if there is any risk of water entry.
- Adjacent to wet rooms (restrooms, janitorial, etc.).
- Areas exposed to excessive heat or direct sunlight.
- Areas exposed to corrosive atmospheric or environmental conditions.
- Near or adjacent to potential sources of electromagnetic interference (EMI) or radio frequency interference (RFI) such as large electric motors, power transformers, arc welding equipment, or high-power radio transmitting antennas.
- In a shared space with electrical equipment other than equipment serving the telecommunications system.

4.3.2 Telecommunications Room Sizing

A. Telecommunications rooms shall typically be one of the following three sizes (and larger where required):

- 8’ x 6’ for a one-rack application
- 10’ x 10’ for a two-rack application
- 13’ x 10’ for a three-rack application

See the sample telecommunications room plan drawings in Appendix 6.2 of the TDDG for further information.

B. If project circumstances prevent the establishment of adequately-sized telecommunications spaces, the following options may be considered on a case-by-case basis, subject to the approval of GSA:

- Reach-in closets and small room designs for minor remodel construction projects may be considered through the SVR process.

- Wall-mounted swing cabinets are appropriate for some remodel applications serving small numbers of people and where floor space for a full telecommunications room would be unavailable or impractical. See the sample wall-mounted cabinet plan and elevation drawings in Appendix 6.2 of the TDDG for further information.

- The Designer shall pay close attention to the requirements of the equipment that will reside in the cabinet and the space that will host the cabinet.
  + Don't undersize the cabinet. Use cabinets that are 36" to 48" high.
  + Some applications require cabinets that are 30" deep, and other applications will not permit cabinets that are more than 12" deep (with vertically mounted electronics).

- The cabinet shall be on a painted, ¾" plywood backboard unless it can be determined that studs and backing in the wall are suitable to carry the rated weight of a fully-loaded cabinet (not just the day-1 weight).

- Provide a power outlet inside cabinet so that power cords remain inside the secure, locked cabinet and to prevent convenience use of the power outlet.

- Route cabling into the top of the cabinet using one or more conduits, sized as required to handle the required cabling.

C. Telecommunications room sizing shall be increased if other low voltage systems equipment is intended to be hosted in the TR; for example, fire alarm panels, security system equipment, etc. The Designer shall seek input from the GSA IT ITS regarding room sizing.

D. Telecommunications rooms in new construction and modernization projects shall be sized such that adequate space for equipment maintenance is available after racks and equipment have been installed.

4.3.3 Architectural Provisioning

A. The Designer shall be responsible to inform the Architect of the architectural provisioning requirements for Telecommunications Rooms, and to do this early in the Design Development phase of the project.

B. The Designer shall be responsible to review project documents and determine that the architectural requirements for the telecommunications spaces are met as described in this document. For projects where an architect is involved, the Designer shall coordinate directly with the architect, and verify that the architect's design documentation meets these requirements. For projects without an architect, the Designer shall alert GSA where additional architectural adjustments are needed to meet the requirements.

C. Doors shall open out (180-degree swing) from telecommunications spaces, and shall be a minimum of 36" wide and 80" high, fitted with a lock. Coordinate lock and key requirements with GSA. Doors shall be located in hallways or other common areas. Telecommunications room doors shall never be located in another building occupant's designated space.

- Access control hardware is required for telecommunications rooms and RICs in regional office buildings (ROBs). Access control hardware shall have the capability to require two-factor authentication in compliance with the requirements of NIST SP 800-116. Typically, a card reader with a keypad is

an appropriate solution. See *Building Technologies Technical Reference Guide* for further information.

- For field offices, the Designer shall inquire whether access control electronics are required for a given telecommunications room.

D. Minimum clearance height within a telecommunications space shall be 8 feet without obstructions (light fixtures, ducting, etc.). False ceilings (t-bar ceilings, ceiling grids, etc.) shall not be installed in telecommunications spaces. Walls and plywood backboards shall be painted with a light-color (white) paint. To enhance visibility in the room and reduce dust, GSA IT prefers that ceilings be painted with a light-color paint.

E. Finishes shall be light in color (white) to enhance room lighting. Flooring materials shall be light-colored and slip-resistant; carpet is not acceptable for telecommunications rooms. Interior floor finish and floor covering materials shall also meet the requirements in the International Building Code.

F. The walls in telecommunications rooms shall be covered with either fire retardant-treated ¾" plywood (that has been treated with fire-retardant chemicals by a pressure impregnation process), or plywood that has been painted with a UL listed, non-toxic fire-retardant intumescent coating having a Class A surface flame spread rating, and that has been approved by the GSA PBS fire protection engineer. The plywood shall be painted with primer and two coats of white paint.

- If treated plywood is used, mask the stamp on each sheet prior to priming and painting. Leave the stamps exposed and visible for long-term maintenance awareness.
- If an approved fire-retardant intumescent coating is used, a small plaque shall be attached to the backboard near the door listing the fire spread rating of the backboard, the name of the manufacturer, and the product number of the fire-retardant intumescent coating. This information may be helpful for future maintenance activities.

Plywood backboards shall extend from 6" above the floor up to a height of 8'6" above the finished floor.

4.3.4 Environmental Provisioning

A. The Designer shall be responsible to inform the Mechanical Engineer of the environmental provisioning requirements for Telecommunications Rooms, and to do this early in the Design Development phase of the project.

B. The Designer shall be responsible to determine that the mechanical HVAC requirements for the telecommunications spaces are met as described in this document. For projects where a Mechanical Engineer is involved, the Designer shall coordinate directly with the engineer, and verify that the engineer's design documentation meets these requirements. For projects without the involvement of a Mechanical Engineer, the Designer shall alert GSA where adjustments to the mechanical infrastructure are needed to meet the requirements.

C. The Designer shall coordinate with the Mechanical Engineer to ensure that the HVAC requirements for the telecommunications spaces are met and also that HVAC ductwork and motors do not conflict with cable tray or conduit routing.

D. In addition to the requirements in the BICSI TDMM, telecommunications rooms shall be environmentally provisioned as follows:

- A fundamental design assumption is that all TRs will at some time contain active electronic equipment (routers, switches, etc.) even if the current design does not call for such devices.

  In some telecommunications rooms, the quantity of network electronics devices will produce a heat load that requires mechanical cooling. If the building system cannot assure continuous cooling operation (year round), a stand-alone unit shall be provided for the TR.

  In other telecommunications rooms with less active equipment and correspondingly limited heat loads, it may be possible to adequately cool the rooms through the use of an air supply fan to exchange air in the room with ambient air from the corridor.

  The Designer shall evaluate the expected heat load and recommend an economical solution that is adequate for the load.

  In addition, a positive pressure differential with respect to surrounding areas is required to help keep dust and other particles out of the room.

  + In cooler climates and seasons, the use of outside air for cooling is encouraged. Dehumidification and filtration may be required for systems using outdoor air.
  + Environmental management and monitoring systems shall be designed for TRs. The Designer shall inquire with GSA to determine the required features of the monitoring solution for a given application.
  + Split systems are permissible for remodel projects, with the equipment located outside the TRs wherever possible. The temperature controls shall be located inside the TR.
  + The PBS P100-2016 in Section 6.5.9 states that air conditioning systems for technology/server and UPS rooms shall be supported by emergency power systems.
  + Air conditioning units serving TRs shall be procured with the network management option, providing a network jack to connect to an Ethernet switch.

- GSA typically provides network electronics that provide Power-over-Ethernet (POE). The Designer shall request power consumption data for the equipment that GSA will use, and work with the mechanical systems designer to ensure that the cooling capacity is sufficient to support the POE heat load.

- Humidity is not typically controlled in a TR. However, the desirable range is between 45% and 55% relative humidity.

4.3.5 Fire Suppression

A. All telecommunication rooms shall be protected by a wet-pipe sprinkler system that is designed and installed in accordance with the requirements in PBS P100-2016, Section 7.8. In addition, listed sprinkler guards shall be provided.

4.3.6 Equipment Racks and Cabinets

A. Each telecommunications room shall be provisioned with a minimum of one floor-standing 7’ high x 19” wide x 3” deep ANSI/TIA/EIA standard open-frame equipment rack, regardless of whether or not equipment is required at the time of construction.

- For minor remodel construction, this requirement may be waived given budget, project size, or other limiting factors. The use of a wall-mounted swing rack or a wall-mounted hinged bracket may be acceptable, subject to GSA approval via the SVR process.

B. 36” clearances are required surrounding racks, cabinets, and any equipment that may be mounted in the racks, as required by code. See the sample telecommunications room plan drawings in Appendix 6.2 of the TDDG for further information.

C. Racks shall be sized to accommodate, at a minimum, all existing and new equipment that is to be installed in the rack plus an additional 50% unused space for additional equipment that may be added in the future. If a rack is more than 50% full at design time, a spare rack shall be specified.

D. It can be difficult to read labeling and see cables and connectors inside cabinets during maintenance activities. The Designer shall seek guidance from the GSA IT Tech PM about whether to specify LED lighting inside cabinets (in the front, rear and sides).

4.3.6.1 Floor-standing Equipment Racks

A. See the sample floor plan details in Appendix 6.2 of the TDDG for rack arrangement guidance.

B. Floor-standing racks shall be securely bolted to the floor, and shall be braced to the wall with cable ladder racking. Multiple racks in the same TR shall be interconnected with cable ladder racks.

C. To provide the required clearances, rack locations shall be designed to have 72” of clear space between the front of the rack and the wall behind the rack. Also, a workspace access clearance of 36” is required on one side of an aisle of racks. The Designer shall discuss with GSA the potential for future requirements for additional racks, and identify spaces on the plan drawings for future racks. See the sample telecommunications room plan drawings in Appendix 6.2 of the TDDG for further information.

D. Racks shall be mounted such that the rack post shall be no closer than 14” to the nearest wall, allowing space for an 8”, 10”, or 12” vertical cable manager to be

used near the wall, including space for the vertical cable manager door to swing open.

E. Racks shall be equipped with horizontal and vertical cable management modules both front and rear, with strain relief brackets to support proper patch cord bend radius and to maintain strain relief for patch cords. Vertical cable management (VCM) modules shall include spools/posts to manage cable slack. VCM modules shall be used to manage patch cords. Do not store horizontal cable slack in VCM modules. Typically slack shall be stored in the overhead ladder rack in the telecommunications room, or using some other solution intentionally designed for this purpose.

- VCM modules shall be engineered to function with the racks as a system.
- VCM covers (doors) shall be metal, and shall be easily removable.
- VCM doors shall have at least two metal, cam-style hinges, being capable of opening to the right or left to accommodate workspace requirements of a technician's task. Doors shall latch closed or open with a single knob. Snap-on covers are not acceptable.
- VCM modules shall have openings in the back wall to allow cabling to pass between the front and rear of the rack.
- The VCMs shall have adjustable cable management panels, cable spools, and other accessories that can be adapted to accommodate the volume of cables that they contain, and to meet special requirements.
- The Designer shall evaluate the patch cord quantities expected to be managed in the vertical cable management and shall specify appropriately sized VCM hardware for each telecommunications room.
- Vertical cable management between racks typically ranges between 10" and 15" wide.
- Vertical cable management on the ends of rack rows shall typically be 10" wide. Some applications, however, may require 12" or 15" wide vertical cable management for the sides of racks. The Designer shall consider whether additional space might be required between the VCM and the wall to allow the door to pivot on its hinge as it swings open.

F. Horizontal cable management products shall belong to the same product family (and same manufacturer) as the VCM products. Horizontal cable management products shall be engineered to function together with the VCM, such that patch cords can transition smoothly between horizontal and vertical cable management modules.

G. Sometimes an equipment cabinet is required for larger IT equipment (servers, large UPSs, etc.) with both front and rear mounting rails. The Designer shall discuss with GSA the network electronics that will be hosted in each TR and shall design appropriate racks and cabinets to support the equipment. Racks and cabinets shall be shown on the rack elevation details in the plan drawings.

H. Ladder racking shall be provided at 7' and 8' above finished floor circling the room and crossing the room over the tops of the equipment racks. Backbone cables and patch cords shall be routed via the 7'-level ladder racking. Horizontal cables and their service loops shall be stored in the 8'-level ladder racking.

I. Horizontal cables and patch cords shall be secured to cable supports (such as ladder rack and VCM) using hook-and-loop straps. The Contractor is welcome to use its choice of white, black, or grey straps, as long as that single color choice is used consistently throughout the telecom room.

- Tie-wraps (zip-ties) shall not be used to secure any cables, at any time (even temporarily during installation).

4.3.6.2 Telecommunications Cabinets

A. When planning the size and location of TRs in existing buildings, the Designer shall make every reasonable effort to meet the requirements for telecommunications rooms. In certain instances, the only viable alternative may be the use of one or several telecommunications cabinets in lieu of TRs.

B. In minor remodel projects, some buildings may not justify a separate room as the telecommunications room. In some circumstances, sufficient space may not be available for a telecommunications room. In these instances, a wall-mounted or floor-standing telecommunications cabinet may be used.

C. Cabinets shall be sized to allocate space for cabling termination infrastructure, network electronics and UPS equipment, and shall also include space allocated for future growth.

D. Cabinets shall be equipped with horizontal wire management modules with strain relief brackets to support proper cable bend radius and to maintain strain relief for the cabling.

E. All telecommunications cabinets require lockable doors, and most applications need more security than can be provided with the manufacturer's standard door lock. The Designer shall inquire for each application whether GSA would prefer to have uniquely keyed locks installed on each cabinet door, and whether GSA would prefer to have electronic locks with card readers in lieu of keyed locks.

F. Power and telecommunications cables for equipment housed within the cabinet are to be contained within the cabinet. Exposed wiring or cables are not permitted. Power and telecommunications cables routed to or from the cabinet shall be contained in conduit, surface-mounted raceway, or concealed within the adjacent wall.

G. Each cabinet shall have a telecommunications grounding busbar (TGB) installed inside, in accordance with the grounding requirements discussed in the BICSI TDMM Chapter 9 – *Bonding and Grounding (Earthing)*.

H. The cabinet shall not be located in or adjacent to areas containing sources of electromagnetic interference (EMI). See TDDG Section 4.2 – *Electromagnetic Compatibility* (above) for further information.

4.3.6.2.1 Floor Standing Cabinets

A. Each cabinet that hosts equipment that produces a significant heat load shall have front and rear screen doors, allowing airflow through the equipment. Cooling fans are typically not required.

- The Designer shall inquire with GSA regarding the network equipment that GSA will install in each cabinet. Some equipment (such as the Cisco 6500 series) has side-to-side airflow, while other equipment has front-to-back airflow. Based on this information from GSA, the Designer shall specify the appropriate air baffles that will be suitable for the airflow pattern needed.

4.3.6.2.2 Wall-Mounted Cabinets

A. Wall-mounted cabinets shall be double-hinged to permit access to both the front and rear of the equipment. Telecommunications cabinets shall be constructed of heavy gauge steel and be lockable. Care shall be taken to specify cabinets with strong hinges that do not begin to sag over time due to the weight of the cabinet's contents. Cabinets shall have a clear Plexiglas window in the front door to allow non-technical people to view equipment status without accessing the locked door. See the sample wall-mounted cabinet plan and elevation drawings in Appendix 6.2 of the TDDG for further information.

B. Wall space shall be allocated to permit cabinets to fully swing open.

C. Technical power outlets serving wall-mounted cabinets shall be mounted inside the cabinet. Wall-mounted cabinets typically require a single 5-20 receptacle.

4.3.7 Power Requirements

A. The Designer shall be responsible to determine that the power requirements for the telecommunications spaces are met as described in this document. For projects where an electrical engineer is involved, the Designer shall coordinate directly with the engineer, and verify that the engineer's design documentation meets these requirements. For projects without the involvement of an electrical engineer, the Designer shall alert GSA where additional power infrastructure is needed to meet the requirements.

B. GSA typically provides network electronics that provide Power-over-Ethernet. The Designer shall request power consumption data for the equipment that GSA will use, and work with the electrical power distribution designer to ensure that the cooling capacity is sufficient to support the POE heat load.

4.3.7.1 Uninterruptible Power Supplies

A. For Regional Information Centers (RIC), GSA generally prefers centralized uninterruptible power supply (UPS) equipment, which shall also serve the telecommunications rooms in the building. However, for non-regional office buildings, rack-mounted UPS equipment in each telecommunications room will likely suffice. The Designer shall discuss with GSA on a project-by-project basis which UPS would be best for that project. See Section 4.18.3.9.2 – *Backup Power* for further information.

B. The Designer shall design appropriate power receptacles that will be suitable to serve the UPS equipment that will be used on the project.

C. The Designer shall inquire whether a rack-mounted auto-transfer switch would be desirable for applications where distributed UPSs are used. Rack-mounted auto

transfer switches can be helpful to supply redundant power to single-corded equipment or to switch power to bypass a failed UPS during normal power conditions.

D. UPS equipment shall be procured with the network management option, providing a network jack to connect to an Ethernet switch.

4.3.7.2 Technical Power Panels

A. The technical power circuits in each telecommunications room shall originate from a technical power panel, dedicated to serving the TR. In the absence of other influencing circumstances, the panel shall be sized for 100 amp service. The technical power panel shall not be used to supply power to sources of electromagnetic interference such as large electric motors, arc welding, or industrial equipment. The power panel shall be located in the TR or in close proximity to the TR. The technical power panel shall be labeled "Telecommunications Equipment Only."

   - If an Optional Standby Generator (NEC 702.2) is available to the facility, the TR technical power panel shall be served by the generator.
   - Some circumstances might not justify a dedicated technical power panel. In these cases, an available general-purpose electrical panel may be used. The Designer shall seek direction from GSA regarding a decision not to design a dedicated technical power panel.

B. The panel schedule affixed inside each technical power panel shall indicate the rack number or cabinet number and outlet type served by each circuit. The practice of describing circuit with vague references such as "IT Load" or something similar is not permitted.

C. The following two diagrams depict strategies for distributing technical power to telecommunications rooms where a centralized UPS is used and where UPS equipment is distributed to each telecommunications room:

FIGURE 5: POWER AND GROUNDING FOR TELECOMMUNICATIONS ROOMS WITH CENTRALIZED UPS EQUIPMENT

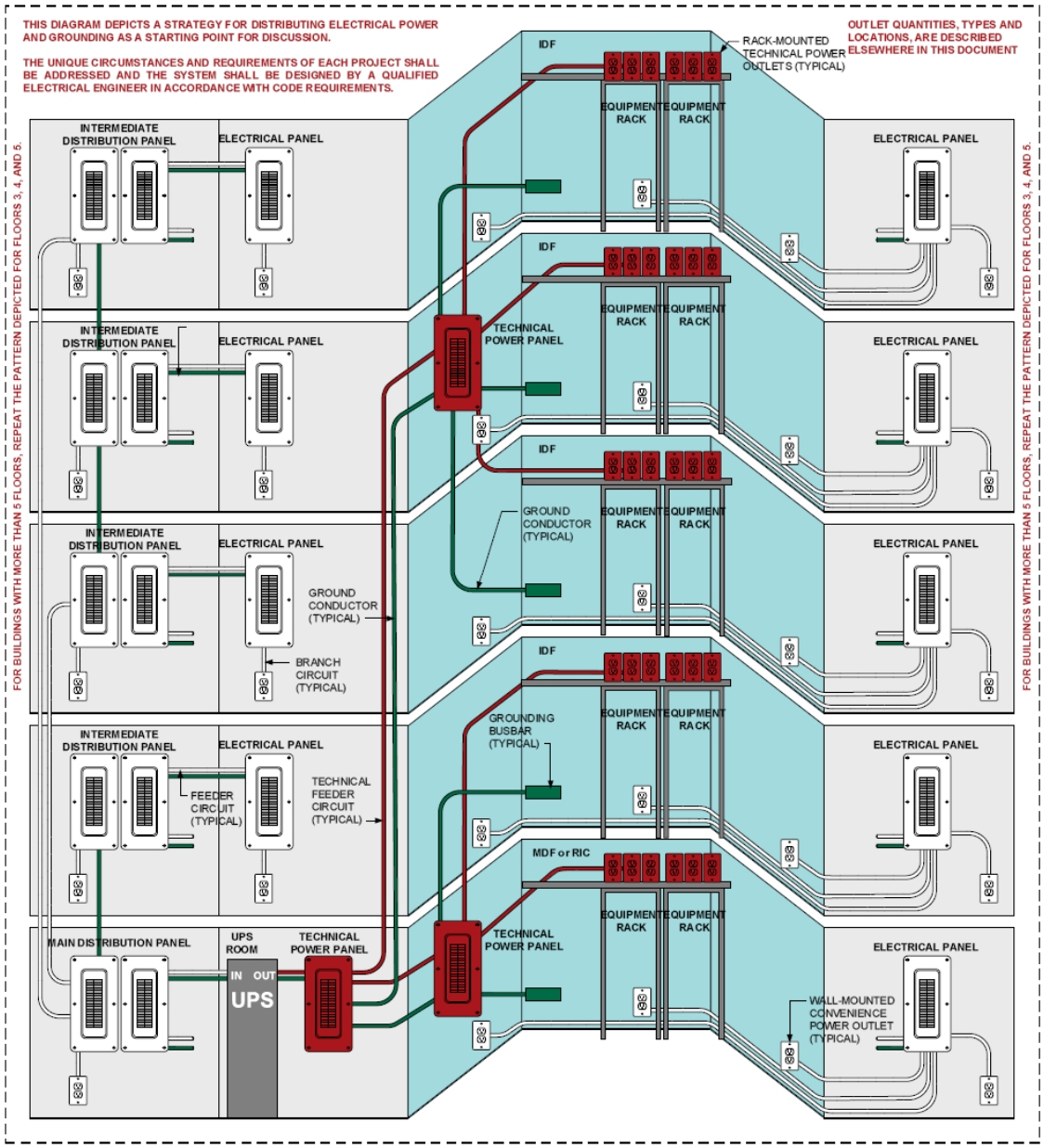
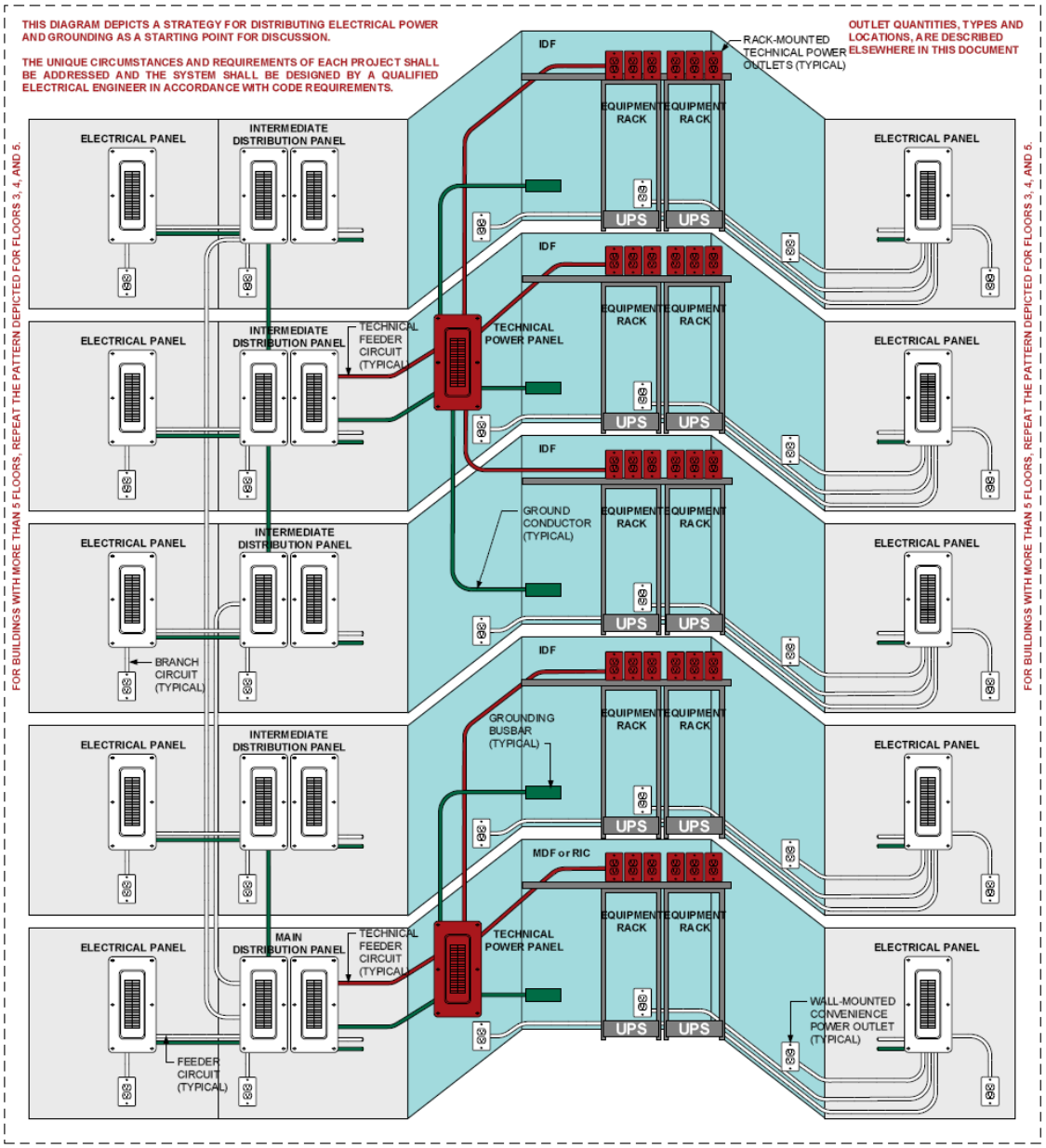


FIGURE 6: POWER AND GROUNDING FOR TELECOMMUNICATIONS ROOMS WITH DISTRIBUTED UPS EQUIPMENT



D. Where wall-mounted telecommunications cabinets are used in lieu of a TR, an available general-purpose power panel may be used to support the telecommunications cabinet power outlet. However, the power panel shall not be used to supply power to sources of electromagnetic interference such as large electric motors, arc welding, or industrial equipment. The power panel shall be located in close proximity to the cabinet.

E. Technical power panels shall be provided with a Transient Voltage Surge Suppressor (TVSS) to protect equipment served by the panel from destructive voltage spikes.

F. Convenience power panels serving workstation computers and printers would also benefit from having a Transient Voltage Surge Suppressor (TVSS) to protect the equipment served by the panel.

4.3.7.3 Technical Power Outlets

A. Every site will have different requirements depending on the applications that it supports. The Designer shall obtain electrical power connection/load requirements from GSA for each piece of equipment, and tabulate the information for review and confirmation by GSA. This equipment may include network electronics, UPS equipment, computers/servers, phone system equipment, voice mail systems, video equipment, and service provider equipment. The Designer shall be attentive to equipment that uses dual-redundant power supplies. The Designer shall be responsible to verify, validate, and account for device quantities and associated power loads to ensure that proper capacity and outlet types are designed for the project.

B. The Designer shall specifically investigate the potential need for voltage or ampere requirements other than 110VAC/20 Ampere power. Some UPS and network switch equipment requires specialized plugs or electrical service. The Designer shall inquire with the GSA ITS to determine whether any dedicated or specialized circuit requirements exist.

C. Preferably, technical power outlets would be supplied by a panel that is dedicated for technical purposes only, to reduce the possibility of electrical noise from motors and other sources of disruptive interference.

D. At a minimum, each rack (or cabinet) in a telecommunications room or RIC will require the following set of power outlets (each with dedicated circuits) for exclusive use by telecommunications-related electronic equipment:

- L6-30 (single phase, 208V, 30A) – quantity of 2
- L5-20 (single phase, 120V, 20A) – quantity of 2
- 5-20 (single phase, 120V, 20A) – quantity of 2
- Each pair of outlet types shall be fed from separate power phases.

FIGURE 7: POWER DISTRIBUTION ARCHITECTURE FOR TRS IN ROBS WITH 1U NETWORK SWITCHES

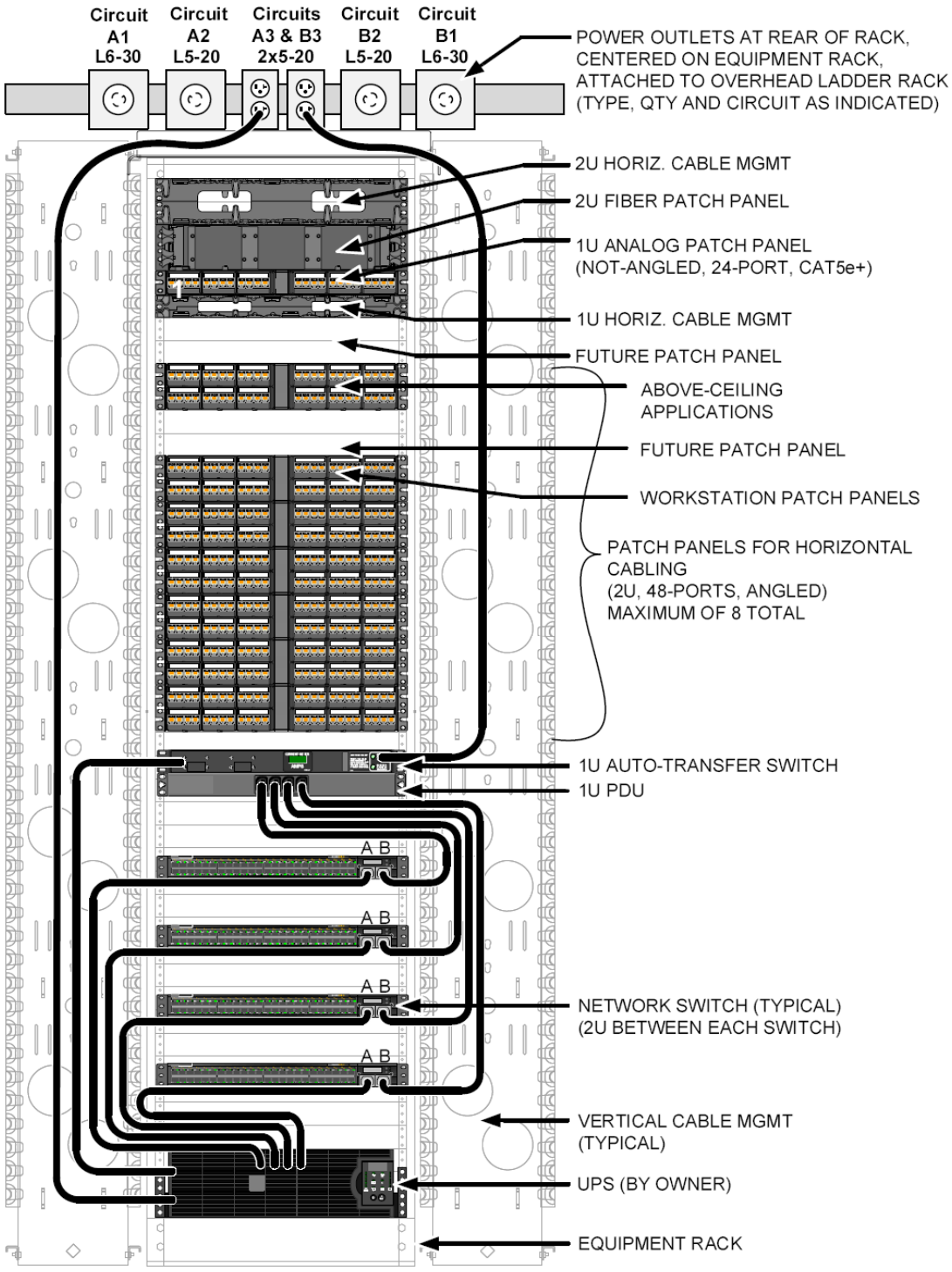
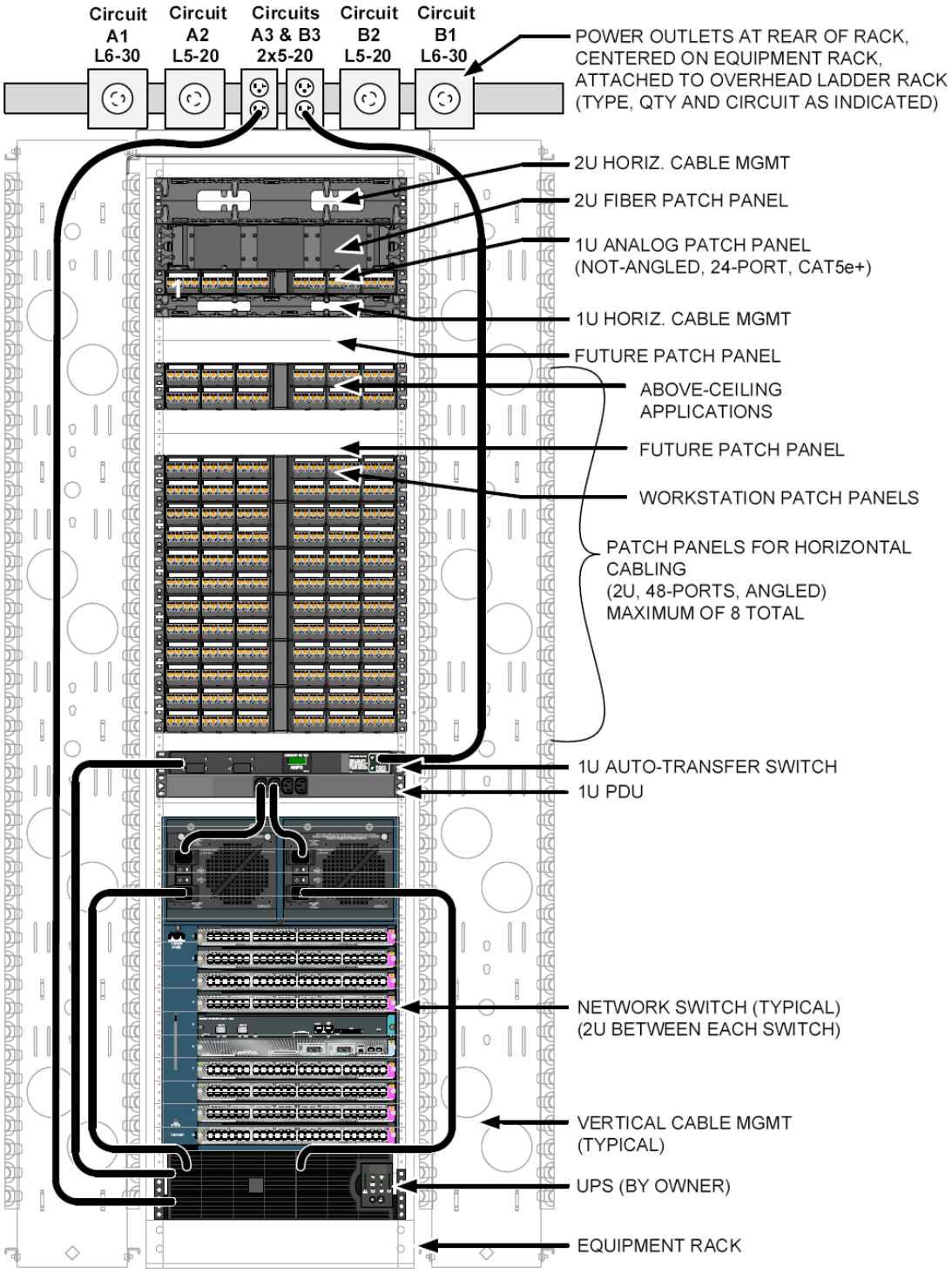


FIGURE 8: POWER DISTRIBUTION ARCHITECTURE FOR TRS IN ROBS WITH CHASSIS NETWORK SWITCHES



E. Each wall-mounted telecommunications cabinet (typically located in non-telecommunications room spaces) shall be equipped with a minimum of one quad 120V technical power outlet, installed inside, near the bottom of the cabinet. See the sample wall-mounted cabinet plan and elevation drawings in Appendix 6.2 of the TDDG for further information.

F. Other requirements:

- Outlets shall be labeled as "Technical Power" and shall show the panel and circuit numbers.
- Where 110VAC Technical power outlets are required, outlets shall be equipped for "straight-blade plugs" (NEMA 5-20R), rather than twist-lock style receptacles. In addition, receptacles shall have a T-shaped universal blade slot to support both plugs with vertically oriented blades as well as 20A plugs with one blade rotated 90 degrees.
- Where 208VAC Technical power outlets are required, the Designer shall inquire with GSA to determine the plug requirements for the equipment to be served.
- Each outlet shall be equipped with a dedicated insulated solid copper equipment-grounding conductor.
- Ground conductors serving technical power outlets ***shall not*** be ***isolated*** ground conductors.
- See the telecommunications room plan details in Appendix 6.2 of the TDDG for technical power outlet locations.

4.3.7.3.1 For New Construction and Modernization Projects

A. Faceplates for convenience power receptacles and light switches in the TR shall be mounted at the surface of the plywood backboard (as opposed to being recessed into a cutout in the plywood backboard). In other words, the device boxes shall be recessed into the wall rather than surface-mounted.

B. Power receptacles shall be attached to the overhead ladder racking at the rear of the rack or cabinet. Each set of receptacles serving a rack or cabinet shall be centered within the width and above the rack or cabinet they serve. See outlet types, quantities, and locations in Figure 7: Power Distribution Architecture for TRs in ROBs with 1U Network Switches, and in Figure 8: Power Distribution Architecture for TRs in ROBs with Chassis Network Switches.

C. The rack nearest the wall is expected to host a rack-mounted UPS at the base of the rack as well as a horizontal (19") rack-mounted power strip or Power Distribution Unit (PDU). The UPS will plug into the power outlet, and the power strip or PDU will plug into the UPS.

- GSA prefers to use horizontal PDUs that provide both rear and front facing receptacles in a single unit.
- The Designer shall specify appropriate plug types for each application and cord lengths that are sized without unnecessary slack.

D. Typically, the contractor is required to furnish and install the horizontally-mounted PDU equipment.

4.3.7.3.2 For Minor Remodel Projects

A. Wherever possible, the design shall include technical power outlets according to the "new construction" requirements. However, for some projects it may not be practical to meet those requirements. The following two paragraphs describe an alternative arrangement of technical power outlets that may be approved on a project-by-project basis via the SVR process:

- If it is not practical to install a new power outlet at the top of each equipment rack, it may be acceptable to serve the rack's power needs from a wall-mounted outlet.
- If power outlets are not installed at the top of each rack, the number of wall-mounted technical power outlets shall be increased to an interval of one outlet every 4 feet. Power outlets in this arrangement shall be located such that they are conveniently aligned with the equipment racks to avoid inadvertent disconnection of the power cords.

B. Where telecommunications backboards are applied to existing walls with existing power outlets and light switches, the design shall require backboards to be provided with cutouts permitting access to the existing electrical devices.

4.3.7.4 Additional Convenience Power Outlets

A. In addition to the technical power outlets described above, the design shall require the Contractor to provide other duplex convenience outlets (120VAC, 15 Ampere) that would be available for use with power tools and testing equipment. Each outlet shall be gray or white colored, and be labeled with its panel identification and circuit number.

B. Where telecommunications cabinets are used in lieu of a TR, there shall be at least one general-purpose convenience power outlet (120VAC, 15 Ampere) located within six feet of each telecommunications cabinet. This outlet shall be colored consistently with other convenience outlets in the building. The general-purpose outlet shall not be used to power telecommunications equipment associated with the cabinet.

- For minor remodel projects, the number of convenience outlets in a TR can be reduced.

C. Convenience power outlets can be circuited to the technical power panel.

4.3.8 Lighting

A. Light levels in telecommunications spaces shall be 50 foot-candles at 3 feet above finished floor.

B. Light fixtures shall be mounted at approximately 8 or 9 feet above finished floor. Fixtures shall not be located directly above racks or ladder racking, but rather to the side of racking. The intent is that overhead light fixtures illuminate the front

and rear of racks and cabinets. See Appendix 6.2 for recommended light fixture locations.

C. Light fixtures in telecommunications rooms shall be industrial style fixtures, as opposed to artistic or architectural grade fixtures that are typically more costly. Fixtures shall be specified to be appropriately sized for the application (not too large or too small). Fixtures shall be secured with a diagonal member to prevent the fixture from swinging due to airflow in the telecommunications room.

4.3.9 Grounding, Bonding, and Electrical Protection

All equipment racks, metallic conduits, and exposed non-current carrying metal parts of telecommunications and information technology equipment in the TR shall be bonded to the TMGB. Refer to Chapter 9 – *Bonding and Grounding* in the BICSI TDMM and TDDG Section 4.8, *Bonding and Grounding (Earthing)* for more information regarding the design of grounding, bonding, and electrical protection systems.

A. Grounding and bonding conductors shall be sized according to the requirements in ANSI/TIA/EIA J-STD-607-B.

B. See PBS P100-2016, Section 6.5 for additional requirements.

4.3.10 Cables Entering Telecommunications Rooms

A. All cables shall be fully supported and properly transitioned throughout their lengths, including proper bend radius fittings at pathway transitions. Where cabling is routed vertically, it shall be appropriately secured such that the weight of the cabling does not subject the cabling to stresses that could potentially reduce the performance of the cabling.

B. Cabling shall be bundled in quantities not exceeding 24 cables per bundle.

4.3.11 Entrance Facilities

The stewardship over entrance facilities falls largely under GSA PBS. Therefore, only a few design guidelines from GSA IT are contained in the TDDG:

A. GSA IT requires a minimum of one 4’ x 8’ backboard space within the entrance facility for GSA IT-specific service demarc equipment. The Designer shall inquire whether a given project requires more space than this.

B. The Designer shall inquire with GSA PBS about backup power for utility-provided circuits:

- How will operations in the building be affected if telephone or data circuits shut off due to power outage?
- Does the project require backup power for the utility-provided circuits?
- What are the backup power runtime requirements?

C. The Designer shall provide GSA IT-dedicated pathway from the GSA IT backboard to the main telecommunications room (MDF) in the building. Conduits shall be provided, with the following quantities and designated purposes:

- Three 4” conduits shall be provided. In some cases, a minimum of two 4” conduits might be sufficient. Where circumstances do not allow the installation of 4” conduit, the equivalent carrying capacity (cross-sectional conduit area) using a larger quantity of 2” conduit might be sufficient. The Designer shall inquire with the GSA IT Tech PM before designing pathway other than three 4” conduits.
- One conduit to carry a 50PR (minimum) copper backbone cable from the utility demarc in the entrance facility to the MDF/RIC for analog phone circuits.
- One conduit for utility-provided cables for use with extended demarc circuits terminated in the MDF/RIC.
- One spare conduit.

See Section 4.4 – *Backbone Distribution Systems*.

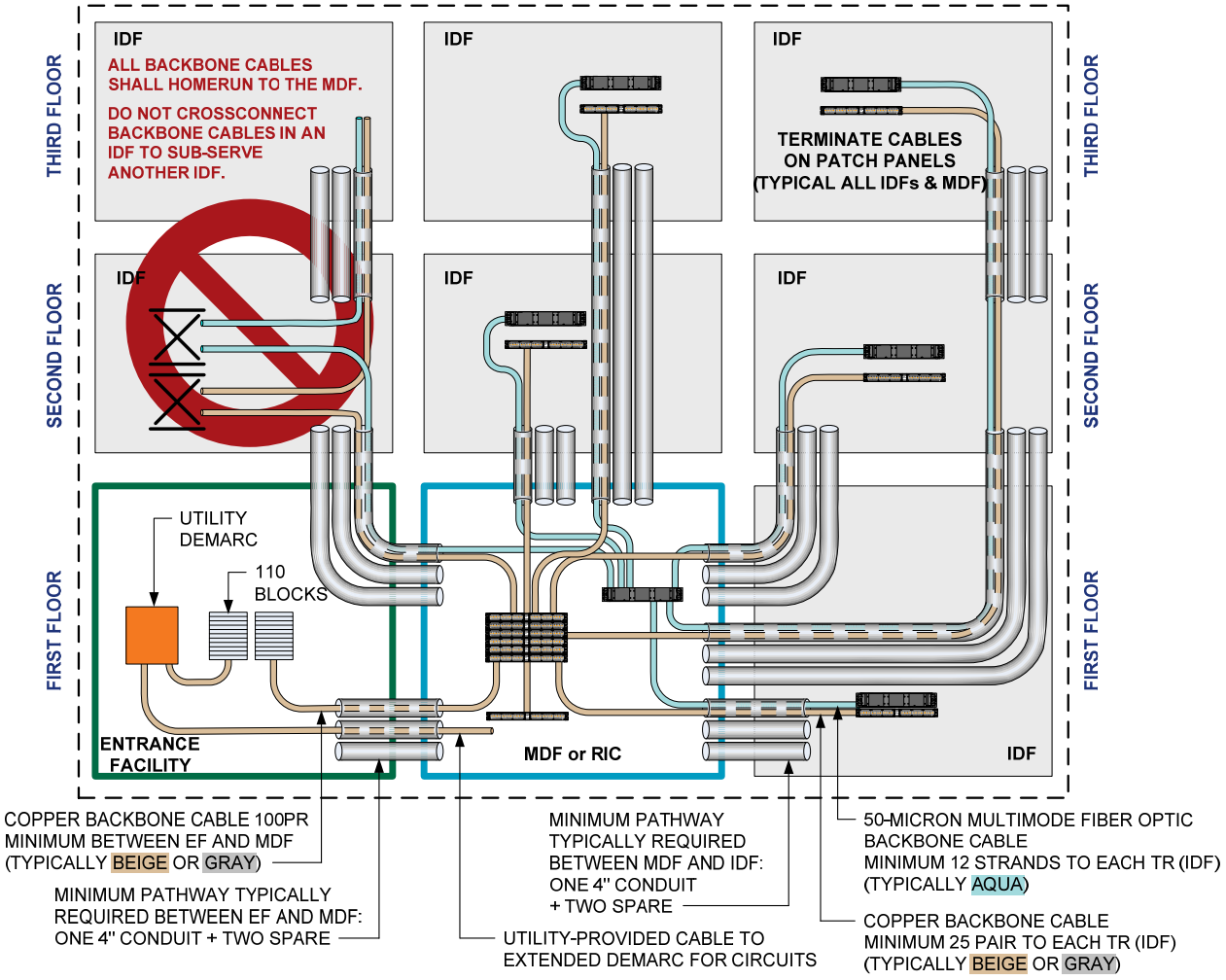
D. One or more wall-mounted grounding busbars shall be provided for use with utility demarc equipment. Utility circuits are normally extended to the RIC where GSA IT requires grounding and bonding infrastructure. Grounding and bonding infrastructure is also typically required in the Entrance Facility. The Entrance Facility is normally under the stewardship of the building owner. Therefore, the building owner shall work with the utility service provider to provide appropriate grounding and bonding for the Entrance Facility.

4.4 Backbone Distribution Systems

Please refer to Chapter 4 – *Backbone Distribution Systems* in the BICSI TDMM, Chapter 3 – *Cabling Topologies* and Chapter 4 – *Pathways and Spaces* in the BICSI OSPDRM, and Chapter 3 – *Cabling, Pathways and Spaces* in the BICSI ITSIMM for general information regarding the design of backbone distribution pathway and cabling. The following requirements take precedence over the guidelines in those documents for telecommunications infrastructure at GSA facilities.

The following diagram applies to all intra-building backbone pathways and cabling:

FIGURE 8: UTILITY SERVICE AND RISER BACKBONE CABLING



4.4.1 Intra-building Backbone Pathways

A. Intra-building backbone pathway shall utilize a physical star topology. However, the Designer shall inquire whether another pathway topology would be appropriate for a given application. Backbone raceway shall consist of conduit, chases or shafts, sleeves, and/or vertically-mounted ladder racking.

B. All cables shall be fully supported and properly transitioned throughout their lengths, including proper bend radius fittings at pathway transitions. Where cabling is routed vertically, it shall be appropriately secured such that the weight of the cabling does not subject the cabling to stresses that could potentially reduce the performance of the cabling.

C. In new construction and modernization projects:

1. The main telecommunications room in the building shall have a direct pathway connection to the entrance facility.
2. All intermediate telecommunications rooms (IDFs) shall have pathway connections to the main telecommunications room in the building (RIC).
3. Backbone pathways are generally not required between two intermediate telecommunications rooms on the same floor, as long as both telecommunications rooms have pathways to the main telecommunications room.

D. It may be prudent (due to budgetary or other project limitations) to design the intra-building backbone pathway in an arrangement that sub-feeds an intermediate telecommunications room from a second intermediate telecommunications room on the same floor.

- Even though pathway from one telecommunications room may route through another telecommunications room before connecting to the main telecommunications room, backbone cabling shall not cross-connect in the interposing telecommunications room. Intra-building backbone cabling shall be continuous (non-spliced) between the main telecommunications room and each intermediate telecommunications room.

4.4.1.1 Backbone Raceway Size and Quantity Requirements

A. Future growth requirements shall be considered when sizing intra-building backbone pathways. The cost to install additional spare pathways during initial construction is significantly less than the cost of retrofitting additional pathways in the future.

B. In general, for new construction and modernization projects, GSA will need one or more 4” EMT conduits or sleeves (whatever is sufficient to handle the volume of riser/backbone cabling being designed) between the main telecommunications room (MDF) and each intermediate telecommunications room. In addition to the above backbone conduits, GSA requires two more 4” conduits (or sleeves) that are vacant, for future cabling needs.

4.4.1.1.1 Single-Story Buildings

C. For single-story buildings with multiple telecommunications rooms, 4” conduit pathways shall be routed through the ceiling, not in or under the floor slab. The Designer shall determine the number of 4” conduits required to serve initial and future backbone cabling requirements.

- In cases where it is not possible to route 4” conduits to each of the telecommunications rooms, three 2” conduits may be substituted for each required 4” conduit.

4.4.1.1.2 Multi-Story Buildings

A. In new construction and modernization projects, telecommunications rooms shall be stacked wherever possible. Sleeves may be used in lieu of conduit if the

telecommunications rooms are stacked. Sleeved vertical pathways shall be extended to the roof (or to an attic space with access to the roof) to facilitate access for future roof-mounted or side-of-building-mounted telecommunications equipment.

B. Ladder racking shall be vertically mounted on the walls in stacked telecommunications rooms to route and support backbone cables passing between telecommunications rooms through the vertical riser pathway. Cabling shall be supported at maximum intervals of 24", attached to the ladder rungs using hook-and-loop style straps (for example, Velcro). The use of zip ties is prohibited, even as a temporary convenience during construction.

C. If design constraints prevent vertical stacking of telecommunications rooms, a centrally located vertical pathway (chase) shall be provided and shall be dedicated to the telecommunications distribution system. This pathway shall have a minimum cross-sectional area of 2 ft^2 (two square feet), shall be accessible at a maximum interval length of 3 feet, and shall extend to the roof or attic space.

- 4" conduits shall be routed between the vertical chase and the telecommunications rooms on each floor. The Designer shall determine the number of 4" conduits required to serve initial and future backbone cabling requirements.
- In cases where it is not possible to route 4" conduits to each of the telecommunications rooms from the vertical chase, three 2" conduits may be substituted for each required 4" conduit.

4.4.2 Intra-building Backbone Cabling

GSA requires both copper backbone cabling and fiber optic backbone cabling between the main telecommunications room (typically the RIC) and the secondary telecommunications rooms (IDFs) in the building. The following sections describe the requirements for intra-building backbone cabling.

4.4.2.1 Intra-building Backbone Cable Types

A. GSA uses three types of telecommunications cabling for intra-building backbone systems, terminated on rack-mounted patch panels:

- For distances less than 300 meters: 50/125µm OM3 Multimode fiber optic cabling (aqua color).
- For distances between 300 meters and 550 meters: 50/125µm OM4 Multimode fiber optic cabling (aqua color).
- Multipair copper backbone cable: minimum 25PR, Category 5e rated or higher.

B. GSA rarely uses singlemode or 62.5/125µm multimode fiber optic cabling, except for providing new patch cords for existing applications.

C. In the past, GSA typically required the use of armored construction for all fiber optic cabling. GSA is now switching to lower-cost, all-dielectric cable wherever applicable.

- Some situations may not offer a necessary level of protection against physical damage during the life of the cable. In such cases, armored construction may be advantageous.
- Armored cable would also be desirable when fiber optic cabling passes through a multitenant-accessible shared space en route to serving a GSA IT application.
- All-dielectric (plastic) armored cable provides the physical protection benefit, while being resilient to external impact and not requiring grounding.

D. Splices are prohibited for backbone cabling.

4.4.2.2 Strand and Pair Counts

A. Each telecommunications room shall be served with multimode fiber. The Designer shall inquire on a project-by-project basis whether a CAT6A backbone cable is also required.

B. Backbone cable sizing (# of strands) shall be considered with respect to possible future requirements. The cost to add additional backbone pairs and strands during the initial installation is significantly less than the cost of adding another cable in the future.

The Designer shall inquire whether 40GB or 100GB backbone bandwidths are required. These bandwidths require multiple strands for each circuit.

C. The minimum number of multimode fiber optic strands to be provided shall be equal to four strands per piece of equipment being hosted in the telecommunications room plus 100% expansion capability. The Designer shall discuss with GSA whether additional equipment (apart from network electronics) will also require fiber optic cabling. At a minimum, require the Contractor to provide each telecommunications room with a 12-strand multimode fiber optic cable to support only network electronics.

- GSA does not typically attribute value or advantage to the use of redundant pathways or backbone cables between telecommunications rooms within a building. However, if the Designer identifies a situation where redundancy would have merit, the topic should be brought to the attention of GSA IT.

D. Between the Entrance Facility and the MDF or RIC, require the Contractor to provide a copper backbone cable with a minimum of 48 pairs to distribute analog/POTS dial tone throughout the building. The RIC/MDF end of this cable shall be terminated on angled copper patch panels (Category 5e or better).

E. Each telecommunications room shall be served with a minimum of a 25-pair copper backbone cable terminated on a flat (not angled) copper patch panel (Category 5e or better). For projects where VOIP telephone systems are not being deployed, the copper backbone cabling pair-count may need to be increased to support the number of non-VOIP telephones to be used in the

building. Consequently, this will also change the number of horizontal cables to the desktop. See Section 4.6.3.6 – *Horizontal Cable to Support Voice Applications*.

F. Backbone fiber optic cabling shall each be installed as a single cable containing all specified strands or pairs. For example,

   Where 24 strands of fiber are specified, a single fiber optic cable containing 24 strands shall be provided. It is not acceptable to provide two cables containing 12 strands each.

G. Category 5e copper backbone copper cabling is typically manufactured in cables with 25 pairs of copper wire per cable. Therefore, copper backbone cabling shall be installed in multiples of 25-pair cables in quantities sufficient to provide the total number of pairs required for the application. For example,

   Where a 50-pair copper cable is specified, it is acceptable to provide two Category 5e cables with 25 pairs each.

4.4.2.3 Fiber Optic Patch Cords

TABLE 9: FIBER OPTIC PATCH CORD REQUIREMENTS

Applications	Patch Cord Requirements	Length
Telecom Room (Patch panel and equipment connections)	Typically require that patch cords matching the rating of the cable shall be furnished but not installed by the Contractor. A minimum quantity of 6 fiber optic patch cords is typically required for each telecommunications room. Typically, cables shall be terminated with LC-duplex connectors. These details shall be confirmed with the GSA IT ITS on a case-by-case basis.	2 to 3 meter length is typically appropriate. The Designer shall work with GSA IT ITS to evaluate the equipment that GSA will provide and determine whether the patch cord length should be increased. Patch cords shall be long enough to permit future repatching without excessive slack.

A. Fiber optic patch cords shall be stored in the manufacturer-sealed bag until use.

B. Prior to using a fiber optic patch cord, clean the cord and test it. Clean the fiber optic connector on the network electronics also prior to use.

C. Properly cap all fiber optic connectors and terminations when not in use.

D. As a best practice, do not reuse existing fiber optic patch cords that are salvaged from other applications.

4.4.2.4 Cable Segregation

In no case shall copper or fiber optic backbone cabling be run in the same raceways as those used by electrical power conductors. However, copper and fiber optic cables are permitted to run together in shared raceways.

4.4.2.5 Innerduct

GSA IT does not require innerduct for inside plant fiber optic cabling, unless it is otherwise required by the local authority having jurisdiction, local building policy, or other applicable guidelines.

4.4.3 Inter-building (Campus) Backbone Pathways

Projects for GSA facilities rarely involve underground outside plant pathways. When they are required, the Designer shall follow the guidelines in the BICSI TDMM and the BICSI OSPDRM.

The design of the entrance facility is under the direction of the GSA PBS PM. Entrance facilities shall always be separate from equipment rooms.

4.4.3.1 Wireless and Radio System Distribution

GSA facilities frequently use rooftop satellite, wireless, or radio systems. These systems typically use one or more radio antennas connected by cabling to radio transceiver equipment. Pathways shall be designed from rooftop locations down to telecommunications rooms to serve these applications.

4.4.4 Inter-building (Campus) Backbone Cabling

Projects for GSA facilities rarely involve underground outside plant cabling. When OSP cabling is required, the Designer shall follow the guidelines in the BICSI TDMM and the BICSI OSPDRM.

4.4.4.1 Utility Services

At GSA, telephone services, cable television services, and Internet services are typically provided by third-party utility service providers. The Designer shall request from the GSA IT Tech PM information about any needed telecommunications infrastructure to support the required services. The Designer shall also request similar information from the GSA PBS PM for requirements to support other departments and tenants of the building.

4.4.4.2 Wireless and Radio System Distribution

A. Outdoor-rated backbone cabling shall be designed to serve rooftop satellite, wireless, or other radio system applications. Lightning protection equipment shall also be designed as appropriate.

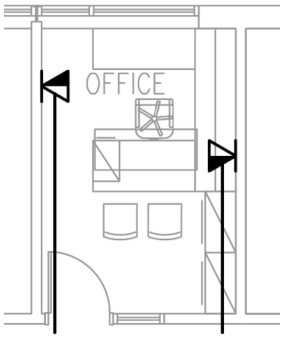
B. Radio antenna transmission cables that connect the antenna to the radio transceiver emit radio frequency (RF) radiation. These cables may be routed in a separate conduit from other telecommunications cables. Cables containing RF radiation shall be shielded cables.

4.5 Horizontal Distribution Systems

Please refer to Chapter 5 – *Horizontal Distribution Systems* in the BICSI TDMM for general information regarding the design of horizontal distribution pathway and cabling. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at GSA facilities:

4.5.1 Work Areas

4.5.1.1 Permanent Office Spaces



A. The standard treatment for each permanent office space (walls, door, etc.) is two outlets on opposite sides of the room with two angled ports (two copper cables) per outlet. The outlets shall be arranged as shown in the floor plan at right, intended to complement the possible furniture orientations.

B. For larger offices, a third outlet (two ports) shall be provided.

C. Outlets shall not be placed on the wall with the door.

4.5.1.2 Open Office/Modular Furniture

A. GSA prefers to serve open office areas by routing cable trays in a zone-like fashion throughout the ceiling spaces above the open office areas, and then establish J-hook pathways (where necessary) to reach each building column. Preferably, the cable trays would route along the column lines so that J-hooks would not be needed. The cables would then be routed down the columns to the modular furniture.

- Columns that are wrapped or furred are preferable because conduits and device boxes can be concealed inside.
- Surface-mounted raceway may be designed for columns that are not able to conceal raceway.
- Where columns do not exist, utility poles shall be designed as a last resort.
- Raceways shall route cabling down from ceiling space to two outlets on opposite sides of each column, allowing furniture to sit against the columns on the sides lacking outlets.
- Outlets on columns shall have up to 6 ports per outlet, using angled connectors.
- Outlets that are mounted near the floor can be difficult to use with angled jacks. The Designer shall design a solution that allows patch cords to be inserted and removed without bend radius conflict.

B. In applications where outlets are installed at desk height or bench height, the Designer shall specify that that the angled jacks are facing down as opposed to side-facing. The Designer shall specify the appropriate faceplate and jack parts

to make the cable terminations and furniture well-coordinated.

C. In some applications, GSA may wish to outfit each workstation with a monitor arm, integrated cable raceway to manage cabling, power bricks for a docking station mounted under the desk, power strips, power cords, and power splitters. The Designer shall consult with the GSA IT Tech PM to determine whether a given project will require these features.

D. Raceways integrated into modular furniture shall have separate channels for power and data. The channels shall be designed with abrasion protection features. Abrasion protection shall be installed prior to installation of cabling.

- The Designer shall be attentive to this requirement and make it a condition of the Construction Contract.

E. For workspace applications with more than four workstations in an area, the standard treatment is 1.25 ports per workstation.

- Provide one port and one cable per workstation. For every fourth workstation, provide a second cable in a pattern distributed evenly throughout the workspace.
- In addition to the workstations, provide cabling for each printer pod location. For each designated printer pod (modular furniture stations used to host printers and multifunction copiers), provide two cables per printer but no less than four cables per printer pod.
- For workstations intended for use by GSA IT personnel, provide four cables per desk.

F. For cubicle sets of four or fewer modular furniture workstations, the standard treatment is on average 1.25 ports per cubicle for a total of five ports (with five copper cables) per cluster of four cubicles.

- Where the design would result with a fractional cable under this formula, round up. For example, a cluster of two cubicles should be provided with three ports and three cables (one cubicle would have an outlet with one port and the other cubicle would have an outlet with two ports).

G. The Designer shall be attentive to cases where a higher cable count would be beneficial, and shall seek input from the GSA IT ITS on this topic.

H. There are four approved methods of routing cabling to modular furniture, each with strengths and weaknesses:

1. One Patch Cord Pass-Through
2. Terminated Half Patch Cord
3. Two Coupled Patch Cords
4. Horizontal Cable Pass-Through

The Designer shall discuss with GSA which option(s) is/are to be used for a particular project. The diagrams below depict the approved options:

FIGURE 9: ONE PATCH CORD PASS-THROUGH

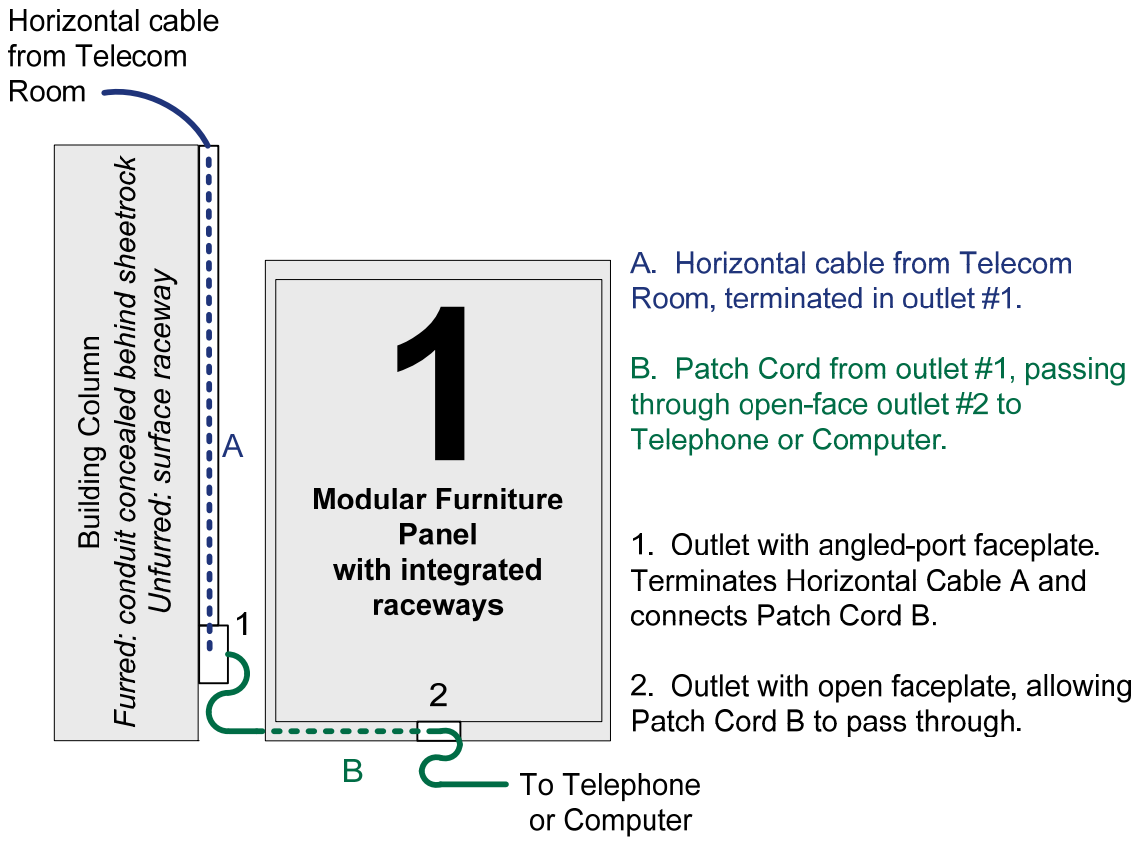
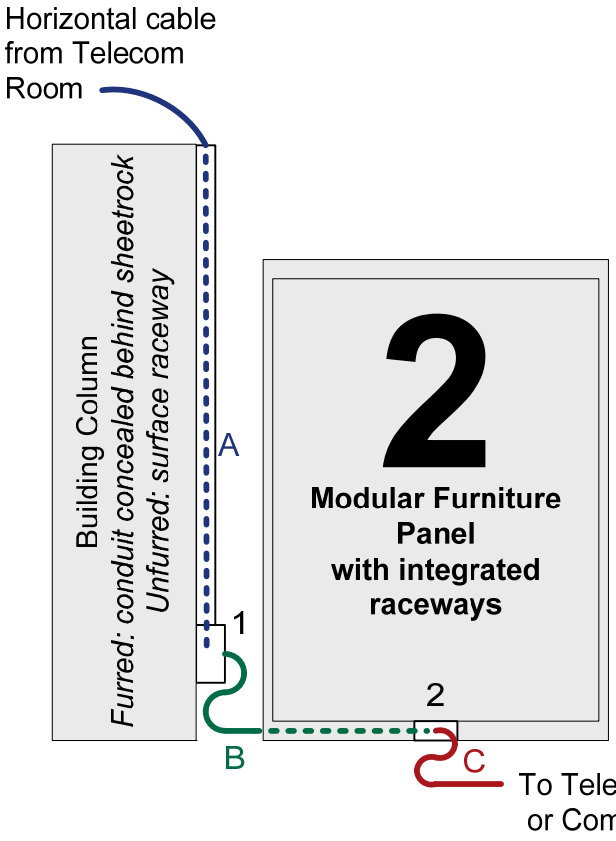


FIGURE 10: TERMINATED HALF PATCH CORD



A. Horizontal cable from Telecom Room, terminated in outlet #1.

B. ½ Patch Cord connected in outlet #1 and terminated in jack in outlet #2.

C. Patch Cord connected in outlet #2 to Telephone or Computer.

1. Outlet with angled-port faceplate. Terminates Horizontal Cable A and connects ½ Patch Cord B.

2. Outlet with angled-port faceplate. Terminates ½ Patch Cord B and connects Patch Cord C.

FIGURE 11: TWO COUPLED PATCH CORDS

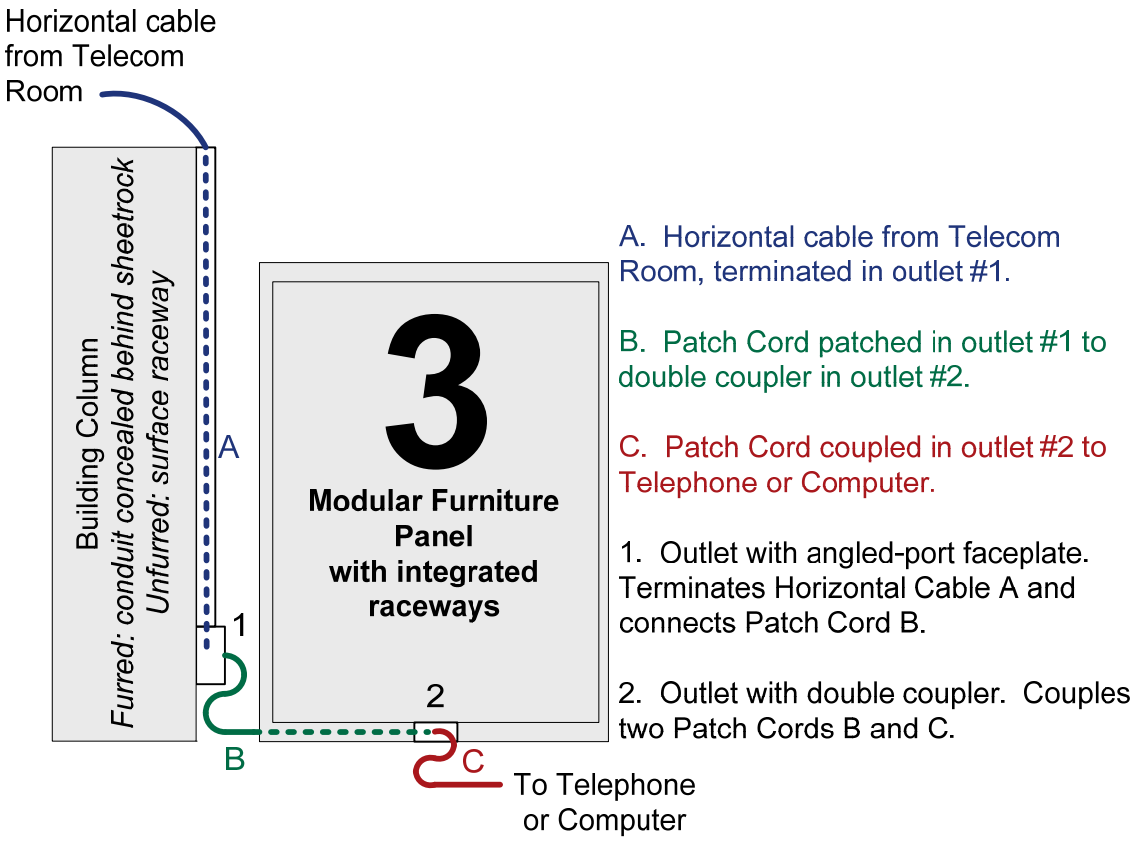
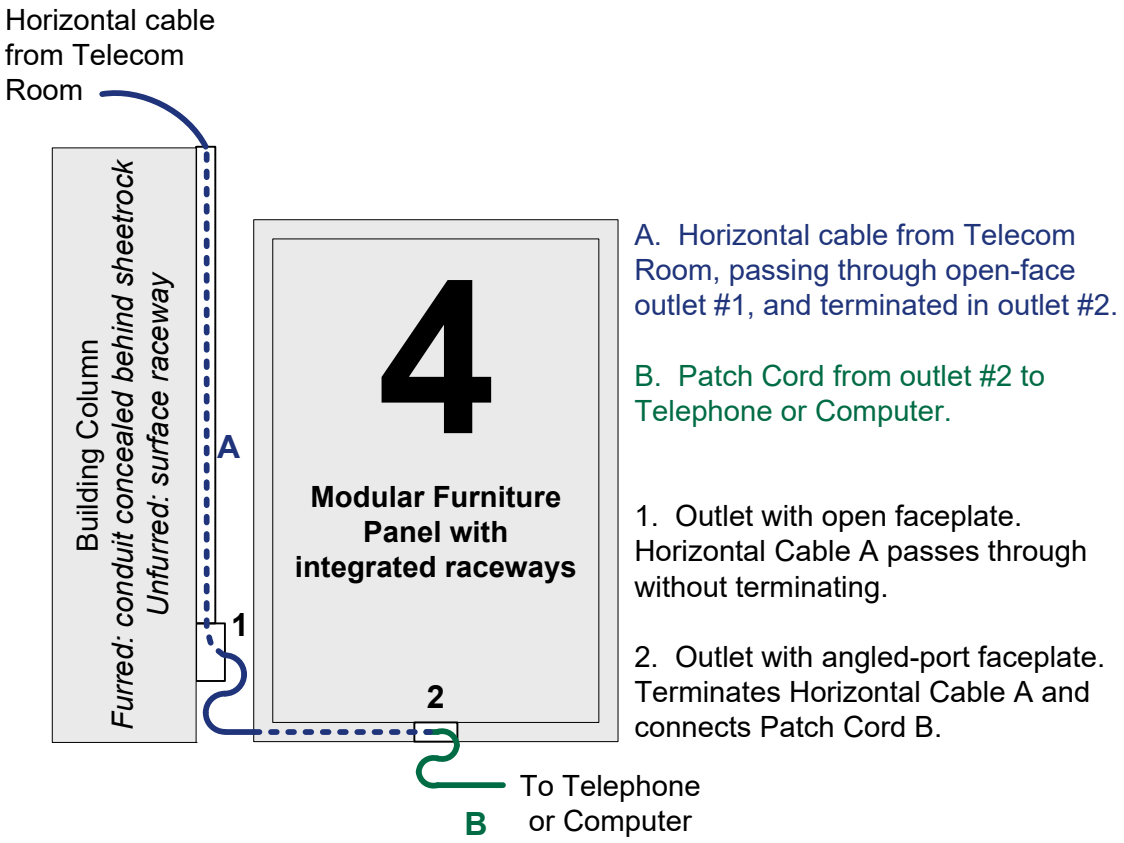


FIGURE 12: HORIZONTAL CABLE PASS-THROUGH



I. For office areas lacking columns and where workstations are located away from the wall-mounted outlets:

- The design shall include beveled rubber or vinyl cable protection to route cabling across the floor while protecting it from foot traffic.
- Some situations may require flexible, protective cable whips or wraps.
- Utility poles shall be designed as a last resort.

4.5.1.3 Small Conference Rooms

A. Small conference rooms may also be called “teaming rooms,” “gathering rooms,” or “mini conference rooms.” The rooms are typically sized for 4 occupants (6 maximum) and usually do not have a conference-style table.

B. Two outlets shall be provided in Small Conference Rooms. The outlets shall be located on opposite walls (not on a wall with a door) and each shall be provided with two ports (jacks).

4.5.1.4 Conference Rooms

A. On the end wall of the conference room, provide two power outlets, two telecom outlets, and two A/V outlets located (concealed) behind a flat panel television and concealed behind the Equipment Credenza. (See wall elevation below.)

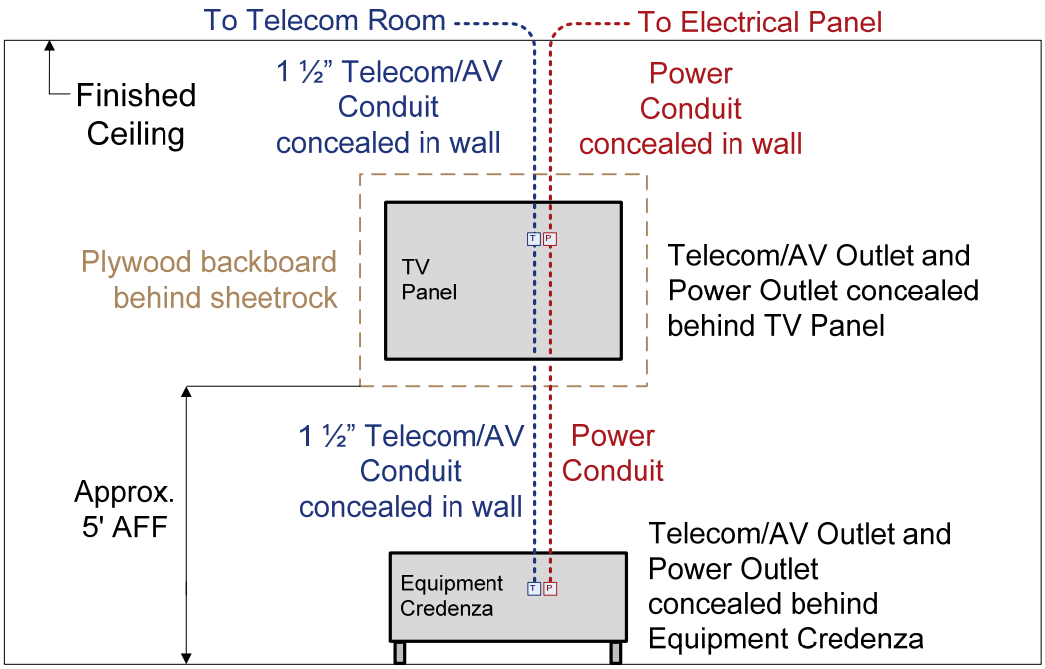
Each application shall be provided with a telecommunications outlet with no fewer than 4 data ports. The Designer shall inquire with GSA about the A/V equipment requirements for each application and provide sufficient cabling to support the equipment.

Each A/V outlet shall be provided with the following features:

- 1 coax TV port.
- 1 HDMI port.
- The Designer shall inquire whether a VGA port is also desired.

In cases where a television panel will not be installed initially, the A/V cabling may be eliminated from this requirement. However, the conduits and A/V outlet boxes shall be provided with blank faceplates, along with two power outlets and two telecom outlets.

FIGURE 13: OUTLET LOCATIONS ON END WALL OF CONFERENCE ROOM



B. Conference tables shall either have floor boxes installed beneath them or wall-mounted boxes installed adjacent to the tables, with patch cords routed up to a pop-up console providing access to power, HDMI, and data outlets.
   - Provide a minimum of two ports per table.
   - Provide four power receptacles per table.
   - Provide one HDMI port, with the cable routed to a flat panel television on the end wall of the conference room.

C. Provide one data outlet with two ports in the ceiling in or near each conference room to host a wireless access point.

D. In addition to a power outlet for a projector, provide one data outlet with two ports to host a projector in the ceiling of each conference room.

E. If the conference room is intended for shared use by multiple tenants, provide keyed/secure jacks and matching patch cords for the data outlets. Coordinate with the GSA IT ITS and GSA PBS PM for the requirements specific to each conference room.

4.5.1.5 Conference Tables

A. GSA prefers to serve conference tables via a wall-mounted outlet or a floor box and a tabletop pop-up device to provide access to the ports. Since tables can be located against a wall or away from a wall, the following six combinations can occur:

   1a. Terminated Half Patch Cord – Table against Wall, Wall Outlet

   1b. Terminated Half Patch Cord – Table away from Wall, Wall Outlet

   1c. Terminated Half Patch Cord – Table away from Wall, Floor Box

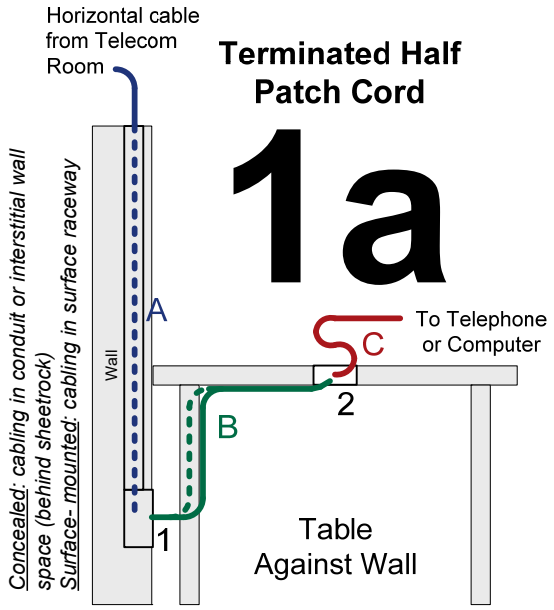
   2a. Two Coupled Patch Cords – Table against Wall, Wall Outlet

   2b. Two Coupled Patch Cords – Table away from Wall, Wall Outlet

   2c. Two Coupled Patch Cords – Table away from Wall, Floor Box

   The Designer shall discuss with GSA which option(s) is/are to be used for a particular project. The diagrams below depict the approved options:

FIGURE 14: TERMINATED HALF PATCH CORD (OPTION 1A)



A. Horizontal Cable A from Telecom Room, terminated in outlet #1.

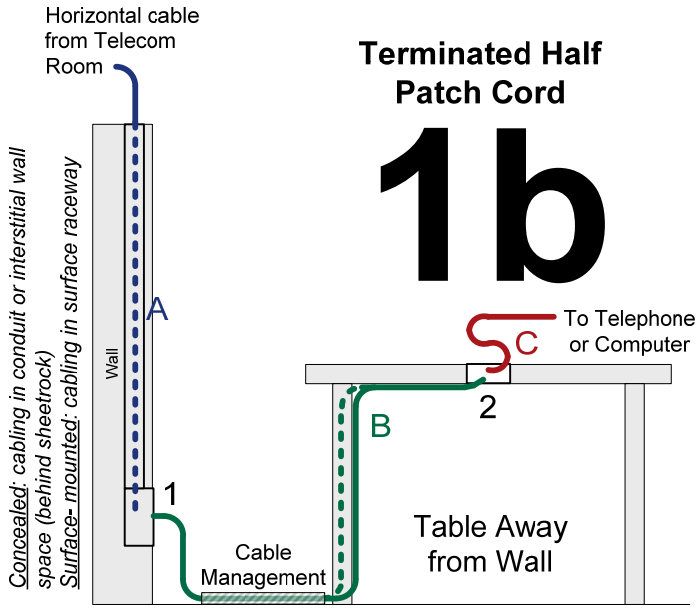
B. ½ Patch Cord connected in outlet #1 and terminated in jack in outlet #2. Patch cord may route concealed inside table leg or attached to the exterior of the leg.

C. Patch Cord connected in outlet #2 to Telephone or Computer.

1. Outlet with angled-port faceplate. Terminates Horizontal Cable A and connects ½ Patch Cord B.

2. Outlet in table-top pop-up device with faceplate. Terminates ½ Patch Cord B and connects Patch Cord C.

FIGURE 15: TERMINATED HALF PATCH CORD (OPTION 1B)



A. Horizontal Cable A from Telecom Room, terminated in outlet #1.

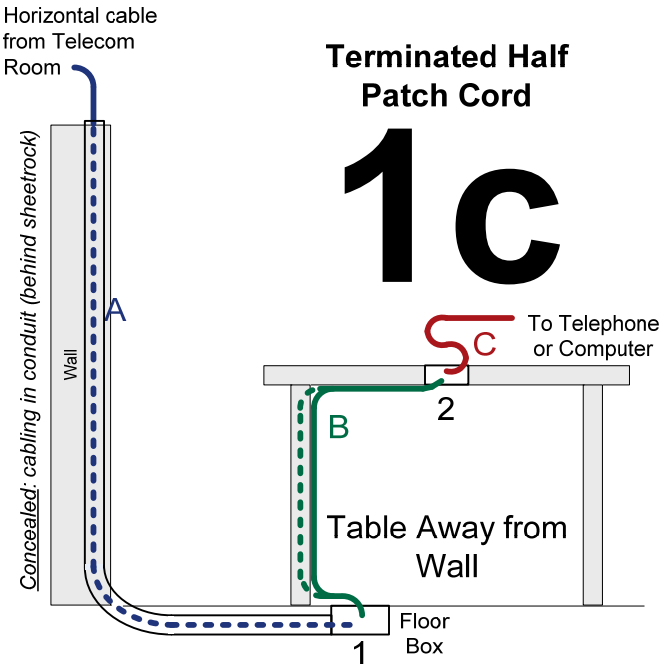
B. ½ Patch Cord connected in outlet #1 and terminated in jack in outlet #2. Patch cord routed through protective cable management across floor to table leg. Patch cord may route concealed inside table leg or attached to the exterior of the leg.

C. Patch Cord connected in outlet #2 to Telephone or Computer.

1. Outlet with angled-port faceplate. Terminates Horizontal Cable A and connects ½ Patch Cord B.

2. Outlet in table-top pop-up device with faceplate. Terminates ½ Patch Cord B and connects Patch Cord C.

FIGURE 16: TERMINATED HALF PATCH CORD (OPTION 1C)



A. Horizontal Cable A from Telecom Room, terminated in floor box outlet #1.

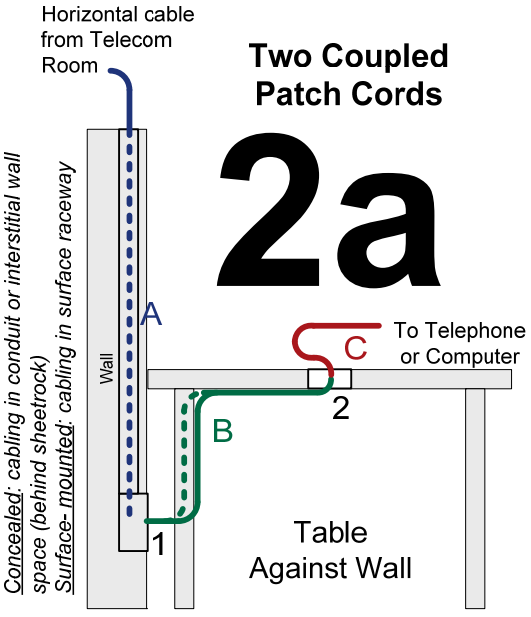
B. ½ Patch Cord connected in floor box outlet #1 and terminated in jack in outlet #2. Patch cord may route concealed inside table leg or attached to the exterior of the leg.

C. Patch Cord connected in outlet #2 to Telephone or Computer.

1. Floor box outlet with angled-port faceplate. Terminates Horizontal Cable A and connects ½ Patch Cord B.

2. Outlet in table-top pop-up device with faceplate. Terminates ½ Patch Cord B and connects Patch Cord C.

FIGURE 17: TWO COUPLED PATCH CORDS (OPTION 2A)



A. Horizontal Cable A from Telecom Room, terminated in outlet #1.

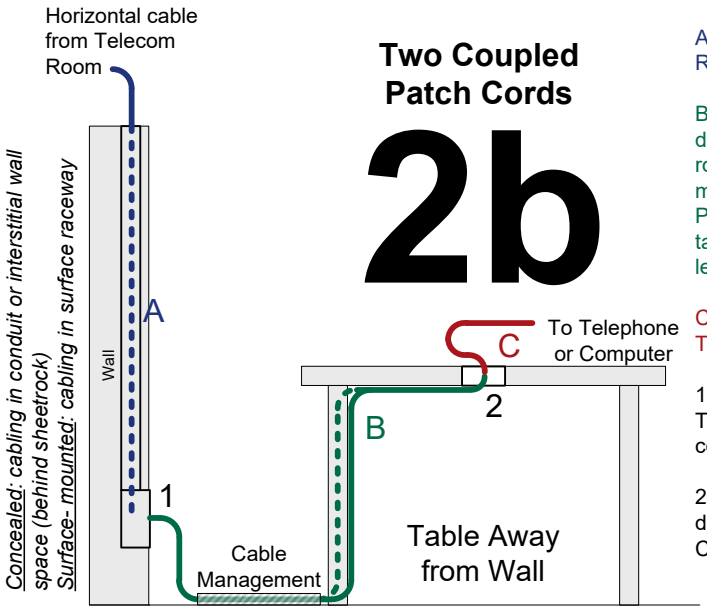
B. Patch Cord patched in outlet #1 to double coupler in outlet #2. Patch cord may route concealed inside table leg or attached to the exterior of the leg.

C. Patch Cord coupled in outlet #2 to Telephone or Computer.

1. Outlet with angled-port faceplate. Terminates Horizontal Cable A and connects Patch Cord B.

2. Outlet in table-top pop-up device with double coupler. Couples two Patch Cords B and C.

FIGURE 18: TWO COUPLED PATCH CORDS (OPTION 2B)



A. Horizontal Cable A from Telecom Room, terminated in outlet #1.

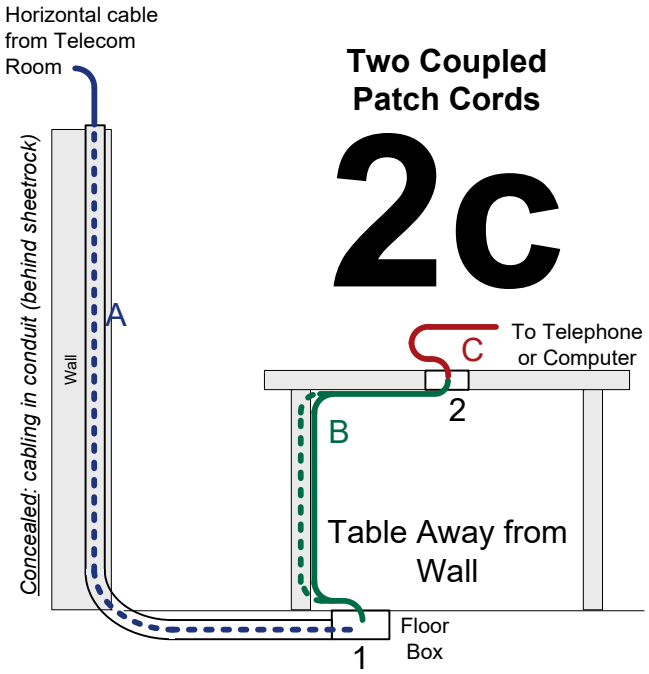
B. Patch Cord patched in outlet #1 to double coupler in outlet #2. Patch cord routed through protective cable management across floor to table leg. Patch cord may route concealed inside table leg or attached to the exterior of the leg.

C. Patch Cord coupled in outlet #2 to Telephone or Computer.

1. Outlet with angled-port faceplate. Terminates Horizontal Cable A and connects Patch Cord B.

2. Outlet in table-top pop-up device with double coupler. Couples two Patch Cords B and C.

FIGURE 19: TWO COUPLED PATCH CORDS (OPTION 2C)



A. Horizontal Cable A from Telecom Room, terminated in floor box outlet #1.

B. Patch Cord patched in floor box outlet #1 to double coupler in outlet #2. Patch cord may route concealed inside table leg or attached to the exterior of the leg.

C. Patch Cord coupled in outlet #2 to Telephone or Computer.

1. Floor box outlet with angled-port faceplate. Terminates Horizontal Cable A and connects Patch Cord B.

2. Outlet in table-top pop-up device with double coupler. Couples two Patch Cords B and C.

4.5.1.6 Combination IT Storage Room and Staging Workbench

A. Some buildings will require a space for GSA IT storage combined with a workbench for GSA IT personnel to use while configuring and commissioning new computers and other IT equipment.

B. The Designer shall inquire with the GSA IT Tech PM about specific design features needed for this space. As a starting point for this discussion, the Designer shall anticipate providing a higher concentration of jacks in the vicinity of the workbench. Outlets shall be mounted approximately 4" above the height of the workbench surface (without conflicting with a bench-top hutch), and could conceivably have a dozen or more jacks spread along the length of the workbench. A corresponding number of duplex power outlets shall also be provided in a ratio of one duplex receptacle per jack in order to power a computer and monitor per computer.

4.5.1.7 Special Indoor Applications

A. Outlets serving wireless access points (WAP) shall have two ports each and shall be mounted near the desired WAP location.

B. Outlets serving IP dome security cameras (some TRs, Data Centers, etc.) shall have one port each and shall be mounted near the desired camera location.

C. Outlets serving VOIP telephones in waiting areas shall have two ports.

D. Outlets may be designed in mechanical and electrical spaces to provide network services to mechanical control equipment, electrical power monitoring equipment and lighting control panels.

E. Outlets serving digital signage shall be provided with one port and appropriate baluns.

F. Outlets serving televisions shall be provided with one data port and one coax port.

- The Designer shall be aware of modern audio/visual technologies such as HDBaseT, which performs most reliably with Shielded CAT6A cabling.
- Equipment (such as television panels) shall be HDBaseT-certified if Power-over-HDBaseT (POH) is intended for use.

G. Outlets shall be provided in technical spaces to support power monitoring equipment and other technical equipment.

H. Outlets serving fire alarm panels, elevators, security systems, access control systems, security systems, security scanning stations, point-of-sale equipment, etc. shall be provided under the direction of the GSA PBS PM, with input from the GSA IT ITS and other departments and tenants.

I. During the past decade, many non-computer applications (such as IP Security Cameras) have converged into the IP network environment. While GSA IT does not administer these applications, GSA IT does support the cabling and pathway for them.

- During the design process, consideration shall be given to providing IP Security Cameras in the following locations:
  - + The corridor near a RIC and TR
  - + Inside a RIC
  - + Storage Rooms

J. Outlets serving Room Wizard applications shall typically be located above the ceiling. Category 5E cabling shall be used for Room Wizard applications. At the device end of the cable, provide a field-installed RJ45 connector (not a jack). Protect cabling as it routes through metallic mullions and drilled holes by using braided mesh sleeving that is appropriately sized for the cable volume that it contains. Cabling terminated in an outlet above the ceiling is also acceptable.

4.5.1.8 Special Outdoor Applications

A. Outdoor-rated data outlets may be required to serve outdoor wireless access points.

B. Outlets serving security cameras, pay phones, power monitoring equipment, security systems, guard shacks, gate houses, irrigation controllers, etc. shall be provided under the direction of the GSA PBS PM, with input from the GSA IT ITS and other departments and tenants.

4.5.1.9 Other Considerations

A. While GSA would prefer to avoid using consolidation points, it is recognized that there are circumstances that can justify their use.

B. GSA considers undercarpet telecommunications cabling (UTC) solutions to be undesirable in most cases. The Designer shall discuss any apparent justifications for undercarpet cabling with the GSA IT ITS prior to its inclusion in a design and shall also discuss the next best alternative to using undercarpet cabling.

4.5.1.10 Workstation Power Outlets

A. There shall be at least one general-purpose convenience power outlet (120VAC, 15 Ampere minimum) located within three feet of every telecommunications outlet. The Designer shall discuss any application-specific needs with GSA IT staff and adjust the power outlet locations and amperage accordingly.

- In the case of new construction and modernization projects, the power outlet associated with each telecommunications outlet shall be a 4” x 4” device box (dual gang) with four power receptacles. It is the Designer’s responsibility to coordinate with the electrical engineer to ensure that power outlets are located near telecommunications device boxes.
- In the case of minor remodel, historical building remodel, and telecommunications-only projects, it may be difficult to meet this requirement. Therefore, where existing power outlets are not located within six feet of each

telecommunications outlet, the Designer shall alert GSA IT staff and request their consideration of the situation on a case-by-case basis.

4.5.1.11 Special Design Considerations

The Designer shall inquire about the requirements for any special design considerations and how the Architectural Barriers Act Accessibility Standard (ABAAS) requirements will affect these features, including:

- Coin-operated and other public-use telephones within GSA facilities
- Spaces within GSA facilities which must include ABAAS features
- Point-of-Sale applications
- ATM Machines
- Reception Areas
- Digital Signage

4.5.1.12 Device Box Considerations

A. Device boxes intended for use with low voltage cabling (telecommunications, CATV, etc.) shall not host electrical power receptacles or power wiring. "Combo boxes" (divided, multi-gang device boxes for power and data behind a single faceplate) are not permitted.

B. Device boxes shall not be mounted in the floor (i.e. "floor boxes") except where no suitable alternative exists. If device boxes must be mounted in the floor, each device box shall be served with its own individual conduit – floor boxes shall not be "daisy-chained" together.

C. Power outlets may be combined with CATV and telecommunications cabling in floor boxes if the power wiring is routed to the floor boxes separately from the other cable media and if the floor box provides for metallic barrier segregation of the power and telecommunications cabling within the box.

D. Providing spare ports for an outlet in a work area and providing spare outlets in a room are encouraged, within the limitations of the project budget, to meet projected future needs.

E. Both telecommunications cabling and CATV coaxial cabling are permitted to be terminated in a shared device box.

F. Device boxes for telecommunications outlets shall be mounted at the same height as the electrical power receptacles.

G. For projects using Category 6A (Augmented) cabling, the commonly-used 4" x 4" device boxes may be too small to provide sufficient cable bend radius, for example when there are five or more cables terminating in the box. Therefore, where device boxes are used with CAT6A cabling, 5" x 5" device boxes might be needed, with reducing extension rings and faceplates with angled jacks. The Designer shall verify cable dimensions and bend radius limitations with the cable manufacturer to determine whether larger boxes are required.

- As of the date of this writing, there are three sources of 5” x 5” device boxes:
  + RANDL Industries, Inc. (www.randl-inc.com)
  + Thomas & Betts (www.tnb.com)
  + Siemon (www.siemon.com)

4.5.1.12.1 For New Construction and Modernization

A. A device box shall be provided for each telecommunications outlet. Device boxes shall be 4” x 4” x 3½” (where 2¼” is the depth of the box and 1¼” is the depth of the extension ring, with an overall depth of 3½”). Device boxes shall be recess-mounted.
   - If Category 6A cabling will be used, the Designer shall require 5” x 5” device boxes regardless of the cable count.

B. Surface-mounted device boxes are not acceptable. However, for concrete masonry unit (CMU) walls or other wall types that may obstruct cable or conduit installation, the Designer shall request direction from the GSA IT ITS on a case-by-case basis.

4.5.1.12.2 For Minor Remodel, Historical Building and Telecommunications-Only Projects

A. Existing device boxes and conduits shall be reused where existing boxes are standards-compliant, or where it can be verified that the existing conduits and boxes will permit telecommunications cabling to be installed without negatively affecting the performance of the cabling. The bend radius of the cabling inside each box shall be considered carefully in evaluating existing boxes. For concealed conduits that cannot be verified, the GSA IT ITS will decide on a case-by-case basis whether they are suitable for reuse.

B. A device box shall be provided for each telecommunications outlet. Device boxes shall be recess-mounted wherever possible, and shall be 4” x 4” and at least 2½” deep (a 3½” depth is preferable). Surface-mounted device boxes (if required) may be standard single gang (2” x 4”) and at least 2½” deep.

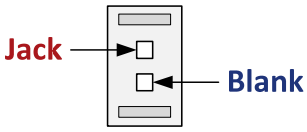
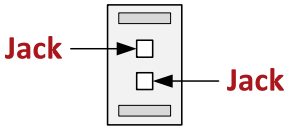
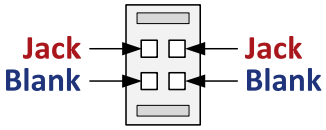
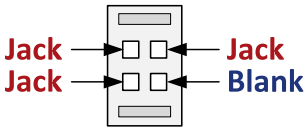
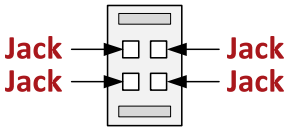
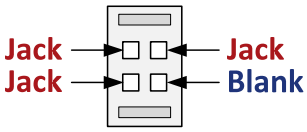
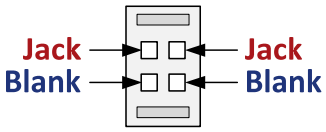
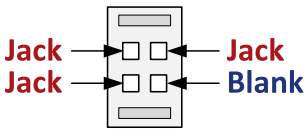
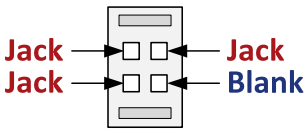
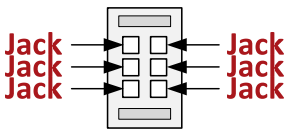
C. Where cabling can be fished through interstitial wall spaces, it is typically permissible to use faceplate mounting brackets in lieu of device boxes.

4.5.1.13 Faceplate Considerations

A. GSA prefers to not use 6-pack or 3-pack faceplates for the following reasons:
   - Six labels are difficult to fit in the spaces at the top and bottom of the faceplates.
   - There is ambiguity about the labels corresponding to the middle row jacks.
   - Utility poles might be the only approvable exception to this requirement due to potential lack of space for another faceplate.

B. The following table depicts the faceplate, jack, and blank insert combinations that shall be used:

TABLE 20: FACEPLATES, JACKS AND BLANK INSERTS

Outlets with **1** Cable	
Outlets with **2** Cables	 OR 
Outlets with **3** Cables	
Outlets with **4** Cables	
Locations with **5** Cables	 + 
Locations with **6** Cables	 + 
Utility Pole Outlets with **6** Cables	 **Only for utility poles. This requires the approval of the GSA IT Tech PM**

4.5.1.14 Horizontal Pathway Systems

The process of selecting the type of pathway that would be appropriate for a particular project shall be a cooperative effort involving the Designer and the GSA IT ITS.

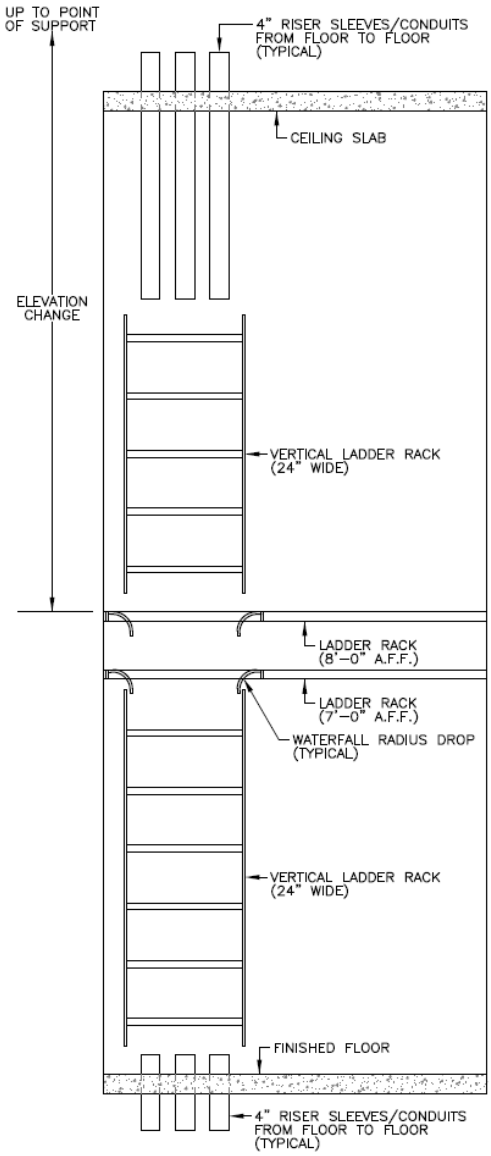
4.5.1.14.1 General Pathway Design Considerations

A. All cables shall be fully supported and properly transitioned throughout the length of the cables, including proper bend radius fittings at pathway transitions. Where cabling is routed vertically, it shall be appropriately secured such that the weight of the cabling does not subject the cabling to stresses that could potentially reduce the performance of the cabling.

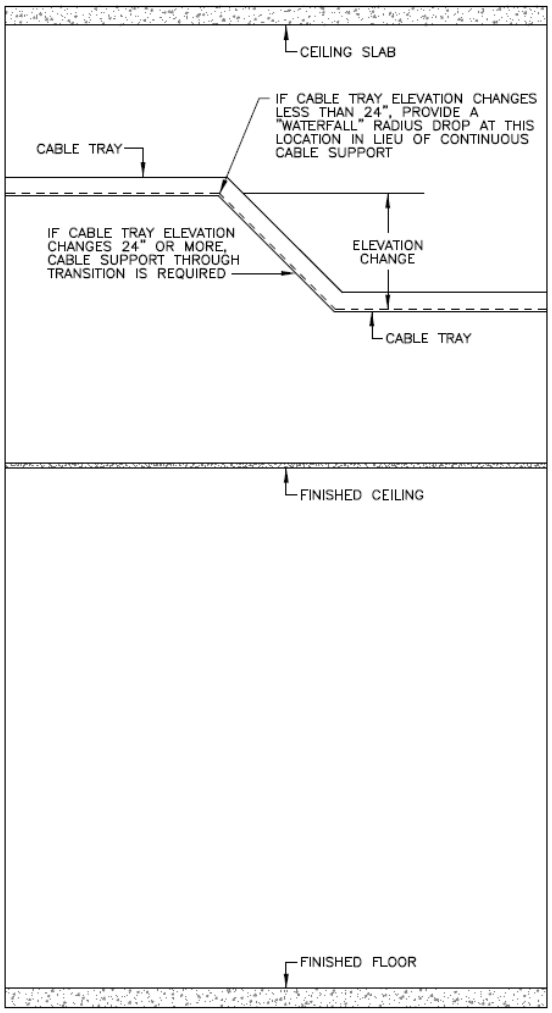
   - Cable supports shall be installed prior to the installation of cabling. It is not acceptable to install cabling first, allowing it to hang unsupported, until supports are later installed.

B. Cabling shall be properly supported whenever it changes elevation (routes higher or lower). Whenever cabling changes elevation via a free-air gap from one raceway to another, a radius drop or waterfall fitting is required on the upper raceway. Whenever the elevation change exceeds 24”, a vertical supporting raceway is required (such as a wall-mounted ladder rack, or a sloping cable tray). The following are some examples of solutions that shall be used to prevent damage to cabling during vertical elevation changes:

FIGURE 21: CABLE SUPPORT ELEVATIONS

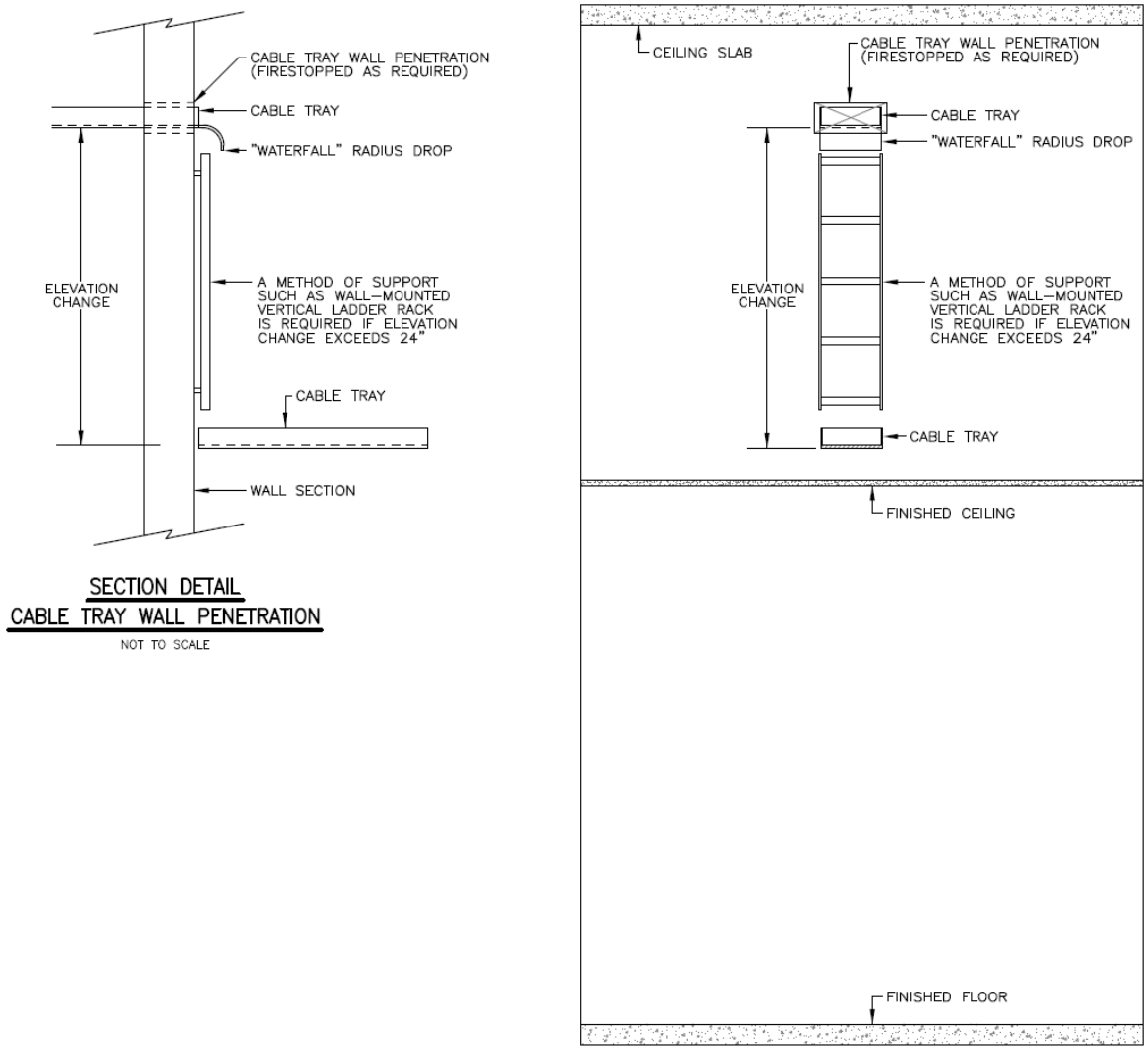


CABLE SUPPORT THROUGH ELEVATION CHANGE
RISER PATHWAY / TELECOMMUNICATIONS ROOMS
NOT TO SCALE



CABLE SUPPORT THROUGH ELEVATION CHANGE
CABLE TRAY
NOT TO SCALE

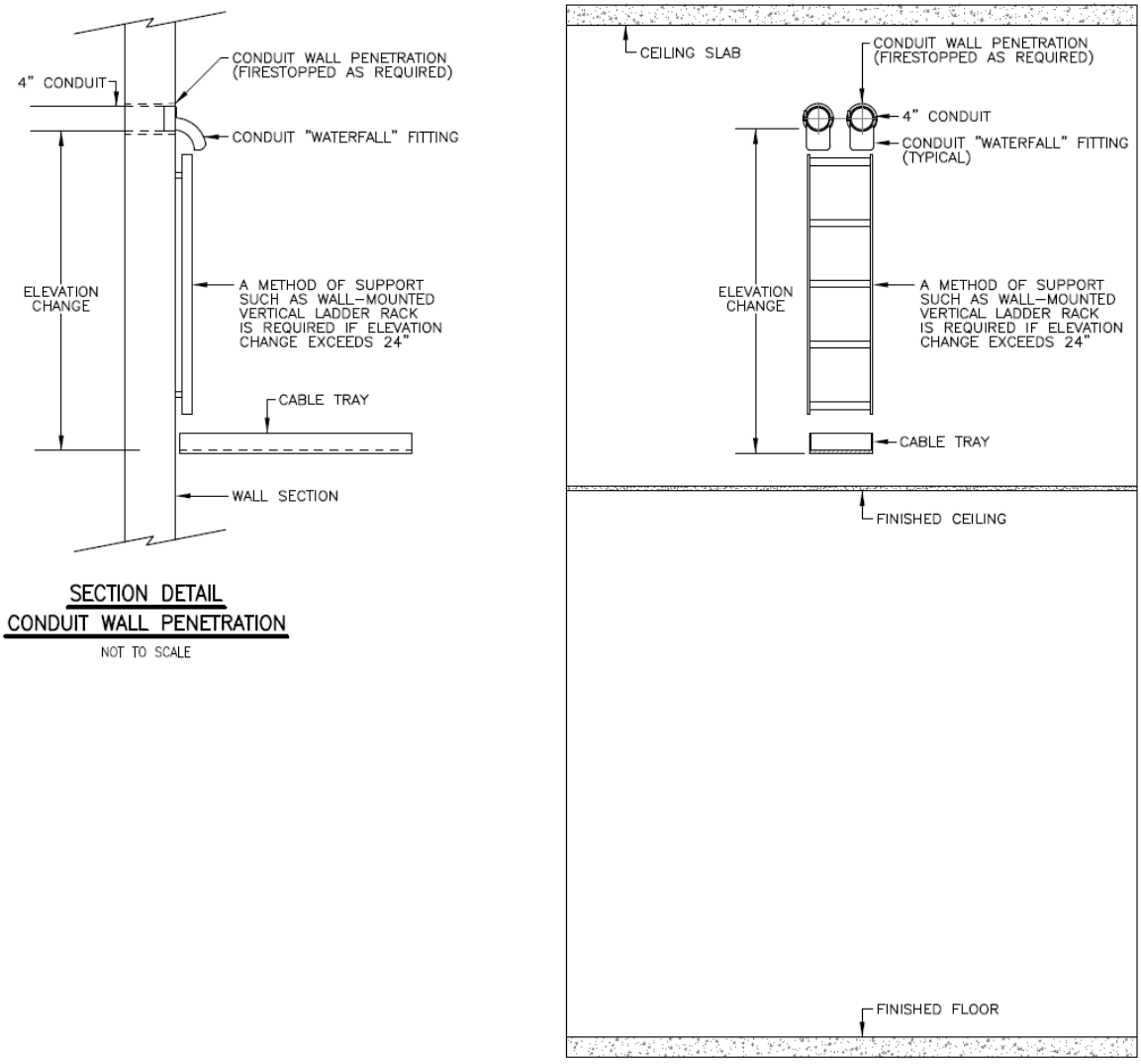
FIGURE 22: CABLE SUPPORT ELEVATIONS



SECTION DETAIL
CABLE TRAY WALL PENETRATION
NOT TO SCALE

CABLE SUPPORT THROUGH ELEVATION CHANGE
CABLE TRAY WALL PENETRATION
NOT TO SCALE

FIGURE 23: CABLE SUPPORT ELEVATIONS



C. During the Schematic Design phase, the Designer shall discuss pathway type and size with the GSA IT ITS.

- The Designer shall discuss the relative merits of the pathway options available and shall assist the GSA ITS staff and the project design team to select the most appropriate pathway solution for the project.

- The future growth anticipated for the facilities affected by the project shall be discussed. Horizontal feeder pathways (cable trays, conduits from TRs to distribution junction boxes) shall be sized to support the initial cabling installation plus a minimum of 50% growth. In other words, the pathway shall not exceed 66% of rated capacity after installation is completed.
- J-hook pathways shall be sized to support 100% additional cables after the original cabling installation. In other words, the pathway shall be no more than 50% full after installation is completed.

D. Spare pathway shall be designed to terminate at building perimeters where future expansion of the building is anticipated.

E. When considering the design of a ceiling-located cable tray or J-hook pathway, the Designer shall verify that the pathway locations will comply with accessibility and clearance requirements. Cable tray and J-hook pathways routed through ceiling spaces shall be designed such that all installed cable is conveniently accessible after construction, both for cable maintenance and to install subsequent cable additions. J-hooks shall be installed at approximate intervals of 4 to 5 feet. Conduit shall be used to span inaccessible areas where the pathway will cross “hard-lid” ceilings, where ceiling tiles are not readily removable, or where accessibility is impeded.

F. Pathway routing shall remain on the same floor as the telecommunications room and telecommunications outlets served by the pathways. Where project-specific conditions exist that justify other routing, the Designer shall request GSA approval through the SVR process.

G. “Poke-thru” penetrations to the ceiling space of the floor below are normally not permitted. For minor remodel construction, poke-thru penetrations may be allowed given budgetary, project size, or other limiting factors. Permission to use poke-thru pathways in any circumstance requires an SVR on a project-by-project basis, and always requires the services of a structural engineer to avoid irreparable structural damage.

H. All wall and floor penetrations for cabling shall be fully sleeved with bushings, and protected in accordance with the requirements in the International Building Code.

4.5.1.14.2 Pathways for New Construction and Modernization Projects

A. Where ceiling spaces will be inaccessible after construction, the only permitted pathway option is conduit. J-hook pathways, cable tray, and wire basket are not permitted if ceiling spaces will be difficult to access after construction.

B. Surface raceways and surface-mounted device boxes are not permitted.

4.5.1.14.3 Pathways for Minor Remodel and Telecommunications-Only Projects

A. For minor remodel construction, there may not be an existing (or suitable space for a new) telecommunications room available on the same floor as an outlet. While pathways shall generally be designed from the device box serving the

telecommunications outlet to the nearest telecommunications room on the same floor as the outlet, this requirement may be waived by the GSA IT ITS.

B. Existing pathways shall be reused where existing raceway is standards-compliant, or where it can be verified that the existing pathway will permit telecommunications cabling to be installed without negatively affecting the performance of the cabling. Where a pathway is concealed or cannot otherwise be verified, the Designer shall request direction from the GSA IT ITS on a case-by-case basis.

C. Where existing pathways cannot be reused, or where additional pathways are required:

- Where less than 40 cables are to be added, J-hook pathway may be used. D-ring and bridal-ring pathways are not permitted. J-hook pathways shall be established through concealed, accessible spaces. J-hook pathways shall be sized for a minimum of 100% expansion. In other words, the pathway shall be at no more than 50% of rated capacity after installation is completed.
- When 40 or more cables are designed to be routed through an area, the use of cable tray or conduit shall be considered in lieu of J-hooks.

D. It may be permissible to use faceplate mounting brackets in lieu of device boxes. In these cases, cabling is routed to the outlet location through interstitial wall spaces. Permission from GSA IT is required for this method on a project-by-project basis.

4.5.1.14.4 Cable Tray Pathway Systems

A. In general, cable tray systems shall be located in corridor or office throughway spaces, and shall not be installed above office or conference room space. Distances from EMI/RFI sources shall be maintained according to Section 4.2 – *Electromagnetic Compatibility* (above), regardless of whether the raceway is routing copper- or fiber optic-based media.

B. Projects designed using cable tray may use welded-wire type trays in locations concealed in the ceiling. Where it is not possible to conceal cable trays, the design shall specify aesthetically finished aluminum or steel cable trays.

C. The Designer shall coordinate the selection of the cable tray materials with the design intent of the Architect or interior designer.

D. Cable trays shall not be shared with power cables.

E. Conduit used to route cabling from the cable tray to the work area outlet shall be a minimum of 1” trade-size conduit.

F. Ladder racking shall be used only in the telecommunications rooms. It shall not be used anywhere else.

G. Spine-style tray is not acceptable.

4.5.1.14.5 Conduit and Junction Box Pathway Systems

A. Ceiling-routed home-run conduit is not a primary preference of GSA. While certain design circumstances will require this type of pathway, it is expected that these situations will be rare.

B. In "slab-on-grade" constructed buildings, conduits both in and under the ground floor slab are considered "wet locations" where indoor-rated cabling is not permitted. Therefore, conduit serving the main floors of such buildings shall be routed in walls and ceilings – not in or under the slab. Intra-building and horizontal pathways shall only be installed in "dry" locations where indoor cabling can be protected from humidity levels and condensation that are beyond the intended range of indoor-only rated cable.

C. Where conduit runs terminate at cable trays, the conduits shall be arranged in an organized, uniform manner to facilitate an orderly cable transition from conduit to cable tray. Conduits shall terminate within 18" of the cable tray.

D. Where conduit runs terminate in telecommunications rooms, the conduits shall be arranged in an organized, uniform manner to facilitate an orderly cable transition from conduit to backboard.

E. Non-metallic conduit and flex conduit shall not be used for horizontal pathways.

- GSA recognizes that in rare cases an application may not be possible without the use of flex conduit. In such instances, the Designer shall request a Standards Variance. The Contractor shall consult with GSA prior to using flex conduit.

F. Conduits shall not be filled beyond 40%. The Designer shall verify the outer diameter of the cabling for a project at the time of the design, to determine the maximum number of cables that can be placed inside a conduit without exceeding the 40% fill limitation.

   The Designer shall review the Contractor's submittals to verify that the cabling provided is sized such that it is compatible with BICSI's conduit fill/sizing tables and that it will not exceed conduit fill limits.

G. In new construction, all work area outlets shall have a minimum 1" conduit routing from the device box to an accessible cable pulling location. The conduit size shall be increased as necessary for the quantity of cables to be installed.

- Where new conduit is installed in existing buildings, the Designer shall notify GSA when existing conditions prevent the use of 1" trade size conduit as a minimum conduit size. This is not an option left to the Contractor's prerogative. In such instances, the Designer shall request a Standards Variance.

H. Device boxes shall not be "daisy-chained." Each device box shall be complete with its own dedicated conduit to the nearest distribution point/pathway.

I. Junction boxes and pull boxes shall be oriented so that access doors can open from the area where the cable installer will normally work. For ceiling-mounted boxes, this is typically from the bottom (floor) side of the box.

J. Ceiling access to junction boxes and pull boxes shall be designed to allow full access to the door and adequate working room for the installation personnel. Access shall also be designed to provide space for proper pulling and looping of the cable during installation.

K. Junction boxes and pull boxes shall be located in spaces that are easily accessible during normal working hours, such as hallways and common areas. Junction boxes and pull boxes shall not be located in conference rooms or offices unless there is an overriding design reason for doing so, dependent upon approval from GSA.

4.5.1.14.6 Surface Raceway

A. Surface raceway may be permissible in areas where no suitable alternatives exist. Surface raceway shall conform to bend radius requirements for the cable type being installed.

B. Surface raceway may be either plastic or metal.

4.5.1.14.7 Underfloor Duct Systems

A. The design of new underfloor duct systems is discouraged. Some existing buildings have existing underfloor duct systems, and as long as the existing ducts are suitable for use with new cabling, using the existing ducts is permitted.

B. Walkerduct is permitted where required.

4.5.1.14.8 Access Floors

A. See Section 4.18.3 – *Regional Information Center (RIC)* for additional details.

4.6 ITS Cables and Connecting Hardware

Please refer to Chapter 6 – *ITS Cables and Connecting Hardware* in the BICSI TDMM for information regarding the design of telecommunications cables and connecting hardware. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at GSA facilities:

4.6.1 Copper Cabling

A. Where termination blocks are required in the design of new telecommunications infrastructure at GSA facilities, patch panels and connectors shall be used for voice and/or data.

B. Utility demarcation points (demarcs) for copper cabling shall use 110-style blocks. This is the only acceptable use of 110 blocks for GSA IT facilities.

C. The design of new telecommunications infrastructure at GSA facilities shall not include the use of the following termination blocks or connectors. This prohibition applies to both voice and data circuits.

- 66-style blocks or connectors
- BIX-style blocks or connectors
- LSA-style blocks or connectors
- 50-position miniature ribbon connectors

4.6.2 Fiber Optic Cabling

A. Fiber optic cabling shall be terminated at both patch panels and outlets using LC-style connectors.

B. Where an application requires connectors with more than two strands of fiber (40GB/100GB high bandwidth applications, pre-terminated cables, etc.), MTP or MPO connectors shall be used in accordance with manufacturer recommendations. Other connector types may be approved by GSA IT ITS on a case-by-case basis.

C. All other connector styles (including SC, ST, and MTRJ) are prohibited for new fiber optic cabling at GSA facilities. Where equipment does not support LC-style connectors, the Designer shall specify hybrid patch cords with LC connectors on one end, with the other end matching the requirements of the equipment.

4.6.3 Splicing

Except for the purpose of connectorizing fiber optic cabling at the termination points (typically in telecommunication rooms), splicing or coupling copper or fiber optic cable is prohibited for inside plant infrastructure.

- Spliced or coupled copper cabling will not pass the industry-standard testing procedures.
- Spliced fiber optic cabling will exhibit a reduced link-loss budget compared with unspliced fiber optic cabling. Some systems (such as Distributed Antenna Systems) are very sensitive to reductions in headroom.

Inside plant fiber optic and copper cabling shall not be installed new in a spliced or coupled manner. Inadvertent damage to existing inside plant fiber optic and copper cabling shall be repaired by completely replacing the damaged cable from end to end. Repairs shall not be achieved through splicing or coupling cables.

4.6.3.1 General

A. The Designer shall work with the GSA PBS PM and the GSA IT ITS to identify and understand the needs and requirements for the facility on a project-by-project basis. This includes understanding the expected future uses of the facility. The Designer shall design the horizontal cabling accordingly.

B. Telecommunications infrastructure designs and specifications shall be based upon products from approvable manufacturers, as defined in TDDG Section 2.4.1.2.2 – *Approvable SCS Manufacturers*, above.

C. GSA has standardized on the use of plenum-rated cabling, regardless of the application and regardless of whether the building contains plenum-rated pathways.

D. The modular jacks on both the workstation outlet and patch panel shall use the T568A eight-position pin/pair assignment for new cabling in new construction, as required by FIPS 174.

E. Splitting of wire pairs degrades the performance of the cable pairs and voids the manufacturer's warranty.

- Under no circumstances shall cable pairs be split or removed from the back of a modular jack or patch panel. All four (4) pairs of each horizontal distribution cable must be terminated to a single eight (8)-position, eight (8)-conductor jack.
- To support an additional analog telephone at a work area on existing cable, install an external line-splitting device on the outside of the faceplate and connect the additional cross-connect wires to the appropriate pins on the connecting blocks in the TR.

F. Whenever moves, adds, or changes (MAC) are made to existing systems, the new cabling shall follow the routes of existing established telecommunications cabling pathways.

G. Recently, some manufacturers have developed "small-diameter" Category 6A cable products. These products can provide desirable benefits (compared with standard Category 6A products). The Designer shall suggest this option for GSA's consideration where appropriate in horizontal applications and for patch cords.

4.6.3.2 Topology

A. GSA has standardized on the star topology for all horizontal cabling, with some exceptions for certain building automation systems that require (or benefit greatly from) ring or other topologies.

- Horizontal cables must terminate in a patch panel. Do not "connectorize" horizontal cables, bypassing the patch panel to plug directly into a network switch.

B. GSA IT accepts the ANSI/BICSI 005 standard practice of field-connectorizing the outlet end of a horizontal cable (as opposed to terminating the cable in a jack) for permanent building feature applications that are installed by technicians. This solution allows the horizontal cable to plug directly into a video surveillance camera or other device without requiring a jack, faceplate, or patch cord. The telecommunications room end of the cable must still terminate on a patch panel. Horizontal cables terminated in this fashion shall be tested using the appropriate test methodology for a connectorized horizontal cable.

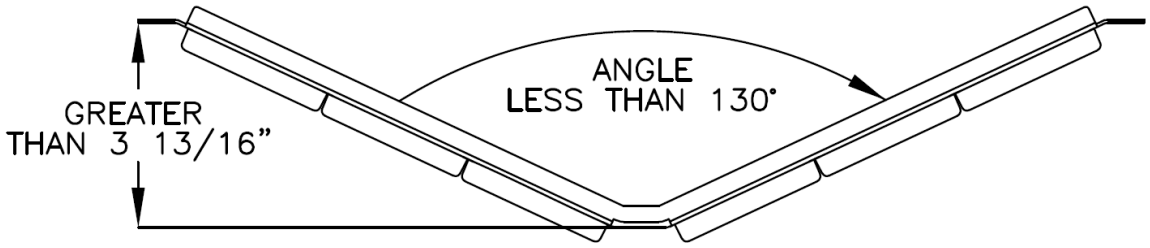
C. The centralized fiber optic cabling alternative topology is rarely useful for GSA facilities.

4.6.3.3 Horizontal Cross-Connect (HC)

A. GSA has standardized on angled patch panels with black ports/jacks for terminating all copper horizontal telecommunications media, regardless of the intended use of the horizontal cabling, including cabling that will be used for voice, data, or IP video.

- The two primary benefits of angled patch panels are to:
  + Provide additional finger space for patch cord insertion.
  + Dress patch cords without the use of adjacent horizontal cable management panels.
- In order to achieve these two benefits, the angle of the patch panel must be less than 130 degrees, but at least 90 degrees. In other words, the peak of the patch panel must extend at least four inches away from the face of the rack, as shown in the figure below. The purposes of these requirements are to:
  + Increase the amount of space available for labeling.
  + Improve the patch cord management.
  + Increase the amount of finger space to insert and remove patch cords.

FIGURE 24: ANGLED PATCH PANEL REQUIREMENTS



- Patch panels shall allow for jack modules to snap into the patch panel frame from the rear of the patch panel, so that cables can be rearranged within the patch panel without requiring the cable to be cut from the jack and re-terminated.

B. The following applications require dedicated patch panels:

- All horizontal cabling that supports devices mounted in the ceiling (wireless access points, security cameras, etc.) shall terminate on a patch panel that is separately dedicated for above-ceiling applications.

- All horizontal cabling that supports access control and security devices (door card readers, access code keypads, sensors, etc.) shall terminate on a patch panel that is separately dedicated for access control and security applications.

C. See Appendix 6.6 for a diagram that depicts GSA's standard patch cord colors. Patch cords in the telecommunications rooms shall be colored as follows:

- Workstation applications (computer, phone, etc.) – Yellow
- Network printers – Green
- Servers and managed devices (SANs, Tape Backup, UPSes, etc.) – Black
- Wireless access points – Blue
- Circuits – Red
- Analog connections – Gray
- Audio/visual (Room Wizard) – Orange
- Building automation systems – Purple/Violet
- Security – White

4.6.3.4 Horizontal Cable to Support Data Applications

A. At GSA facilities, horizontal distribution copper cable and components for data applications shall be rated for and installed to support the IEEE 802.3ab 1000Base-T Gigabit Ethernet standard.

B. In new installations, horizontal cable supporting data applications (and all other low voltage systems that are capable of operating with 24 AWG UTP copper cabling) shall be 4-pair 100-ohm Category 5e or better cable. The Designer shall inquire which cabling should be used for a given project.

- Horizontal cables shall be terminated at the work area end and patch panel end with modular jacks.
- The Designer shall coordinate the modular jack and faceplate color (at the outlet) with GSA or the interior designer for a project.
- GSA has standardized on white as the horizontal cable color. The Designer shall inquire with GSA whether cable color should be different for a given project.
  + Some cable manufacturers have developed standards-compliant telecommunications cabling using UTP cabling with conductors that are smaller than 24 AWG. GSA IT is willing to accept such materials so long as they meet all industry-standard performance requirements and also the requirements of the TDDG.
  + The equipment used in RICs operates at 10GB speeds, which require the use of Category 6A cabling. Do not install Category 5e or Category 6 cabling between RIC cabinets. See Section 4.18.3 – *Regional Information Center (RIC)* for additional details.

C. In existing buildings, where additions are made to an existing Category 5 or 5e installation, the Designer shall seek direction from GSA regarding whether to install Category 5e or Category 6 cabling. If the number of additional cables to be installed is small compared to the installed base, GSA will likely wish to add

new Category 5e cabling. If the number of new cables to be installed is relatively large, GSA may choose to use Category 6 cable and matching components.

- Category 5 cable and components shall not be purchased or installed.
- Category 5e or 6 cables shall be terminated at the work area end with a modular jack matching the category of the cabling.
- Modular jack color (at the outlet) shall be coordinated with GSA by the Designer.

D. See Appendix 6.6 for a diagram that depicts GSA's standard horizontal cable colors.

4.6.3.5 Horizontal Cable to Support Above-Ceiling Data Applications

A. All horizontal cabling that supports devices mounted in the ceiling (wireless access points, security cameras, etc.) shall use Category 6A-rated cabling. See TDDG Section 4.16 – *Wireless* for additional information.

B. Provide two cables to each above-ceiling outlet.

C. Plenum-rated patch cords are required for above-ceiling applications.

4.6.3.6 Horizontal Cable to Support Voice Applications

A. GSA uses VOIP for all new voice applications, and networks the workstation computer through the VOIP telephone. Therefore, only one Category 5e or better horizontal cable is required. This cabling shall meet the same performance and test requirements as cabling intended for data applications.

B. In existing buildings where Category 3 cabling currently serves voice applications for non-VOIP telephone systems, Category 5e or better cable shall be used when new voice cabling is installed. GSA is in the process of converting all of its telephone systems to VOIP. Therefore, it would be prudent to install Category 5e or better cabling even if analog telephones are being used. Each workstation will require two cables under this scenario, because the computer and telephone will be separately connected.

4.6.3.7 Horizontal Cable to Support Low Voltage and Building Automation Systems

A. During planning for intra-building telecommunications cabling installations, the Designer shall identify options for supporting power-limited (low voltage) and building automation systems with the common structured cabling system, and present the options to GSA for consideration. These options shall comply with ANSI/TIA/EIA 862-A – *Building Automation Systems Cabling Standard*.

B. By providing a common cabling distribution system for the various building automation systems, it may be possible to reduce construction costs and operational costs while creating an intelligent building that can contribute many other benefits (see TDMM Chapter 16 – *Building Automation Systems* for further information). Low voltage systems that are capable of using a common structured cabling system (either backbone or horizontal cabling) shall be

designed to use telecommunications cable and termination hardware wherever possible.

C. The Designer shall request from GSA a list of systems that will require telecommunications outlets for operations. The Designer shall then include outlets in the design as necessary to meet the listed requirements.

4.6.3.8 Patch Cords

A. Patch cords shall be factory-manufactured and shall be certified by the manufacturer to match the cable type used in the horizontal distribution.

- Category 5e patch cords are only permitted for use with Category 5e horizontal cabling applications.
- Category 6 patch cords are permitted for use with both Category 5e and Category 6 horizontal cabling applications.
- For Category 6A applications, Category 6A patch cords shall be used.
- Patch cords shall be factory-assembled by the SCS manufacturer. Field-connectorized patch cords are not acceptable. Any existing field-connectorized patch cords used in areas affected by a project shall be replaced under the project with factory-assembled patch cords.
- Analog patch cords shall be Category 5e or better.
- Patch cord colors shall be as depicted in Appendix 6.6.

B. Patch cords for devices mounted in the ceiling (wireless access points, security cameras, etc.) shall be plenum-rated, Category 6A-rated, and white-colored. Patch cords would not be required for applications that are terminated with connectors per ANSI/BICSI 005. See Section 4.6.3.2 – *Topology* for further information.

C. The Designer shall quantify and specify the required patch cords in the Contract Documents to be provided by the Contractor for each particular project, as shown in the table, below:

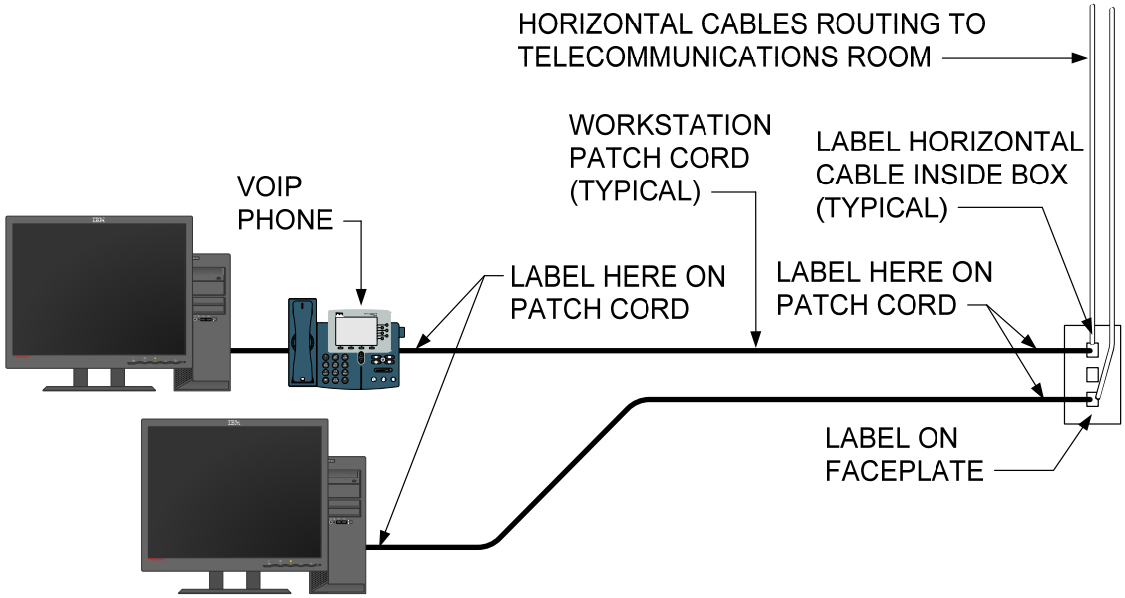
TABLE 25: COPPER PATCH CORD REQUIREMENTS

Applications	Copper Patch Cord Requirements	Length
Work Area (Outlet end)	Typically require that patch cords matching the rating of the horizontal cable shall be furnished and possibly installed by the Contractor. A quantity of one patch cord for each port installed, plus 10% spare. This shall be confirmed with the GSA IT ITS on a case-by-case basis.	For each application that is known, provide a length that will reach the equipment plus 6 ft to 10 ft additional length. Otherwise, provide a 10 ft patch cord.
Telecom Room (Patch Panel end)	Typically require that patch cords matching the rating of the horizontal cable shall be furnished and possibly installed by the Contractor. A quantity of one patch cord for each port installed, plus 10% spare. This shall be confirmed with the GSA IT ITS on a case-by-case basis.	Provide patch cords in lengths sufficient to reach between patch panels and network switches. Patch cords shall also be long enough to permit future repatching without excessive slack. The majority of the patch cords will need to fall within a 5 ft to 7 ft range. A small percentage of short (3 ft) patch cords and long (10 ft) patch cords will typically also be needed.

D. The Designer shall inquire with GSA IT whether the patch cords for a project should be installed by the Contractor or GSA IT, both in the telecommunications rooms and at the workstation end. For projects where the patch cords are to be installed by the Contractor, the Designer shall include requirements in the Construction Documents to achieve the following:

- In the telecommunications rooms, the patch cords do not require labels.
- At the workstation end, the patch cord shall be labeled at the location indicated in the diagram below, with a label matching the label for the faceplate jack to which the patch cord is connected.
- See the diagram below depicting these requirements.
- Horizontal cable testing shall be a Link Test, even for applications where the workstation patch cord is to be installed by the Contractor. Do not perform a Channel Test.

FIGURE 26: HORIZONTAL CABLES AND COPPER PATCH CORD LABELING REQUIREMENTS



4.7 Firestop Systems

Please refer to Chapter 7 – *Firestop Systems* in the BICSI TDMM for general information regarding the design of firestopping for telecommunications infrastructure. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at GSA facilities:

A. The Designer shall pay careful attention to the fire ratings of existing and new walls. Wherever penetrations are made through fire-rated walls, the Drawings shall identify the firestopping requirements.

B. Penetrations through fire-rated walls and floors shall be firestopped in accordance with the requirements of the manufacturer of the firestopping materials and shall also satisfy local code officials.

C. The Designer shall avoid design solutions calling for penetration of fire walls, fire barriers, fire partitions, smoke barriers, and smoke partitions when other reasonable cable-routing options exist.

D. The predominant color of fire-rated pathway devices shall be red.

E. The use of manufactured closeable fire-rated penetration devices is encouraged and accepted.

4.8 Bonding and Grounding (Earthing)

Please refer to Chapter 8 – *Bonding and Grounding (Earthing)* in the BICSI TDMM for general information regarding the design of grounding, bonding, and electrical protection systems. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at GSA facilities:

- Grounding and bonding conductors shall be sized according to the requirements in ANSI/TIA/EIA J-STD-607-B.

A. See PBS P100-2016, Section 6.5 for additional requirements.

B. The Telecommunications Grounding Busbar shall be sized to allow for at least 25% available (unused) terminal spaces for future use after the project is completed.

C. Bonding conductors shall be run between each piece of non-current-carrying, metallic equipment in each telecommunications room and the Telecommunications Grounding Busbar in that room.

D. Bonding conductors shall run unspliced between termination points. Riser bonding conductors that route from the MDF up to upper floor IDFs shall be continuous conductors (unspliced, uncut) but exothermically welded at each Telecommunications Grounding Busbar en route to the upper floor.

E. Power outlets circuited to technical power panels shall be properly grounded and bonded. Where power outlets are attached to unistrut mounting hardware, the unistrut shall be bonded. Power outlet bonding shall be checked periodically and tightened when impedance values are approaching maximum limits.

F. Avoid unnecessary loops, unnecessary length, and sharp bends in the bonding conductors. Conductors should run as directly as possible.

G. Bonding conductors shall be terminated at each end using UL-listed termination methods. Verify that conductors are inserted completely into the terminal lugs (visible in the inspection window of the lug), and that crimped connections accomplish a solid mechanical compression. Verify that bonding hardware breaks through paint and powder coatings to make solid, reliable contact with the metal substrate.

- Terminations at grounding busbars shall be made with dual-hole, dual-crimp lugs with two hex-head bolts, properly crimped (using a crimping/swaging tool) and tightened to meet the manufacturer's torque specifications. Phillips-head screws are not acceptable.

H. A #6 AWG bonding conductor shall be run from the grounding busbar in the technical power panel and the Telecommunications Grounding Busbar.

I. All bonding conductors shall be labeled to identify the termination point of the opposite end of the conductor.

J. Contractors who design/bid projects for GSA shall include the bonding and grounding design in their bid submittal, as described in TDDG Section 3.4.4 – *Bidding*, above.

K. In GSA facilities, the TRs in a building may also serve as low voltage systems equipment rooms, typically containing electronic equipment intended to serve the building or a portion of the building. The TR shall not be shared with electrical installations other than those necessary for telecommunications.

4.9 Power Distribution

Please refer to Chapter 10 – *Power Distribution* in the BICSI TDMM for general information regarding the design of power distribution for telecommunications infrastructure. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at GSA facilities:

A. The Designer shall be responsible to determine that the electrical power distribution requirements supporting the telecommunications infrastructure are met as described in this document.

B. For projects where an electrical engineer is involved, the Designer shall coordinate directly with the engineer, and verify that the engineer's design documentation meets these requirements. For projects without the involvement of an electrical engineer, the Designer shall alert GSA where additional power infrastructure is needed to meet the requirements.

- Please refer to Chapter 5.1 – Work Areas in the BICSI TDMM and also in TDDG Section 4.5.1 – Work Areas for information on the power outlet requirements for work areas.
- Please refer to Chapter 3 – *Telecommunications Spaces* in the BICSI TDMM and also in TDDG Section 4.3 – *Telecommunications Spaces* for information on the power outlet requirements for TRs.
  + GSA typically provides network electronics that provide Power-over-Ethernet.
  + The Designer shall request power consumption data for the equipment that GSA will use, and will size the power distribution infrastructure sufficient to support this equipment.
- Please refer to Chapter 21 – *Data Centers* in the BICSI TDMM and also in TDDG Section 4.18 – *Regional Information Centers and Data Centers* for information on the power outlet requirements for RICs and Data Centers.

C. The Designer shall inquire about and evaluate which type of power conditioning/power protection equipment should be designed for each project. The most common solutions for technology projects include:

  + Rack-mounted chemical-battery UPS equipment
  + Centralized UPS equipment (either flywheel or chemical-battery UPS equipment)

4.10 Telecommunications Administration

Please refer to Chapter 10 – *Telecommunications Administration* in the BICSI TDMM for general information regarding the documentation and labeling of telecommunications infrastructure. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at GSA facilities:

4.10.1 Identification Strategy

A. The "identifier" is the unique name or description assigned to a given telecommunications infrastructure component. The Designer shall assign identifiers to the telecommunications infrastructure components listed below and clearly show the identifier assignments on the Construction Documents.

B. While it is the Contractor's responsibility to provide marked-up drawings to the Designer indicating any construction-related changes to the identifiers, the Designer shall verify that the identifiers are clearly and accurately shown on the record drawings.

C. Telecommunications components shall ***not*** be labeled with an application-specific identifier. Ports shall ***not*** be labeled with the name or function of the device that is served by the port (server names, computer types. Also, the use of "V-#" and "D-#" are inconsistent with the industry-standard-based philosophy of designing cabling systems that are independent of the application, and are therefore not permitted.

D. The Designer shall prepare construction specifications that shall contain a comprehensive listing of the identification strategy requirements.

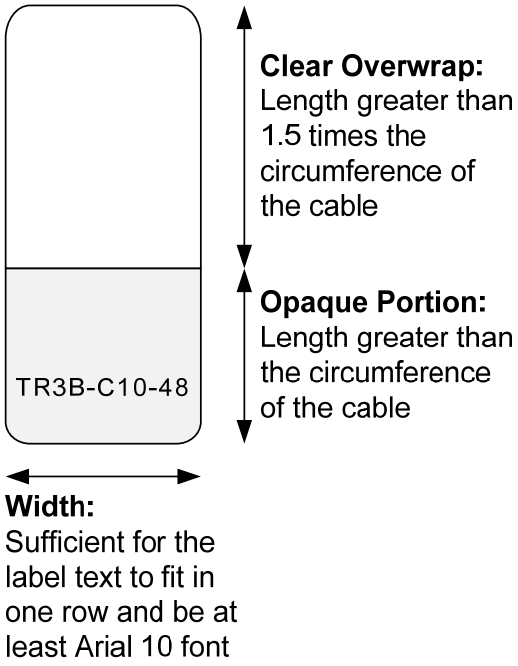
E. Due to widely varying conditions among the many buildings that GSA manages, some building circumstances may require adjustments to the identification scheme. The Designer shall obtain approval from the GSA IT ITS before committing to a scheme. The Designer and installation contractor are advised to confirm with the GSA IT ITS that their intended identification and labeling scheme will be satisfactory to GSA prior to installing labels, to avoid the risk of removing and reapplying labels to make corrections.

4.10.1.1 Labeling Materials

A. Labeling for permanent hardware shall be engraved, phenolic nameplates.

B. Acceptable cable labeling stock must support laser printing and have a clear overwrap. Labeling practices shall be consistent throughout a project. P-Touch labeling and similar labeling equipment is not acceptable. The figure below depicts acceptable labeling materials and practices:

FIGURE 27: CABLE LABELING DIAGRAM

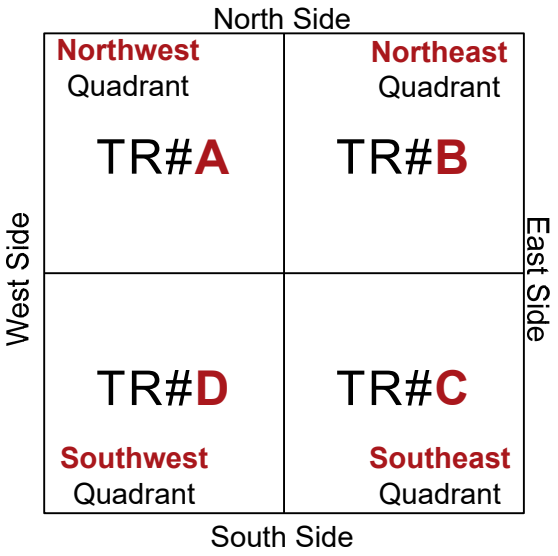


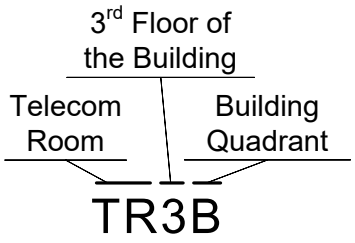
4.10.1.2 New Telecommunications Distribution Systems

The items listed below shall be shown on the Construction Documents. The Designer shall assign the identifiers to the telecommunications components based on the following *suggested* identification strategy. The circumstances of each project may require adjustments. The Designer shall discuss with GSA any recommendations for customization, and cooperatively develop an identification strategy prior to adopting any customizations.

A. Telecommunications Rooms, Equipment Rooms, and Data Centers shall be identified by their room number. If a telecommunications room does not have an assigned room number, then the room shall be identified as “TR#@”, where “#” is the floor number on which the telecommunications room resides and “@” represents the building quadrant as shown in the diagram below.

   + For example: a telecommunications room located in Room #1242 in a building would be identified as “1242”.
   + For example: an un-numbered telecommunications room on the third floor located in the Northeast quadrant would be labeled “TR3B”.

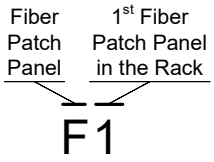




B. Racks in telecommunications rooms shall have identifiers of the form "@" where "@" is a sequentially lettered rack (A, B, C, D, etc.) from left to right as viewed from the front of the rack.

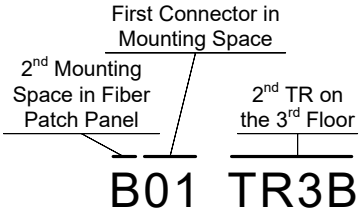
   + For example: Two general-purpose racks in a given telecommunications room would have the labels "A" and "B".

C. Fiber Optic Patch Panels shall have identifiers sequentially numbered in the form of "F#" where "F" stands for "Fiber" and "#" is the sequential fiber optic patch panel number terminated within a given telecommunications room. The numbering sequence does not restart for each rack.



   + For example: the first fiber optic patch panel would be labeled "F1". The second fiber optic patch panel would be labeled "F2".

D. Ports on Patch Panels for fiber optic cabling are typically pre-labeled by the manufacturer with sequential numbers (i.e. 1 to 12). For ports which are not pre-labeled, label each port in the form "@##" where "@" is the alphabetical letter for the mounting space and "##" is the sequential port number within the mounting space. The ports in each mounting space shall start at number "01". Note: the ports are labeled, not the strands.

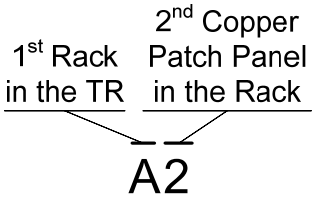


   - In addition to the pre-labeling, each port shall also be labeled with the far-end termination point of the cable terminated at that port.

     + For example: the ports on a patch panel terminating fiber optic cabling in duplex LC ports in the second mounting space in the patch panel would be labeled starting with "B01" for the first duplex port (one label per pair of

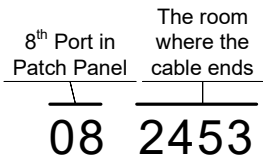
fiber strands) and continue sequentially through the remainder of the duplex ports. Also, the port labeling shall also indicate the room number where the fiber optic cable terminates.

E. Copper Patch Panels shall have identifiers sequentially numbered in the form of "@#" where "@" is the rack designation and "#" is the sequential copper patch panel number terminated within a given telecommunications rack. The numbering sequence restarts for each rack. Patch panels may also be lettered "W" to designate a rack dedicated to Wireless applications



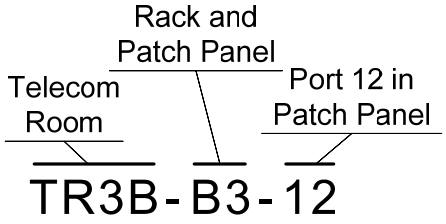
+ For example: the second copper patch panel in Rack A would be labeled "A2". The second copper patch panel in Rack B would be labeled "B2".

F. Ports on Patch Panels for copper cabling are typically pre-labeled by the manufacturer with sequential numbers (i.e. 1 to 48). For ports which are not pre-labeled, label each port in the form "##" where "##" is the sequential port number within the panel. The ports in each patch panel shall start at number "01".



- In addition to the pre-labeling, each port shall also be labeled with the far-end termination point of the cable terminated at that port.
  + For example: the ports on a patch panel terminating horizontal copper cabling serving an outlet would be labeled starting with "01" for the first port and continue sequentially through the remainder of the ports. Also, the port labeling shall also indicate the room number where the copper cable terminates.

G. Work Area Connectors (jacks in outlets) shall have identifiers in the form of "####-@#-##" designating the telecommunications room where the cable terminates on the far end. The label is constructed with "####" as the room number of the telecommunications room, "@#" as the rack and patch panel identifier and "##" as the port number on the patch panel where the horizontal cable terminates.



+ For example: if an outlet is used to terminate two cables from telecom room number "TR3B", rack 2, and patch panel 3 in that rack, on ports 12 and 13, then the connectors (jacks) would have the labels "TR3B-B3-12" and "TR3B-B3-13", respectively.

For outlets that are located above a T-bar ceiling, a duplicate set of white labels shall be applied to the ceiling grid (in addition to the faceplate labeling) so that the jack numbering can be seen without lifting the ceiling tiles. These labels are

intended to be inconspicuous to the casual viewer while allowing a technician to easily find an outlet.

H. Backbone Cables (both fiber optic and copper) shall be labeled every 6 feet throughout the length of the cables. The labels shall designate the origin, destination, and owner of the cable.

4.10.1.3 Moves, Adds, and Changes (MAC)

The only exception to the above identification scheme is for small projects relating to moves or changes to existing cabling, or the addition of new outlets terminated among other existing cables in existing TRs. In such cases (where the amount of new work is small compared to the overall system) the cable identification scheme for the new cables shall be consistent with the existing identification scheme.

For projects where the amount of change is larger, the Designer shall inquire with GSA whether it is desirable to re-label the existing cables when new cabling is being installed.

4.11 Field Testing of Structured Cabling

Please refer to Chapter 11 – *Field Testing of Structured Cabling* in the BICSI TDMM for general information regarding the field testing of telecommunications cabling. The following requirements take precedence over the BICSI TDMM guidelines for field testing at GSA facilities:

A. The Designer shall require the Contractor to test 100% of field-terminated cabling and at least 10% of all pre-terminated cables.
   - GSA reserves the right to require the Contractor to test more than 10% of all pre-terminated cables if the 10% test results are unsatisfactory.
   - Copper cables shall be Link-tested (not Channel-tested).

B. Cable tester equipment shall be manufactured by Fluke.

C. The Designer shall review the cable test results submitted by the Contractor. The test results shall be the actual native machine test results downloaded from the test equipment. In particular, the Designer shall check for the following items on the cable test reports:
   - The cable test report shall be automatically produced by the test equipment.
   - The report shall indicate that the cable passed the test. It shall also indicate the date of calibration, the software version, and the name of the technician who conducted the test. The reports shall also include graphical results of the performance curves obtained during the testing.
   - Indications that the cabling meets distance limitation requirements.
   - Indications that the wire map of the cable is correct.
   - Indications that the cable test equipment was properly configured. For copper cabling, the test equipment's configuration parameter for Nominal

Velocity of Propagation (NVP) shall match the value stated by the cabling manufacturer for the type of cable installed.

- For Fiber Optic Cabling: the cable test report shall indicate a headroom dB value that is equal to or better than the value calculated in the link-loss budget.
- Marginal test results (typically indicated with an asterisk "*") are only acceptable when the condition is "over length" and when the over-length situation was intentional during design. For example, a low-bandwidth device might be served by a cable that would otherwise be too long to support a high-bandwidth device. Over-length issues due to choice of routing or extra service loops are not acceptable.

D. The cabling performance characteristics shall meet or exceed the performance guaranteed by the manufacturer, which may exceed standard industry requirements. In other words, even though a particular cable might pass its tests, the cable might still be rejected (requiring re-termination or replacement) if it does not meet the higher standard of performance that the manufacturer may list for its products.

E. GSA may choose to spot-test cabling to back-check the Contractor's test results.

F. GSA may choose to hire a third-party cable test company to conduct an independent cabling test.

G. The final test results shall have been verified by the Designer to be acceptable before submission to GSA. Test results shall be submitted to GSA in electronic form, both in PDF form and also the original test result data files.

H. Contractors shall be required to retain a copy of the test reports for a period of at least 5 years after installation.

4.12 Outside Plant

Please refer to Chapter 12 – *Outside Plant* in the BICSI TDMM and the BICSI *Outside Plant Design Reference Manual* (OSPDRM) for information regarding the design of outside plant telecommunications infrastructure.

Most of GSA's facilities are stand-alone buildings. Telecommunications services delivered to the building are provided by commercial service providers. As a result, it is unlikely that a project will include requirements for outside plant telecommunications infrastructure.

The Designer shall inquire about the pathway requirements for telecommunications service providers, and shall design the pathway to meet the requirements of the service providers.

4.13 Audio/Visual Systems

Please refer to Chapter 13 – *Audiovisual Systems* in the BICSI TDMM for information regarding the design of telecommunications infrastructure to support private CATV distribution systems at GSA facilities.

4.13.1 Private CATV Distribution Systems

The Designer shall inquire with GSA to determine where cable television outlets are required for a given project. The Designer shall also inquire whether inside plant coaxial cabling or CAT5e cabling with skew-adjustable baluns will be required for cable television distribution inside the building.

4.13.2 Distributed Paging Systems

The Designer shall inquire with GSA to determine whether emergency response paging systems are required for a given project.

4.14 Building Automation Systems

Please refer to Chapter 14 – *Building Automation Systems* in the BICSI TDMM for information regarding the design of telecommunications infrastructure to support building automation systems at GSA facilities.

A. GSA will have a new document titled "*Building Technologies Technical Reference Guide*" to be published soon with guidelines about Building Automation Systems. The Designer shall inquire about the availability of this document during the course of design.

   - Where conflicts may arise between the *Building Technologies Technical Reference Guide* and the TDDG, seek guidance from the project manager or contracting officer.
   - For projects that primarily involve building automation systems, the *Building Technologies Technical Reference Guide* will govern.

B. ANSI/TIA/EIA-862-A applies to telecommunications infrastructure serving building automation systems (BAS). The Designer shall pay particular attention to the following BAS issues:

   - Verify that the voltage and current requirements of each BAS application are satisfied by the cabling materials to be installed.
   - Verify that a suitable horizontal connection point (HCP) is installed for each BAS application.

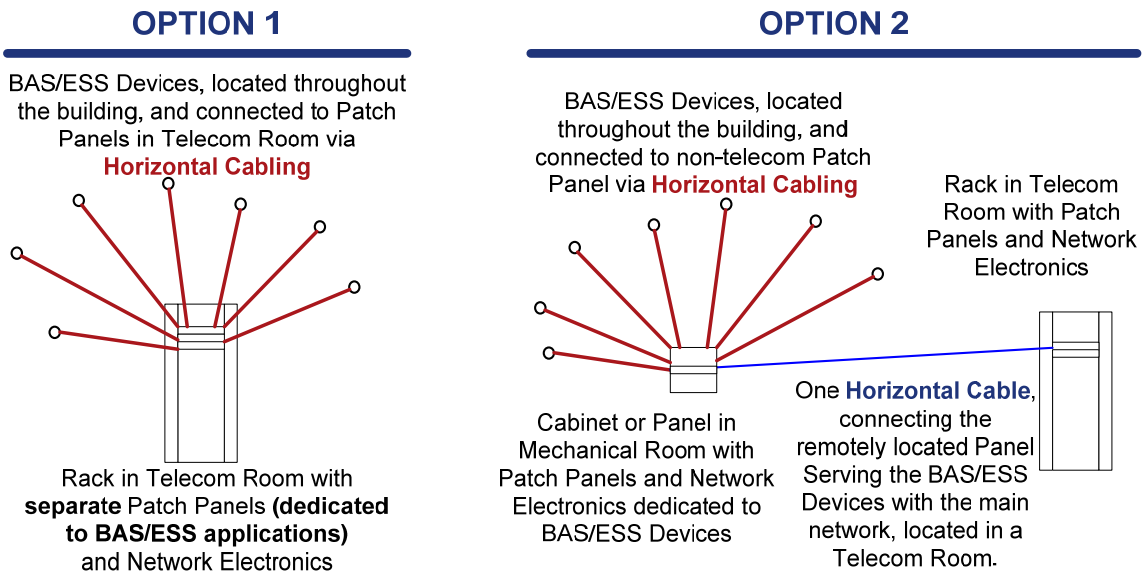
C. BAS devices are increasingly converging onto structured cabling systems. While the design of these systems is typically outside the scope of work of the telecommunications infrastructure designer, the Designer shall design the telecommunications cabling required to support these systems.

D. Typically, BAS systems require telecommunications cabling routed from the devices to a patch panel termination point in a designated mechanical room or other location managed by building maintenance personnel. In addition to the device-specific cables, other cables shall be designed from the telecommunications rooms to the BAS patch panels, to permit these systems to gain access to the data networks.

E. Horizontal connection points are only required for BAS applications. Do not use an HCP for typical voice/data/video applications.

F. The following diagram depicts two approved horizontal cabling strategies for supporting BAS devices and systems. This diagram also applies to Electronic Safety and Security (ESS) devices, as described in TDDG Section 4.17 – *Electronic Safety and Security*, below.

FIGURE 28: HORIZONTAL CABLING OPTIONS FOR BUILDING AUTOMATION SYSTEMS AND ELECTRONIC SAFETY & SECURITY DEVICES



4.15 Data Network Design

Please refer to Chapter 15 – *Data Network Design* in the BICSI TDMM for general information regarding the design of telecommunications infrastructure for serving local area networks. The following requirements take precedence over the BICSI TDMM guidelines for telecommunications infrastructure at GSA facilities:

A. All GSA facilities use the Ethernet LAN protocol. Telecommunications infrastructure for all GSA facilities shall be designed, installed, and tested to support the Institute of Electrical and Electronic Engineers (IEEE) Ethernet 802.3 standards. GSA networks use the 1000Base-X Gigabit Ethernet protocol based on the IEEE 802.3z standard. All newly installed cabling shall support this protocol. The Designer shall give careful consideration to the multimode fiber optic distance limitations and signal loss limitations (less than 2.5 dB end-to-end) necessary to support the IEEE 802.3z protocol. GSA networks are typically based on Cisco switches (Power-over Ethernet), with 1GB or 10GB backbones and 100MB or 1GB service to the work area.

B. The design of the network electronics is the responsibility of GSA IT and is outside the scope of work of the telecommunications designer.

C. The Designer shall coordinate with the GSA IT Internetworking & Security Branch to determine the requirements for supporting the network electronics in each space. The design shall provide rack space to host GSA's network equipment.

4.16 Wireless

Please refer to Chapter 16 – *Wireless* in the BICSI TDMM for information regarding the design of telecommunications infrastructure to support wireless and microwave telecommunications systems at GSA facilities.

A. GSA currently uses Cisco's Aeronet wireless access point equipment in its buildings. Model numbers may change without notice. The Designer shall inquire with GSA to determine which model numbers are currently being used. The manufacturer's requirements shall be met when designing wireless network infrastructure. This equipment operates with Power-over-Ethernet. The Designer shall accommodate POE equipment in the design, including the power and cooling requirements.

- Regional Office Buildings typically use the 3500 series.
- Field offices typically use the 1100 series.

B. GSA currently uses Oberon's 1064 and 1064-T enclosures for wireless access point equipment in its buildings. Model numbers may change without notice. The Designer shall verify that model numbers included in the design are current and appropriate for each project.

C. The Designer shall work cooperatively with GSA IT ITS staff to design telecommunications infrastructure to appropriately support wireless technologies.

Typically, GSA will identify the locations where wireless access points (WAP) are desired. On occasion, however, GSA may request services to identify appropriate WAP locations and prepare associated coverage and signal strength maps.

D. Wireless access points will be "Owner-furnished, Contractor installed" (OFCI). GSA will supply new, packaged wireless access point equipment to the Contractor, who will be required to mount the equipment and provide patch cords at the device end and network switch end to cause the equipment to power on via Power-over-Ethernet. GSA IT will then provide services to configure the wireless access points. The Designer shall indicate these requirements in the Construction Documents.

E. The Industry is trending toward improvements in speed and capacity. Currently, GSA requires at least two CAT6A cables for each WAP outlet location. However, depending on the size of the project and budget, the Designer shall inquire with GSA to determine whether only 1 cable should be provided.

4.17 Electronic Safety and Security

Please refer to Chapter 17 – *Electronic Safety and Security* in the BICSI TDMM for general information regarding the design of telecommunications infrastructure for serving electronic safety and security systems.

A. Electronic safety and security (ESS) devices are increasingly converging onto structured cabling systems. While the design of these systems is typically outside the scope of work of the telecommunications infrastructure designer, the Designer shall design the telecommunications cabling required to support these systems.

B. Occasionally ESS systems require telecommunications cabling routed from the devices to a patch panel termination point in a designated low voltage electronics room, or other location managed by building security personnel. In addition to the device-specific cables, additional cables shall be designed from the telecommunications rooms to the ESS patch panels, to permit these systems to gain access to the data networks.

C. Other times, ESS systems can be cabled directly to patch panels in the telecommunications rooms just like any other computer or telephone device.

D. TDDG Section 4.15 – *Data Network Design* (above) depicts the differences between these two solutions. The Designer shall inquire on a project-by-project basis which solution to apply to a given project. It is common that non-technical issues will affect which solution is used.

4.18 Regional Information Centers and Data Centers

Please refer to Chapter 18 – *Data Centers* in the BICSI TDMM for general information regarding the design of telecommunications infrastructure for serving data centers. Generally speaking, GSA follows the TIA-942-A, *Telecommunications Infrastructure Standard For Data Centers* standard in the design of data centers and larger equipment rooms. The requirements below take precedence over the BICSI TDMM guidelines.

The Designer shall inquire with GSA whether a main telecommunications room (sometimes called the "MDF") in a given project is intended to be designed with telecommunications room features, Data Center features, or Regional Information Center features.

4.18.1 Small Scale Equipment Rooms

The requirements for small-scale equipment rooms are the same as for telecommunications rooms. See TDDG Section 4.3 – *Telecommunications Spaces*.

4.18.2 Data Centers

For projects involving a Data Center, adhere to all data center-related guidelines from the Office of Management and Budget (OMB).

4.18.3 Regional Information Center (RIC)

Regional office buildings shall be designed with a "Regional Information Center" (RIC) to support local operations and field offices in that region.

The requirements for telecommunications rooms (TDDG 4.3) apply to RICs except as described below.

The requirements below are considered to be a minimum set of features and are provided as a starting point for the design process. The Designer shall inquire of the GSA IT ITS to understand the unique requirements of a specific location and shall design the RIC suitably.

4.18.3.1 Location and Sizing Considerations

A. RICs shall be located above ground.

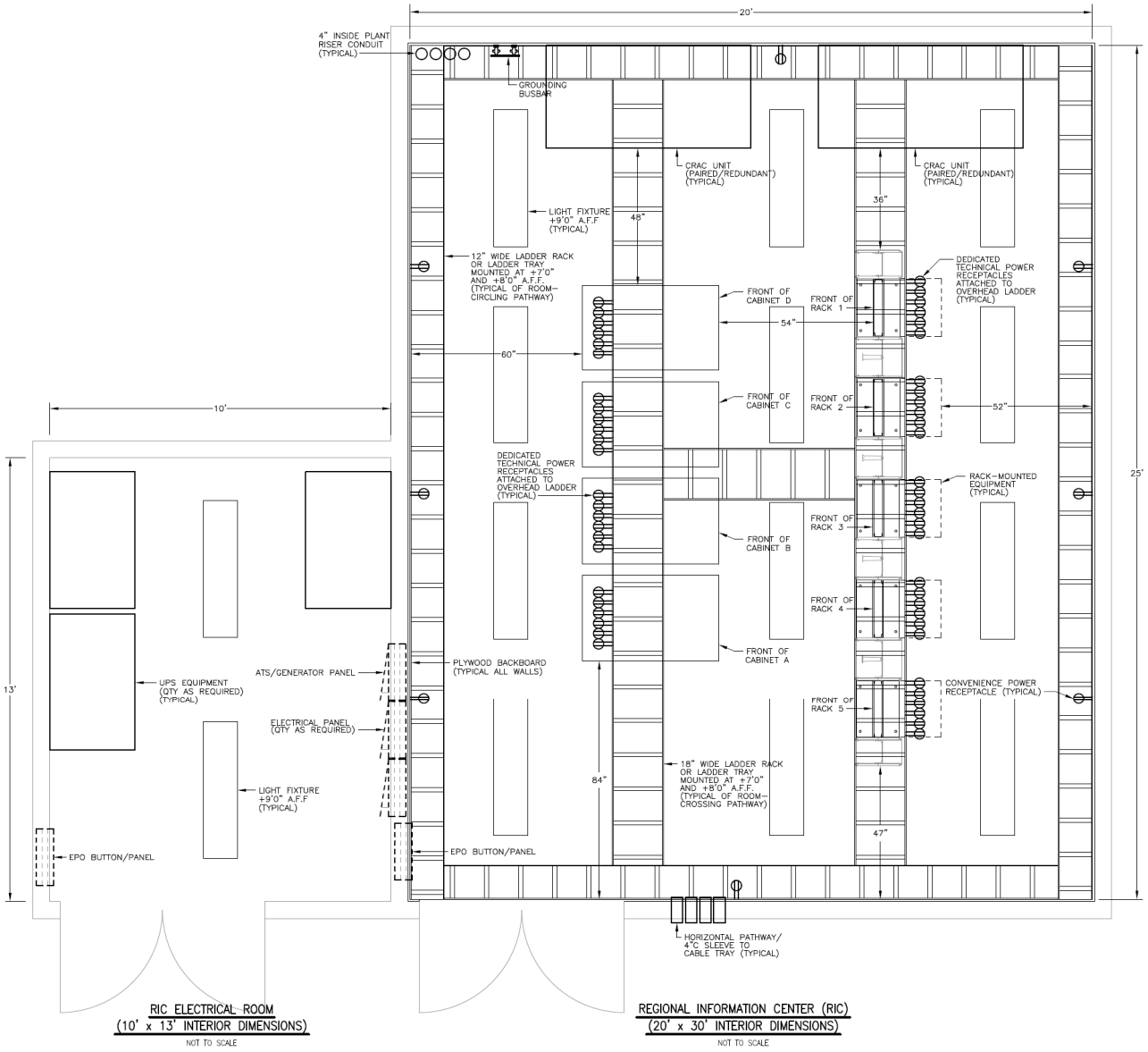
B. RICs shall be designed in place of the main telecommunications room (sometimes called the "MDF"). RICs shall perform all of the functions of the MDF, in addition to hosting the enterprise network headend equipment.

C. A starting point for RIC sizing and arrangement is as follows and as depicted in the diagram below:

- RIC spaces shall include a minimum of 4 server cabinets and 5 two-post racks, including the two-post racks required for MDF functions.
- Either Computer Room Air Conditioning (CRAC) units or in-row cooling is required for the server cabinets.

- RIC spaces shall be large enough to maneuver equipment and cabinets as well as support 25% growth. A starting point for sizing considerations shall be 20’ x 25’ (internal dimensions).
- The Designer shall consult with the GSA IT ITS on a project-by-project basis to determine any additional factors that would contribute to a change in RIC sizing requirements.

FIGURE 29: RIC SIZING AND ARRANGEMENT



D. Every project will encounter unique building circumstances and operational considerations. Some situations will require larger RIC spaces, and in other cases smaller rooms will be appropriate. The Designer shall work with GSA IT to determine the most appropriate solution for the specific needs of that location.

E. The power consumption profile of equipment to be hosted in the data center and its associated heat-load profile are the two key parameters for sizing a data center. The Designer shall work with GSA IT to identify the power consumption per cabinet footprint, which will have a direct correlation to the cooling requirements of the space. The quantity of equipment cabinets that can be powered and cooled in the space drives the sizing plan.

- During the life of the data center, advances in technology may shrink the space requirements for each server, making more physical space available for additional servers. However, if there is not sufficient power to serve another server or sufficient cooling capacity to remove the heat produced by another server, then the additional space is unusable.

F. The GSA IT ITS shall approve the final space requirements and design layout for the equipment and racks.

4.18.3.2 Architectural Considerations

A. Raised (accessible) flooring in RICs is not desirable. Static Dissipative Tile (SDT) flooring is required in RICs and associated telecommunications rooms in ROBs.

   Electrical rooms supporting RICs do not require accessible flooring.

B. The RIC shall be separated from other occupancies within the building by fire-resistant-rated construction of not less than 1 hour.

C. Do not provide gypboard (hard-lid) or T-bar ceilings in RICs. The ceiling spaces in RICs shall be exposed to structure.

4.18.3.3 Cable Pathways

A. Within the RIC, GSA prefers two layers of ladder racking or ladder tray, suspended from above at 7’ and 8’ above finished floor, independent of the cabinet hardware. Ladder racking shall circle the room and cross the room over the tops of the equipment cabinets and racks.

- Backbone cables and patch cords shall be routed via the 7’-level ladder racking.
- Horizontal cables and their service loops shall be stored in the 8’-level ladder racking.

B. Size the ladder racking or ladder tray to support the cable quantity intended for the RIC. It is likely that 12” wide and 18” wide ladder racking will be necessary.

C. The Designer shall create a solution that has the capacity to handle the cable slack in the room.

4.18.3.4 Cabinets in RIC

A. Each cabinet shall have front and rear screen doors, allowing airflow through the equipment. Cooling fans are typically not required.

B. Each cabinet will also have Owner-provided rack-mounted power management equipment (currently from WTI).

C. Server cabinets in RICs shall have the following features:

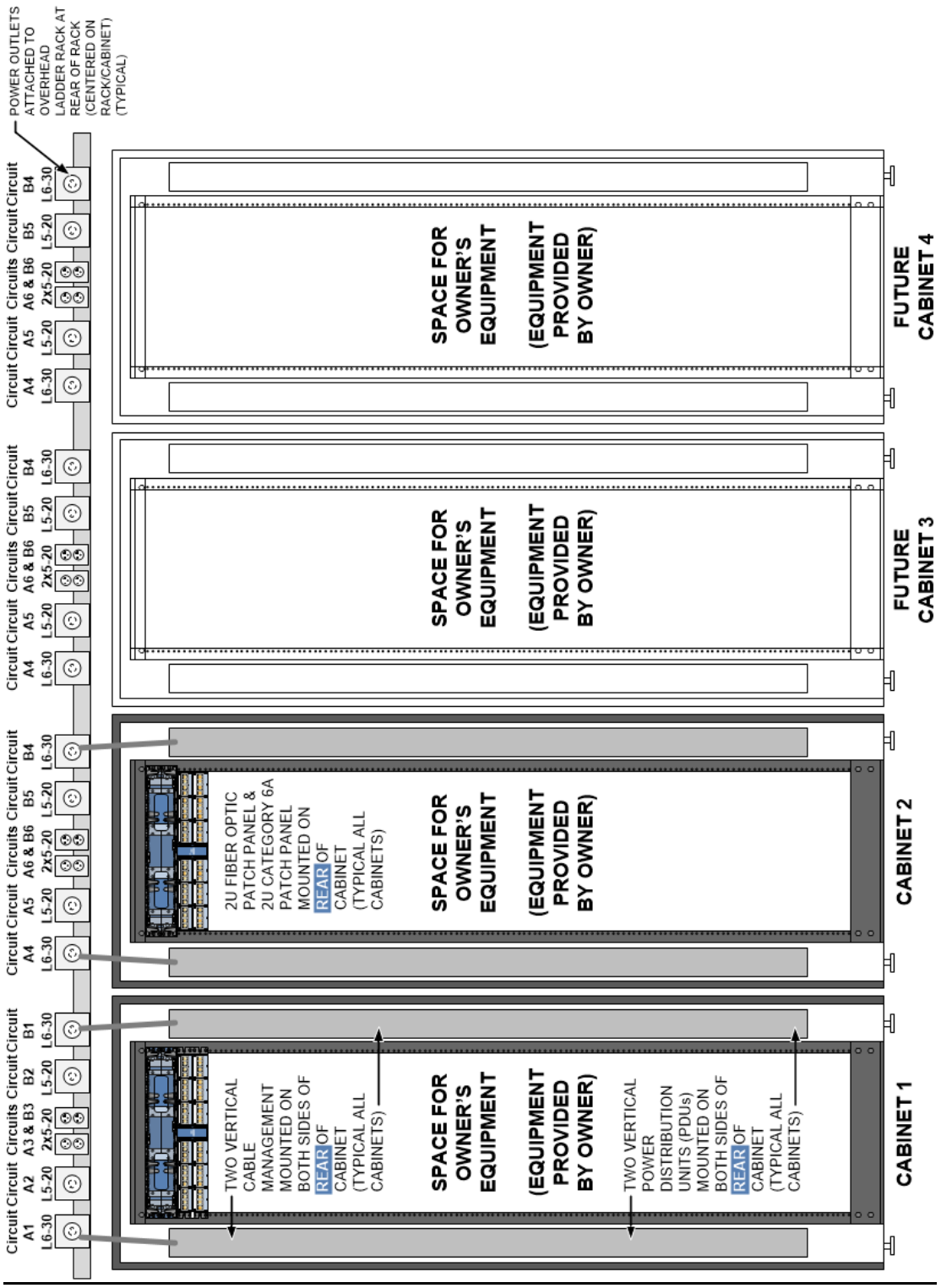
- Sized 30” wide and 48” deep (minimum). All cabinets shall be uniformly sized.
- The Designer shall inquire about whether cabinets shall be 42U high or 48U high, depending on the circumstances applicable to the facility.
- Perforated front and rear door panels.
- Tool-less removal of door and side panels.
- Preference for square punch with cage nuts – the Designer shall discuss this with GSA IT to coordinate with the Owner-provided equipment.
- Adjustable rails.
- Internal cable management with cable grooming features (either integrated or manufacturer-designed accessory), to manage patch cords in rear of cabinet and route between front and back.
- Leveling feet with glide pads and floor bolts (no casters).
- Seismic bracing may be needed where Code-specific requirements exist in geographic areas that are susceptible to earthquakes.
- Two power distribution units (PDU), left and right sides, full height, with receptacles distributed evenly along the full height of the cabinet. PDUs shall be designed for and factory-manufactured to fit the specified cabinets. PDUs shall be managed devices (Ethernet port) and shall meter the power consumption of the cabinet.
- Power cords shall be right-sized (avoid excessive length). The Designer shall work with GSA IT to determine whether the power cords will be provided by the Contractor or whether GSA will provide them along with the network equipment.
- Power cord management inside the rear of the cabinets to route the power cords to the left and right sides of the cabinets.
- White-painted cabinets are desirable (but not required) to enhance visibility. GSA may find this useful for a given project. The Designer shall inquire with GSA whether white, black, or another color should be used for cabinets and associated vertical cable management.

D. Acceptable cabinet manufacturers include APC, CPI, and other manufacturers of equal quality and feature set.

E. The Designer shall also discuss with GSA the potential for future additional cabinets, and identify spaces for the future cabinets on the plan drawings.

F. The following cabinet elevation diagram shall be used as a starting point in the design of the cabinets for a RIC:

FIGURE 30: RIC CABINET ELEVATION DIAGRAM



4.18.3.5 Racks in RIC

A. One two-post rack (7’ high, 19” wide, 3” deep) shall host equipment and terminations for incoming circuits (from utility service providers).

B. A separate two-post rack shall host equipment and terminations for outgoing circuits (to regional field offices).

C. All analog backbone cabling serving other telecommunications rooms in the building shall terminate on rack-mounted angled patch panels, as shown in the diagram below.

D. The Designer shall also discuss with GSA the potential for future additional racks, and identify spaces for the future racks on the plan drawings.

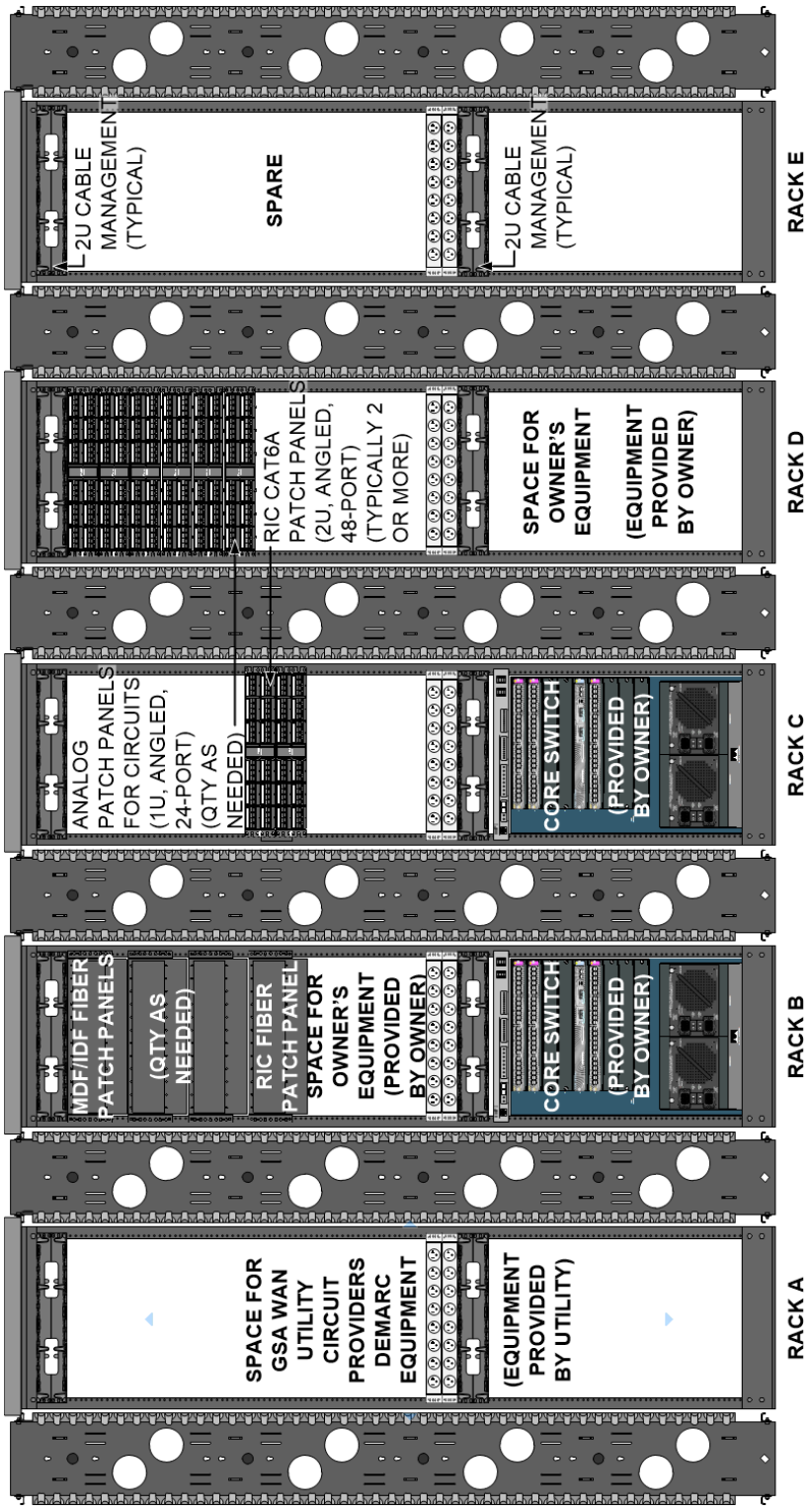
E. All racks shall be from the same manufacturer and from the same product series from that manufacturer. Racks and their associated cable management components shall be factory-engineered to connect and function together as a system.

F. Racks shall support side-to-side airflow.

G. Current RIC network design includes two Cisco 6500-class switches (Owner-provided), mounted in two separate racks. The Designer shall also inquire with GSA about any other rack-mounted equipment that requires a different air-flow pattern, and shall specify appropriate provisions for that equipment.

H. The following rack elevation diagram shall be used as a starting point in the design of the racks for a RIC:

FIGURE 31: RIC RACK ELEVATION DIAGRAM



4.18.3.6 RIC Cabling

A. Copper backbone (riser) cabling between the RIC and the other telecommunications rooms in the building shall be terminated on angled patch panels mounted in Rack D. See the RIC Cabling diagram in the figure below.

B. In addition to managing the cabling entering the RIC from outside the room (the MDF functions of this space), the following cable requirements exist to support the RIC functions of this space:

- Between Cabinet 1 and Rack B (the headend):
  + 24 Cat6A copper cables (small diameter, terminated in a rear-facing, top-of-cabinet, flat (not angled) patch panel with a shallow-style cable manager)
  + 24-strand 50-micron multimode fiber optic cables
- Between Cabinet 2 and Rack B (the headend):
  + 24 Cat6A copper cables (small diameter, terminated in a rear-facing, top-of-cabinet patch panel with a shallow-style cable manager)
  + 24-strand 50-micron multimode fiber optic cables

C. Terminate CAT6A copper cabling at the top of Rack E on angled patch panels and in cabinets on either:

- Zero-U patch panels
- Faceplates mounted in the Zero-U side cable management

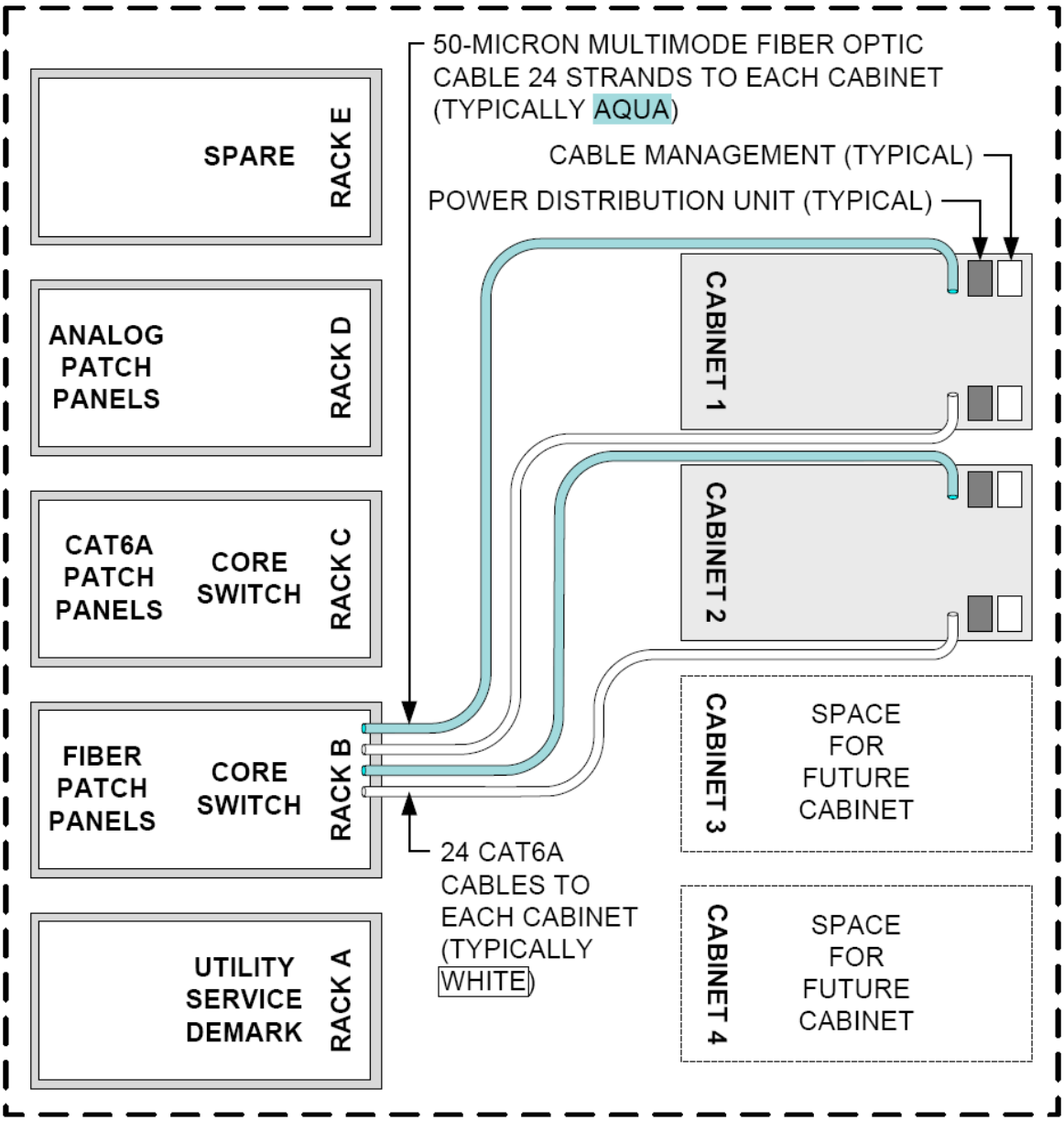
D. Provide two small-diameter CAT6A copper patch cords for each CAT6A cable serving RIC cabinets.

E. Some connections for devices located inside the RIC can be accomplished using a patch cord, in lieu of a horizontal cable terminated in an outlet.

- Patch cords may be used to connect devices that are mounted within a rack or cabinet, or attached to the ladder rack or cable tray inside the RIC.
- Wall-mounted or floor-mounted devices that are not directly attached to patch cord-friendly raceway require a horizontal cable, properly terminated in patch panels and outlet boxes with a faceplate and jack.

F. The following schematic diagram depicts the minimum required cabling between racks and cabinets in each RIC. The Designer shall adjust this design to serve the unique requirements of each RIC, under the guidance of the GSA IT ITS.

FIGURE 32: RIC CABLING DIAGRAM



4.18.3.7 Environmental Provisioning

A. Environmental management and monitoring systems shall be designed for RICs.

B. The PBS P100-2016, Section 6.5.10.1 states that air conditioning systems for technology/server and UPS rooms shall be supported by emergency power systems. Typically, an Optional Standby Generator (NEC 702.2) performs this function.

C. Consideration shall be given to both cooled cabinets and whole-room cooled air solutions, in particular:

- Computer Room Air Conditioning (CRAC) units may the best fit for a RIC space, because the substantial amount of equipment mounted in two-post racks will require ambient cooling. CRAC units shall be designed in redundant pairs, such that either unit could carry the room's whole load should one fail.
- CRAC units shall have variable-speed fans.
- However, the equipment housed in cabinets may be dense enough that it produces a significant amount of concentrated heat, and could therefore benefit from in-row cooling.
- Another consideration that could affect the choice of cooling system is whether the space will have an accessible floor to route piping and supply air.
- The Designer shall work with the Mechanical Engineer and the GSA IT ITS to select the best solution for each application.

D. Cooling capacity shall be designed to appropriately (but not excessively) support the full load capacity of the power distribution system. The Designer shall discuss with GSA whether the full cooling capacity shall be installed on Day 1, or whether provisions shall be made to install a portion of the system first, followed by additions to the system when future loads are added. The Designer shall work with the mechanical designer to calculate the expected heat load for the equipment in a RIC. The mechanical designer shall design CRAC equipment that is appropriate for the heat load, temperature, and humidity circumstances of each project. Below is a list of parameters that the mechanical designer can use as a starting point for the design of appropriately sized CRAC units for a RIC:

- The Designer shall consider the following starting points for CRAC unit capacity design:
  + 1kw per rack
  + 5kw per cabinet
  + two 7 ton CRAC units (n+1=2)
- The nominal environmental target conditions in the RIC are:
  + 72 degrees ambient temperature
  + 45%-55% relative humidity

E. CRAC units shall be procured with the network management option, providing a network jack to connect to an Ethernet switch.

4.18.3.8 Fire Detection and Suppression

All RICs shall be protected by a wet-pipe sprinkler system that is designed and installed in accordance with the requirements in PBS P100-2016, Section 7.11.2. RICs shall also meet the additional requirements in PBS P100-2016 for Information Technology Equipment Rooms.

4.18.3.9 Power Requirements

4.18.3.9.1 Technical Power Panels

A. See PBS P100-2016, Sections 6.5.5.3 and 6.5.7.3 for additional requirements.

B. A separate supply circuit serving the room shall be provided and terminated in its own electrical panel located in the RIC. This power panel shall be designated as "Regional Information Center Technical Power." The Regional Information Center technical power panel shall be used exclusively for supplying power to electronics equipment in the equipment room. Sizing of electrical power supply is dependent upon the equipment types and equipment load, and shall be calculated on a case-by-case basis, including sufficient spare capacity for future growth.

C. The technical power circuits in each RIC shall originate from a technical power panel with a Transient Voltage Surge Suppressor (TVSS), dedicated to serving the RIC. The technical power panel shall not be used to supply power to sources of electromagnetic interference such as large electric motors, arc welding, or industrial equipment.

D. As a starting point for design considerations, the Designer shall include provisions for 10 kW per cabinet and 5 kW per rack, and adjust those values after consultation with GSA IT ITS.

E. GSA typically uses network electronics that provide Power-over-Ethernet (POE). The Designer shall request power consumption data for the equipment that GSA will use, and will size the power distribution infrastructure sufficient to support this equipment.

F. GSA uses (Owner-provided) rack-mounted equipment (currently from WTI, www.wti.com) to allow devices to be rebooted and controlled remotely. The Designer shall inquire with GSA where this equipment will be used, and shall allocate rack space to host the WTI equipment.

4.18.3.9.2 Backup Power

A. Power for critical network components such as servers, routers, switches, and telephone systems shall always be provided through at least one uninterruptible power supply (UPS).

B. GSA IT requires that every RIC facility be provided with a solution to supply electrical power for two hours during a utility power outage. The Designer, electrical engineer, and mechanical engineer shall review the options and present recommendations to GSA regarding the backup power solution that will be the best value for GSA.

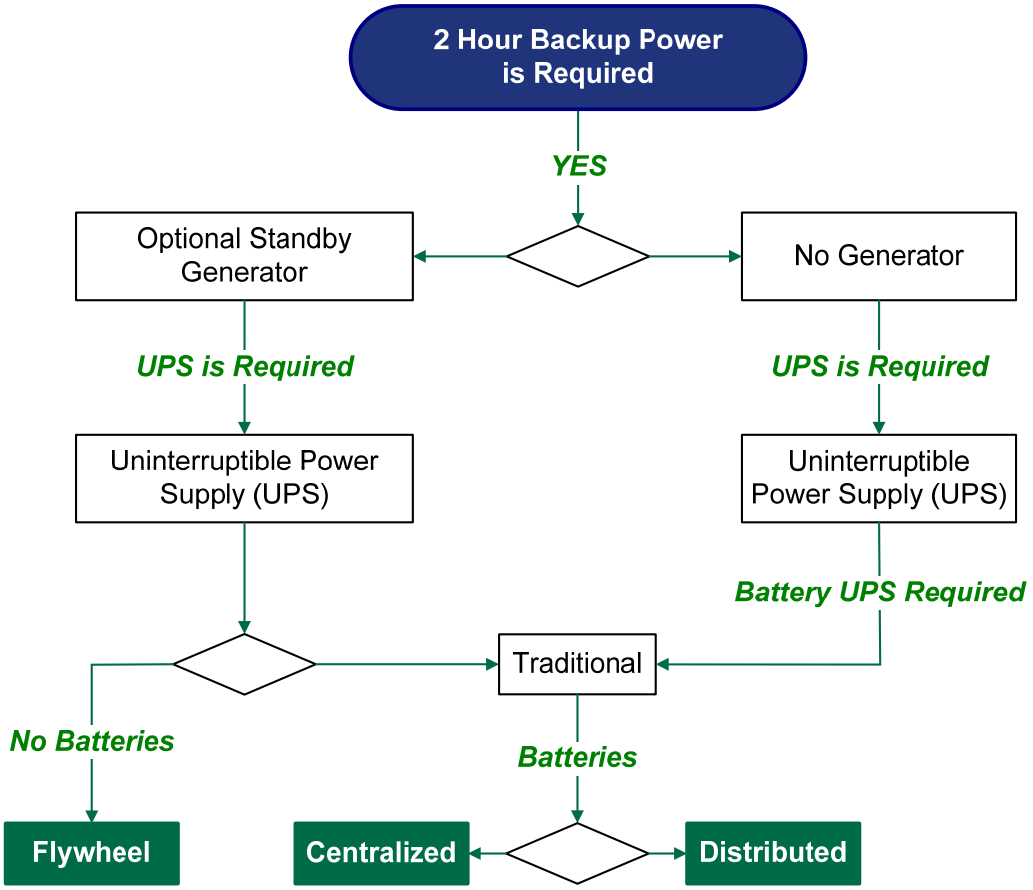
C. The Designer shall refer to the PBS P100-2016, especially Section 6, for guidance on backup power generators.

D. RICs host enterprise-critical systems and support field offices in a Region. RICs therefore will likely need "Optional Standby Generators" and reliable

uninterruptible power supplies (UPS) to provide electrical power when utility power outages occur.

E. The following diagram depicts a possible decision tree that may be of guidance in the process of selecting an appropriate solution for each project:

FIGURE 33: BACKUP POWER DECISION TREE



- Where a generator is provided, the UPS system should be capable of keeping the equipment operating until the generator is carrying the load.
- When a generator is provided, GSA IT prefers to use flywheel-based UPS equipment rather than conventional battery UPS equipment. The Designer shall evaluate the relative merits of these two system types for the specific application, considering the life-cycle economics, periodic battery replacement, equipment maintenance, and additional cooling requirements.
- GSA prefers that the flywheel and UPS equipment be an integrated package from a single manufacturer.

- Flywheel equipment shall be manufactured in the US. As of the date of this writing, the following US manufacturers are known:
  - Vycon (www.vyconenergy.com)
  - ActivePower (www.activepower.com)

F. UPS equipment shall be procured with the network management option, providing a network jack to connect to an Ethernet switch.

G. Please note that the term “Optional” is an NEC Code-defined term (NEC 702.2) contrasting it with “Legally Required” (NEC 701.2) and “Emergency” (NEC 700.1) generators that the NEC also defines. Consistent with the PBS P100-2016, GSA IT supports and encourages the use of appropriately classified generators wherever it makes sense to do so. The following table contains excerpts from the three NEC sections referenced above, and explains the three generator classes, providing examples of the types of facilities in each class:

TABLE 34: NEC-DEFINED GENERATOR CLASSES

Emergency Systems (NEC 700.1)	Legally Required Standby Systems (NEC 701.2)	Optional Standby Systems (NEC 702.2)
Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction. These systems are intended to automatically supply illumination, power, or both, to designated areas and equipment in the event of failure of the normal supply or in the event of accident to elements of a system intended to supply, distribute, and control power and illumination essential for safety to human life.	Those systems required and so classed as **legally required standby by municipal, state, federal, or other codes or by any governmental agency having jurisdiction**. These systems are intended to automatically supply power to selected loads (other than those classed as emergency systems) in the event of failure of the normal source.	Those systems intended to supply power to **public or private facilities or property where life safety does not depend** on the performance of the system. These systems are intended to supply on-site generated power to selected loads either automatically or manually.
Informational Note: Emergency systems are generally installed in places of assembly where artificial illumination is required for safe exiting and for panic control in buildings subject to occupancy by large numbers of persons, such as hotels, theaters, sports arenas, health care facilities, and similar institutions. Emergency systems may also provide power for such functions as ventilation where **essential to maintain life, fire detection and alarm systems, elevators, fire pumps, public safety communications systems**, industrial processes where current interruption **would produce serious life safety or health hazards**, and similar functions.	**Informational Note:** Legally required standby systems are typically installed to serve loads, such as heating and refrigeration systems, **communications systems**, ventilation and smoke removal systems, sewage disposal, lighting systems, and industrial processes, **that, when stopped during any interruption of the normal electrical supply, could create hazards or hamper rescue or fire-fighting operations**.	**Informational Note:** Optional standby systems are typically installed to provide an alternate source of electric power for such facilities as industrial and **commercial buildings**, farms, and residences and to serve loads such as heating and refrigeration systems, **data processing and communications systems**, and industrial processes that, when stopped during any power outage, could cause discomfort, **serious interruption of the process**, damage to the product or process, or the like.

H. If an Optional Standby Generator is available to the facility, the RIC technical power panel shall be linked to the generator power supply.

- Generators shall be designed with fuel tanks sized large enough to run the generator continuously for 48 or 72 hours, as described in PBS P100-2016, Section 5.3.6.9. Fuel tanks shall be sited to allow fuel delivery trucks to conveniently fill the tank.
- GSA prefers generators designed to run on diesel fuel. Natural gas shall not be used as a fuel for generators.

I. GSA will consider the use of centralized UPS equipment as applications warrant, such as for RICs. However, if GSA wishes to use a centralized UPS, the following requirements shall be met:

- Some centralized UPS equipment may vent noxious battery gases. The UPS may therefore need to be housed in a room that is equipped to properly vent the gases. Rooms housing centralized UPS systems shall have the same environmental provisioning features as the RIC.
- Some battery manufacturers claim that valve-regulated lead-acid batteries do not emit gases and therefore might not require mechanical systems for venting battery gases. The Designer shall evaluate such claims for applicability on each project.
- Centralized UPS equipment shall be provided with a network interface card so that the UPS can communicate via the network with servers and other equipment to orchestrate a coordinated safe-shutdown of the equipment in the event of an extended power outage. The telecommunications cabling design shall require a telecommunications outlet located in the centralized UPS room near each UPS to support the UPS's network connection.

J. Where a generator is not provided, the UPS's battery bank shall be sized to provide a minimum of two hours of run time for the supported low voltage systems hardware. The Designer shall request direction from the GSA IT ITS regarding project specific needs for increased run time.

K. Upon installation, a qualified electrician shall test new centralized UPS units for correct output voltage prior to connecting electronic equipment.

L. A separate electrical room will be required to host the RIC's electrical panels, generator control panels and UPS equipment. If flywheel UPS equipment is provided for an application, this equipment shall also be located in the electrical room.

- Ideally, the RIC's electrical room shall be located adjacent to the RIC to minimize the effects of (and cost to mitigate) voltage drop.
- RIC electrical rooms shall be sized to allow for maintenance of equipment and battery replacement, including delivery of crated equipment.

M. The following table summarizes the set of appropriate backup power options for the types of telecommunications rooms and equipment rooms under each scenario:

	RIC in ROB	TRs in ROBs with RIC	TRs in Field Offices
Generator	Yes, if operation requires continuous operation.	Desirable if the RIC has a generator with capacity to support the TRs. Otherwise, no.	Neutral position.
Flywheel UPS with Generator	Preferred if economic analysis shows this to be a best value solution.	Desirable if the RIC has a flywheel with capacity to support the TRs. Otherwise, no.	Unlikely circumstance.
Battery UPS with Generator	Desirable.	Desirable if operations must continue during a power outage.	Unlikely circumstance.
Centralized Battery UPS	Usually preferable over Distributed UPS.	Usually preferable over Distributed UPS.	Unlikely circumstance.
Distributed Battery UPS	Acceptable.	Acceptable. Local decision, but budget for battery replacement.	Acceptable. Local decision, but budget for battery replacement.
Surge Protection	Achieved through the use of a transient voltage surge suppressor (TVSS).	Achieved through the use of a TVSS.	Achieved through the use of a Power Strip with surge suppression. Acceptable if uptime is ***not*** required during a power outage event.

4.18.3.9.3 Emergency Power Off (EPO) Button

A. Where required by Code (NEC 645.A), an Emergency Power Off (EPO) push-button shall be provided near the exit of both the Data Center room and the electrical room serving the RIC. The button shall be located per Code requirements, preferably near the door at eye level but in a location that will not be subject to inadvertent contact. The button shall be provided with a shield to prevent accidental actuation from inadvertent contact.

- Note: the 2011 edition of the NEC has some conditions where an EPO is not required. The Designer shall evaluate these conditions and advise GSA whether this exception would apply to the project.

B. When the EPO button is pressed, the power to the room shall be shut off immediately, per Code requirements. UPS equipment shall also shut off power to equipment when the EPO button is pressed.

C. Provide a permanent, wall-mounted plaque near the EPO with instructions for restarting the power following an EPO event. It is recommended that the plaque be fabricated from engraved plastic or a similar indelible material. The text on each plaque shall be specifically written for the facility. The following is an approximate example to be modified by the Electrical Engineer to reflect actual conditions at the facility:

- Before resetting any EPO pushbutton, verify that:
  + The condition for which EPO activation occurred has been corrected.
  + Fire suppression systems have been reset to clear alarms.
- Reset the activated EPO Station.
- Verify that all loads are fully energized and reset. Shunt any tripped breakers.
- If AHU unit is not working, consult manufacturer's startup procedures.

D. The Electrical Engineer shall prepare written guidelines describing examples of events that would warrant pressing the EPO button. The guidelines are not expected to be a comprehensive list.

4.18.3.9.4 Technical Power Outlets

A. Generally, the power outlet requirements that are applicable to telecommunications rooms are also applicable to RICs. See TDDG Section 4.3.7 – *Power Requirements* (above).

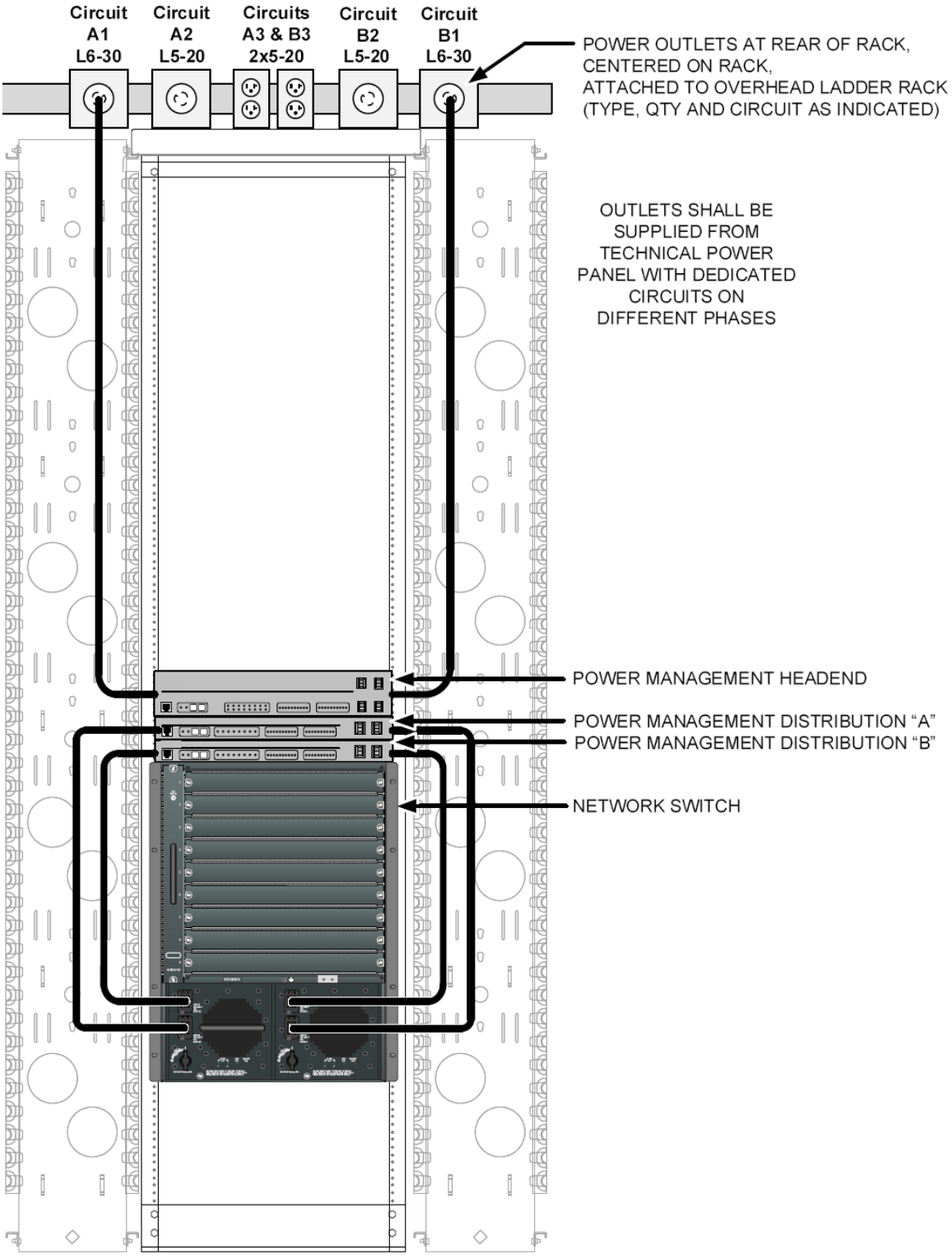
B. The Designer shall obtain connection/load requirements from GSA for each piece of equipment, and tabulate the information for review and confirmation by GSA. This equipment may include network electronics, UPS equipment, computers/servers, phone system equipment, voice mail systems, video equipment, and service provider equipment.

C. Some telephone PBX equipment, UPS equipment, and network switch equipment require specialized plugs or electrical service. The Designer shall specifically investigate the potential need for voltage or current requirements other than the typical 120VAC/20 Ampere power outlet, and shall coordinate with the design team to design the electrical power infrastructure sufficient to serve the needs of the equipment.

D. Technical power outlets shall be mounted at the top of each rack and cabinet in the RIC, attached to the overhead ladder rack (see the diagram below). In addition to a label indicating the panel and circuit number, the outlets shall also be labeled "A" or "B" corresponding to the dual power supplies for network switches and servers.

- For applications where an Optional Standby Generator (NEC 702.2) is available for backup power to the RIC, one outlet of each pair shall be supported by the generator, as depicted in the diagram below.

FIGURE 35: RIC POWER DISTRIBUTION ARCHITECTURE



4.18.3.9.5 Power Cords for Network Switches and Servers

A. For network switches and servers, do not use the 6' long power cords that are typically supplied with this equipment because the excess slack obstructs airflow in the cabinet and causes congestion, making technical support activities difficult. Instead, provide custom-length power cords that are sufficient to reach the horizontal power strip or PDU without excessive slack.

B. Power cords shall be labeled "A" or "B" corresponding to the dual power supplies for network switches and servers, and matching the power outlets that supply the PDU or power strip.

4.18.3.9.6 Convenience Power Outlets

Convenience power outlets shall be provided as described (above) in TDDG Section 4.3.7 – *Power Requirements* (above).

4.18.3.10 Grounding, Bonding, and Electrical Protection

All equipment racks, metallic conduits, and exposed non-current carrying metal parts of telecommunications and information technology equipment in the RIC shall be bonded to the TGB. Please refer to Chapter 9 – *Bonding and Grounding (Earthing)* in the BICSI TDMM and TDDG Section 4.8 – *Bonding and Grounding (Earthing)* for more information regarding the design of grounding, bonding, and electrical protection systems.

- The RIC requires a non-isolated ground wire routed inside a metallic conduit directly from the main electrical service-grounding electrode for PBX equipment. This ground wire is in addition to and separate from the telecommunications grounding system.
- Grounding and bonding conductors shall be sized according to the requirements in ANSI/TIA/EIA J-STD-607-B.
- See PBS P100-2016, Section 6.5 for additional requirements.

4.18.3.11 Lighting

Light fixtures shall be mounted at approximately 8 or 9 feet above finished floor. Fixtures shall not be located directly above racks or ladder racking, but rather to the side of them. The intent is that overhead light fixtures illuminate the front and rear of racks and cabinets. See the RIC Floor Plan figure above depicting recommended light fixture locations.

4.19 Health Care

Please refer to Chapter 19 – *Health Care* in the BICSI TDMM for general information regarding the design of telecommunications infrastructure for serving health care facilities.

GSA owns very few health care-related facilities. The likelihood of encountering a project of this type is low.

4.20 Residential Cabling

Please refer to Chapter 20 – *Residential Cabling* in the BICSI TDMM for information regarding the design of telecommunications infrastructure to support residential facilities within GSA facilities.

GSA owns very few residential-type facilities. The likelihood of encountering a project of this type is low.

Generally speaking, GSA-owned residential facilities shall be provided with the same telecommunications infrastructure materials and methods as are used for all other GSA facilities, except where specifically noted in this document.

The Designer shall inquire about whether a "residential cabling" solution is required for a particular project.

4.21 Business Development and Project Management

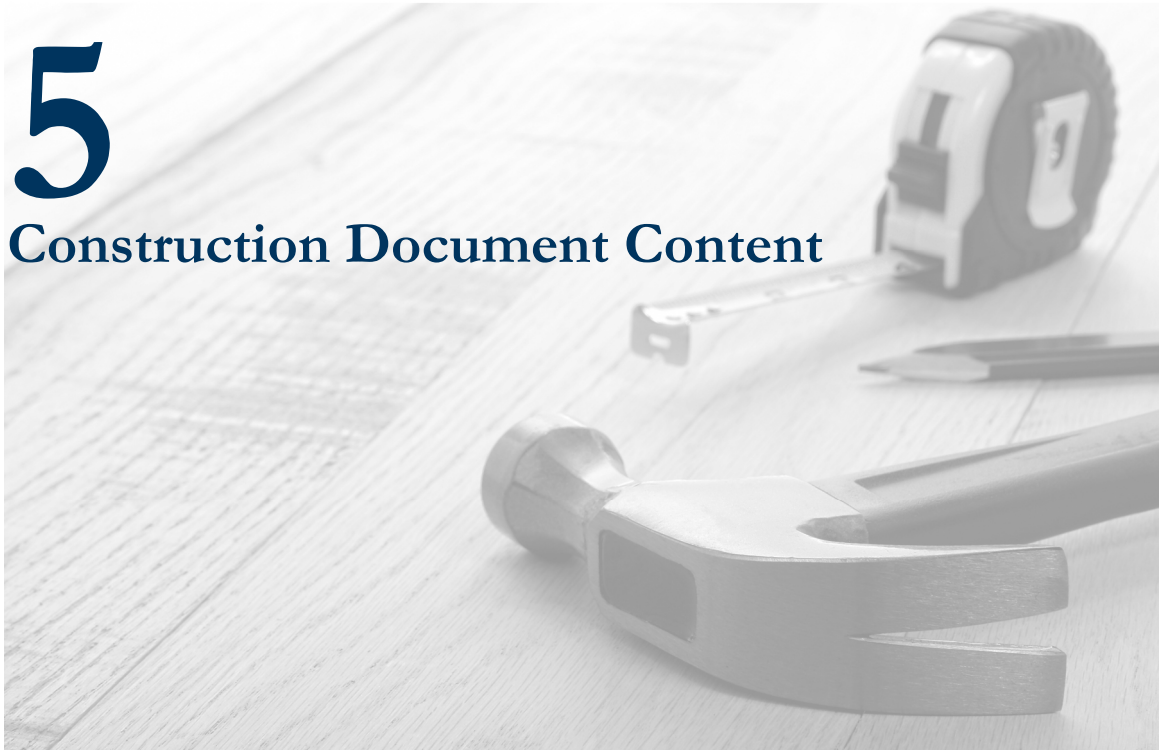
Please refer to Chapter 21 – *Design, Construction and Project Management* in the BICSI TDMM for general information regarding design, construction and project management of telecommunications infrastructure.

Please refer to TDDG Section 3 – *Project Procedures* for GSA-specific telecommunications project procedure requirements.

4.22 Codes, Standards, Regulations, and Organizations

Please refer to *Appendix A: Codes, Standards, Regulations and Organizations* in the BICSI TDMM for general information regarding the codes, standards, regulations, and organizations that apply to telecommunications infrastructure.

5 Construction Document Content



A. This section of the TDDG describes the content requirements that the Designer shall include when creating the Construction Documents. This content is in addition to the content found in some generally accepted document sets.

B. The documents produced by the Designer and the services provided by the Designer shall comply with the requirements in the *Facilities Standards for the Public Buildings Service* document (PBS P100-2016). In addition to these requirements, the Designer shall also meet the requirements in the TDDG, including the Construction Document content requirements in this section.

C. Construction Documents shall communicate a fully detailed and coordinated design (rather than making adjustments in the field during construction) and are expected to result in reduced construction costs and fewer change orders. The level of detail required to meet this objective may be substantially greater than some telecommunications designers may be accustomed to providing.

D. The sections below describe the Construction Document content to be included by the Designer.

5.1 Plans and Diagrams

5.1.1 General

A. GSA has adopted the National CAD Standards. Therefore, all drawings shall be numbered according to the National CAD Standards numbering scheme, and all symbols shall be National CAD Standards-compliant.

B. The drawing set shall include the following:

- Cover Sheet
- Sheet List
- Site Map
- Symbol Schedule – See *National CAD Standards* and BICSI TDMM *Glossary*
- List of Abbreviations
- Plan Sheets – Telecommunications
- Plan Sheets – Grounding/Bonding (when required)
- Elevation Diagrams – (telecom room walls, telecom/equipment racks, and cabinets)
- Schematic Diagrams – (Riser/Backbone Cabling, Grounding/Bonding)
- Demolition (Plans, Elevations, Schematics)

C. Drawings shall be prepared using professional design software such as AutoCAD, Microstation, or other similar caliber CAD software. Drawings that are hand-drawn sketches, scanned images, or produced using bitmap graphics editors shall not be accepted.

D. All plan sheets shall be scaled, shall indicate the scale, and shall show a north arrow. All plan sheets shall show a key plan when the building floor or site is too big to fit on a single sheet.

E. Telecommunications infrastructure identifiers shall be shown on the drawings and diagrams.

5.1.2 Inside Plant Telecommunications Plan Drawings

A. Scaled plan drawings shall be provided for each building showing the horizontal and intra-building backbone telecommunications infrastructure. These drawings shall show the following:

- Routing of new pathway to be constructed during the project.
  + The content of the drawings shall be coordinated with other disciplines and shall be representative of the complete pathway route that the Contractor shall use, rather than a schematic depiction.
  + It is expected that the Designer will expend considerable coordination effort during the design process. Non-coordinated pathway/raceway is not acceptable to GSA.
- Approximate locations of junction boxes and conduit bends.
- The cable quantities and the raceway at any given point in the system.

B. Where new cabling will be pulled into existing conduits, the Construction Documents shall show the routes of each *existing* conduit. Where it is not possible to determine the routing of existing conduits, the Designer shall inform the GSA IT ITS and seek direction on whether to use the existing conduits or design new conduits for use on the project. The Designer is required to identify such conditions during field investigation activities.

5.1.3 Demolition

A. Any existing OSP and ISP cabling intended to be no longer in use following the installation of new cabling shall be removed (demolished) as a part of the project.

B. Existing cabling to be demolished shall be shown on the plans and schematic diagrams. Separate demolition plan sheets and schematic diagrams shall be provided for projects with extensive cable demolition.

C. The Designer shall include requirements in the design that are clear and precise such that the Contractor will meet Code requirements and achieve GSA's objectives. The instructions shall include, but not be limited to the following:

- Notations to indicate items to be salvaged to the Owner.
- Hatched over-marking on items to be demolished.
- Requirements to properly and legally dispose of demolished materials, without additional cost to the Owner.
- Requirements that the Contractor properly tag existing cabling that is intended to remain for future use, avoiding the potential determination by Code officials that an untagged cable has been abandoned and would therefore be subject to removal.

5.1.4 Telecommunications Room Plan Details

A. Construction documents for GSA projects shall show scaled plan drawing details for the telecommunications spaces. The details shall show the footprint and location of each of the major components in the room, including at least the following:

- Backboards
- Ladder Racking
- Work Area
- UPS Equipment
- Backbone Cable Routing
- Entrance Conduits
- Space for Future Racks
- Termination Blocks
- Grounding Busbar
- Space Reserved for Utility Demarc
- Racks and Vertical Cable Mgmt
- Space for other low voltage systems
- Entrance Protection Equipment
- PBX and Voice Mail Equipment

B. For modifications to existing telecommunications rooms, it may be necessary to provide a demolition plan.

C. Sample telecommunications room plan drawings are included in Appendix 6.2 of the TDDG.

5.1.5 Elevation Diagrams

A. The Designer shall provide scaled wall elevation details for each TR and ER/Data Center affected by the project. The Designer shall consider (on a project-by-project basis) whether the plan drawings are better suited for depicting the elevation diagrams, in lieu of the Project Manual.

B. For remodel projects, the Designer shall produce digital photographs of each wall to depict the existing conditions where future TRs and ERs will be located. These photos shall be provided with the wall elevation details in the Construction Documents.

C. The wall elevation details shall show the components that are mounted on the walls in the room including at least the following:

- Backboards
- Ladder Racking
- Cable Slack Loops
- Grounding Busbar
- Existing Devices
- Work Area
- UPS
- Entrance Pit
- Backbone Cable Routing
- Cable Management
- Termination Blocks
- Power Receptacles
- Entrance Conduits
- Space for Future Racks
- PBX and Voice Mail
- Wall-Mounted Electronic Equipment
- Wall-Mounted Swing Racks and Contents
- Racks and Vertical Cable Mgmt
- Entrance Protection Equipment
- Other low voltage systems
- Space for Future Equipment
- Space Reserved for Utility Demarc

D. Elevation details for each of the telecommunications racks in each TR and ER/Data Center shall also be provided. Rack elevation details shall show the racks and any components that are mounted on or near the racks. The details shall depict the telecommunications materials that are listed in the specification, including at least the following:

- Patch Panels
- UPS Equipment
- Existing Devices
- Shelves/Drawers
- Termination Blocks
- Power Receptacles
- Space for Future Equipment
- Electronic Equipment
- Cable Management

E. Where a project involves additions to existing racks, the elevation details shall show the existing equipment in the racks and indicate which items are existing, in addition to indicating which items are “new, to be provided under the Contract.”

F. Examples of rack and wall elevation details are included in Appendix 6.3 and Appendix 6.4 of the TDDG.

5.1.6 Intra-building Backbone Schematic Diagrams

A. Where there are multiple TRs in a given building, a schematic diagram of the intra-building backbone riser is required. At a minimum, the diagram shall depict the following information:

- Copper backbone cable (CAT6A, multipair, etc.)
- Copper termination hardware
- Fiber optic backbone cable for data
- Fiber termination hardware
- Backbone cables that are “existing-to-remain”
- Backbone cables that are “existing-to-be-demolished”
- Backbone connections to the entrance facility and service providers

B. On projects where existing intra-building backbone cabling is to be removed, it may be useful to provide a separate schematic diagram depicting cabling to be demolished.

5.2 Project Manual

A. The *Facilities Standards for the Public Buildings Service* document (PBS P100-2016) lists requirements for the Project Manual and additional requirements for the Designer.

B. The Project Manual shall contain a summary of the telecommunications work on the project, a description of the demolition requirements (if applicable), and a discussion of the utility coordination requirements.

C. In addition to these requirements, the Project Manual shall contain the following items as described below:

- Elevation Diagrams
- Fiber Link-Loss Budget Analyses
- Cutover Plans

5.2.1 Specifications

A. The Designer shall create a set of specifications that are appropriate for a given project.

B. Specifications shall be created in CSI 2014 format, and shall include some or all of the following sections:

- 270500 – Common Work Results for Communications
- 270526 – Grounding and Bonding for Communications Systems
- 270528.29 – Hangers and Supports for Communications Systems
- 270528.33 – Conduits and Backboxes for Communications Systems
- 270528.36 – Cable Trays for Communications Systems
- 271100 – Communications Equipment Room Fittings

- 271300 – Communications Backbone Cabling
- 271500 – Communications Horizontal Cabling
- 271600 – Communications Connecting Cords, Devices, and Adapters
- 273200 – Voice Communications Telephone Sets

C. Other specification sections may also need to be created to meet the needs of a given project.

5.2.2 Cutover Plan

The Designer shall provide a detailed cutover plan that is coordinated with other disciplines on the project as well as with GSA data and telephone equipment cutover requirements. Verbiage describing the sequence of work tasks to accomplish the cutover shall be provided in the Cutover Plan. Limitations on the permissible downtime allowed and temporary service arrangements shall be discussed in the Cutover Plan.

5.2.3 Fiber Link-loss Budget Analysis

A. The Designer shall inquire with GSA on a project-by-project basis whether a link-loss budget analysis is required. If so, the Designer shall include in the Construction Documents a link-loss budget analysis for each fiber optic cable in the project.

B. The link-loss budget analysis shall be formatted as shown in Appendix 6.5 of the TDDG. Upon request, GSA will provide a spreadsheet to be used as a template.

5.3 Record Drawings and Documentation

A. The Designer shall prepare Record Drawings based on Contractor-produced as-built drawings. See TDDG Section 3.4.5.1 – *Construction Observation Checklist* for requirements for preparing accurate Record Drawings. The Record Drawings shall incorporate the same content that the TDDG requires for Construction Documents, including the identifiers for the telecommunications infrastructure components as constructed.

B. The Designer shall provide two sets of CDROMs containing the following record drawing and submittal items at the conclusion of the project. The CDROMs shall have machine-printed labeling that identifies the project name, number, location, date, contact information for the design firms, and contact information for the Contractors. One set shall be delivered to GSA PBS and the other set to GSA IT.

- Record drawings in two electronic formats: the drawings shall be provided both as native AutoCAD 2015 files and also as printed or scanned full-sized PDF documents.
- Digital photographs: photos taken by the Designer and Contractor during the design (field investigation of existing conditions) and construction of the project.

C. In addition to the above record drawing submittals, the following drawings shall be submitted:

- Floor plans showing telecommunications outlets and the port/jack identifiers for each outlet.
- Separate floor plans showing the pathways serving each telecommunications outlet (without outlet identifiers).
- Backbone cable riser diagram.
- All floor plan drawings shall include a key plan with a shaded portion indicating the region of the building to which the drawing applies.

D. An additional set of the above drawings shall be submitted as follows:

- Printed in reduced-size (not to scale) in 11” x 17” or 12” x 18” format.
- Thermally laminated with 5-mil or thicker lamination (flat, with some rigidity – not prone to scrolling).
- Hole-punched in the upper left corner of each sheet, with a 1” split ring in each sheet.

This laminated drawing set will be spread throughout the various telecommunications rooms (applicable portions stored in each TR) by GSA. Local GSA IT staff will use the laminated drawings as they administer the system.

This page intentionally left blank

6 Appendix

6.1 Design Review and Construction Observation

6.1.1 Sample Review Comment Report

The table below depicts an example Review Comment Report form that will be used. The Designer shall create a document formatted as shown below. The document shall be used for any comments from the Designer's review process, and the completed document shall be submitted electronically to GSA. Upon request, GSA will provide an electronic document for this form to be used as a template.

Project Number Project Name Date of Review

Drawing/Spec Reference	Comment	Designer's Response	Final Resolution
Sheet number of drawing	Reviewer's comment, citing the item needing attention and any applicable code or standard reference.	Accept/Reject Comment	
Specification number and paragraph	Reviewer's comment, citing the item needing attention and any applicable code or standard reference.	Accept/Reject Comment	

6.1.2 Design Review Checklist

A Design Review Checklist for reviewers to use as a structured approach to reviewing project documents can be obtained by emailing infrastructure@gsa.gov.

The Design Review Checklist has been prepared as an Adobe Acrobat PDF file that can be hand-marked or edited using PDF editing tools. Reviewers can use a variety of PDF editing tools to directly enter their comments into the checklist.

- Reviewers are welcome to print the checklist pages and hand-mark the checklist during the review.
- Reviewers can request the latest version of the checklist by emailing infrastructure@gsa.gov.

The first page of the Design Review Checklist provides instructions for using the checklist.

The last pages of the Design Review Checklist provide space for review comments to be written.

6.1.3 Construction Observation Checklist

A Construction Observation Checklist has been prepared for observers to use as a structured approach as they walk through and check on the construction completion of projects. The checklist can be obtained by emailing infrastructure@gsa.gov.

The Construction Observation Checklist has been prepared as an Adobe Acrobat PDF file that can be hand-marked or edited using PDF editing tools. Observers can use a variety of PDF editing tools to directly enter their comments into the checklist.

- Observers are welcome to print the checklist pages and hand-mark the checklist during the review.
- Observers can request the latest version of the checklist by emailing infrastructure@gsa.gov.

The first page of the Construction Observation Checklist provides instructions for using the checklist.

The last pages of the Construction Observation Checklist provide space for observation comments to be written.

6.1.4 What to Do with the Completed Checklists

A. After completing a checklist (either Design Review or Construction Observation), please submit the list to infrastructure@gsa.gov for storage with other project files. This will allow the checklists to be available to others on GSA's team when they conduct a follow-up review or construction observation.

6.2 Sample Telecommunications Room Plan Details

Below are sample plan details for three sizes of telecommunications rooms. The Designer shall provide similar information for each telecommunications room and equipment room affected by the project. This information shall be provided either as a portion of the Project Manual or on the drawings, and shall be considered part of the Construction Documents.

The layouts of these sample plan details have been pre-approved for use at GSA. The Designer shall use these layouts wherever appropriate and shall discuss project-specific alternatives with the GSA IT ITS.

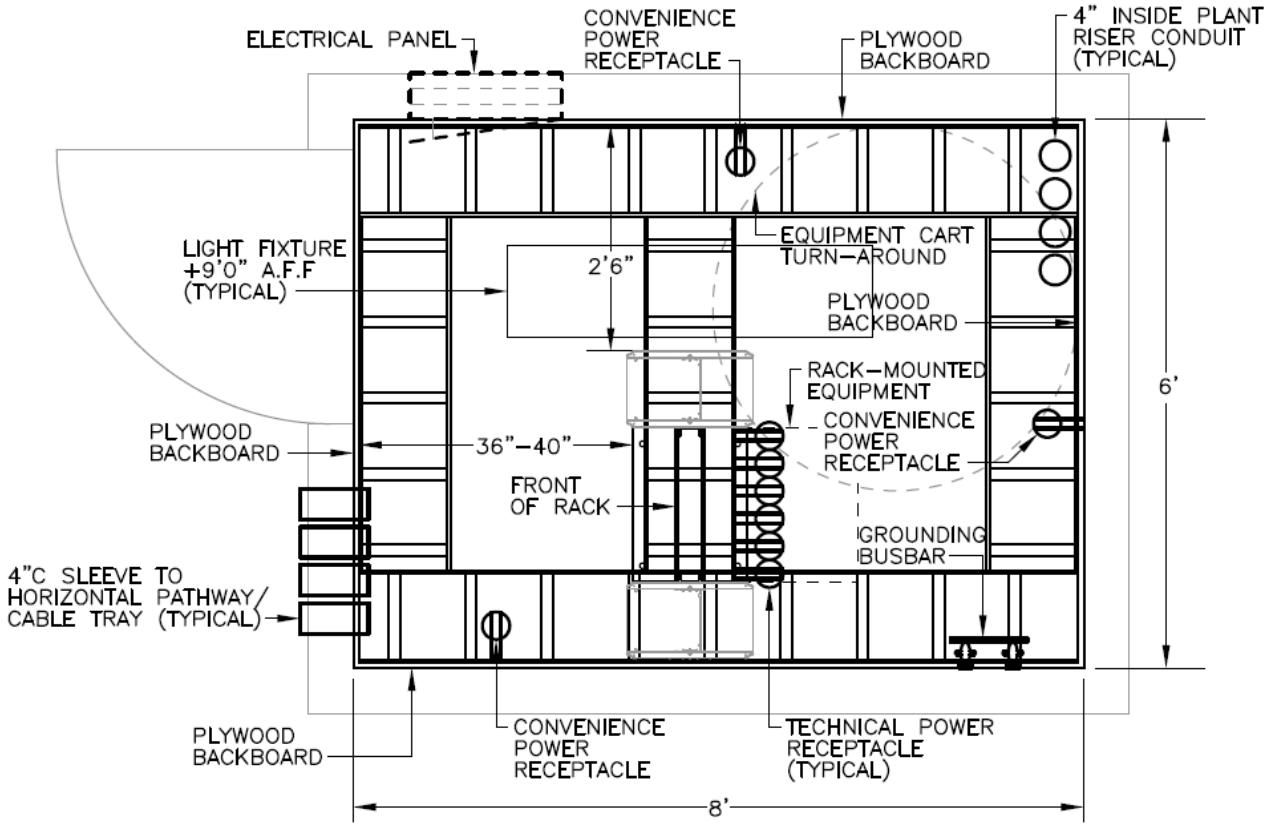
6.2.1 One-Rack Room

A one-rack room is intended only for applications where there is limited need (for example, smaller field offices).

In other rare circumstances, space constraints may be insurmountable, and a one-rack room may be the only possible solution. This situation is considered suboptimal, and is expected to result in higher life-cycle costs since it will likely not have sufficient space to support future requirements. The Designer shall not design a one-rack room for this purpose without approval from the GSA IT ITS.

The Designer shall be attentive to the strong industry trends of devices and systems converging onto Ethernet. It is conceivable that in the near future many systems could present a need for space in telecommunications rooms. The Designer shall take these future space requirements into consideration when designing a one-rack room.

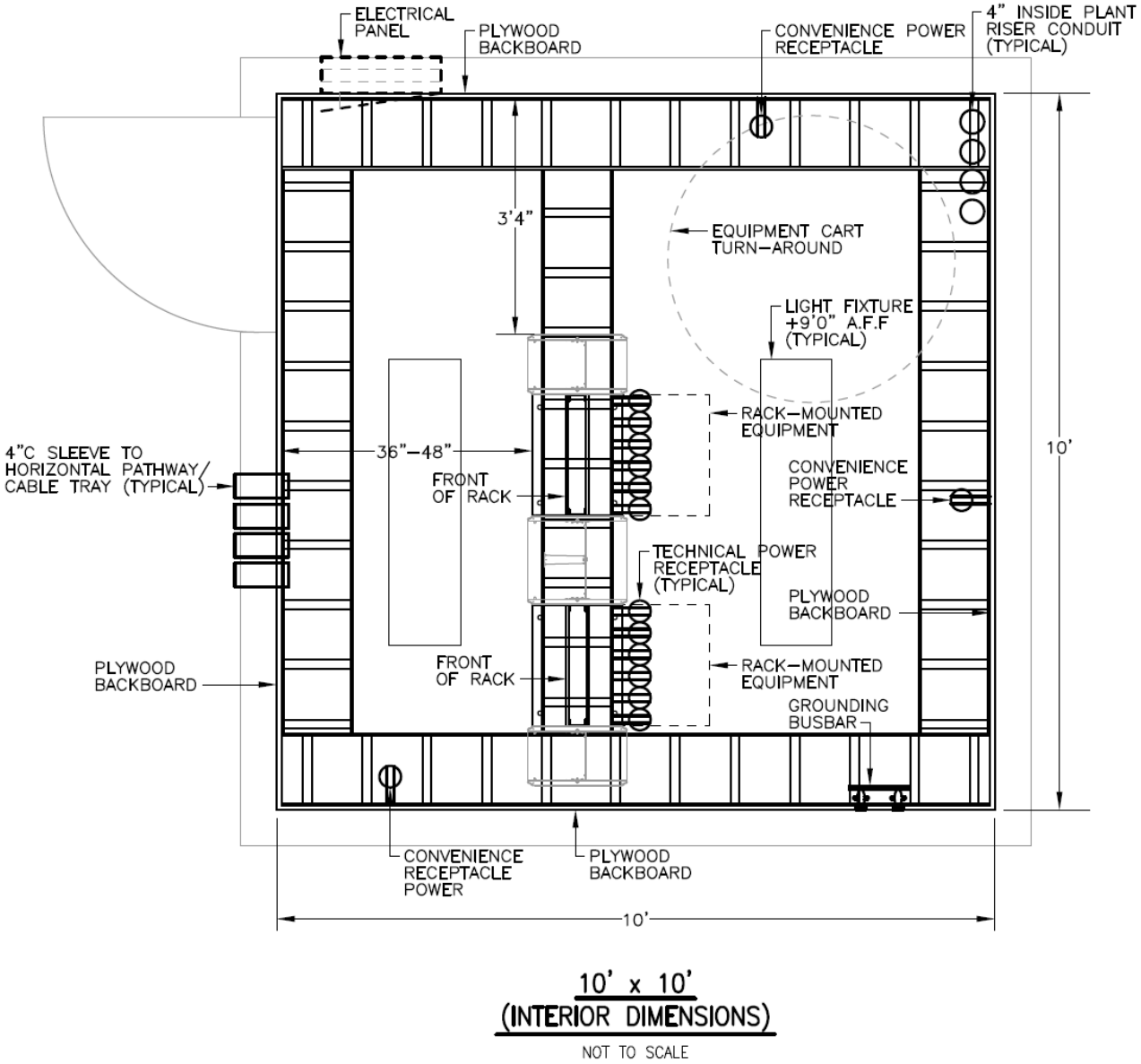
FIGURE 36: ONE-RACK ROOM



6.2.2 Two-Rack Room

A two-rack room is intended only for applications with 384 x 2 = 768 horizontal cables or fewer.

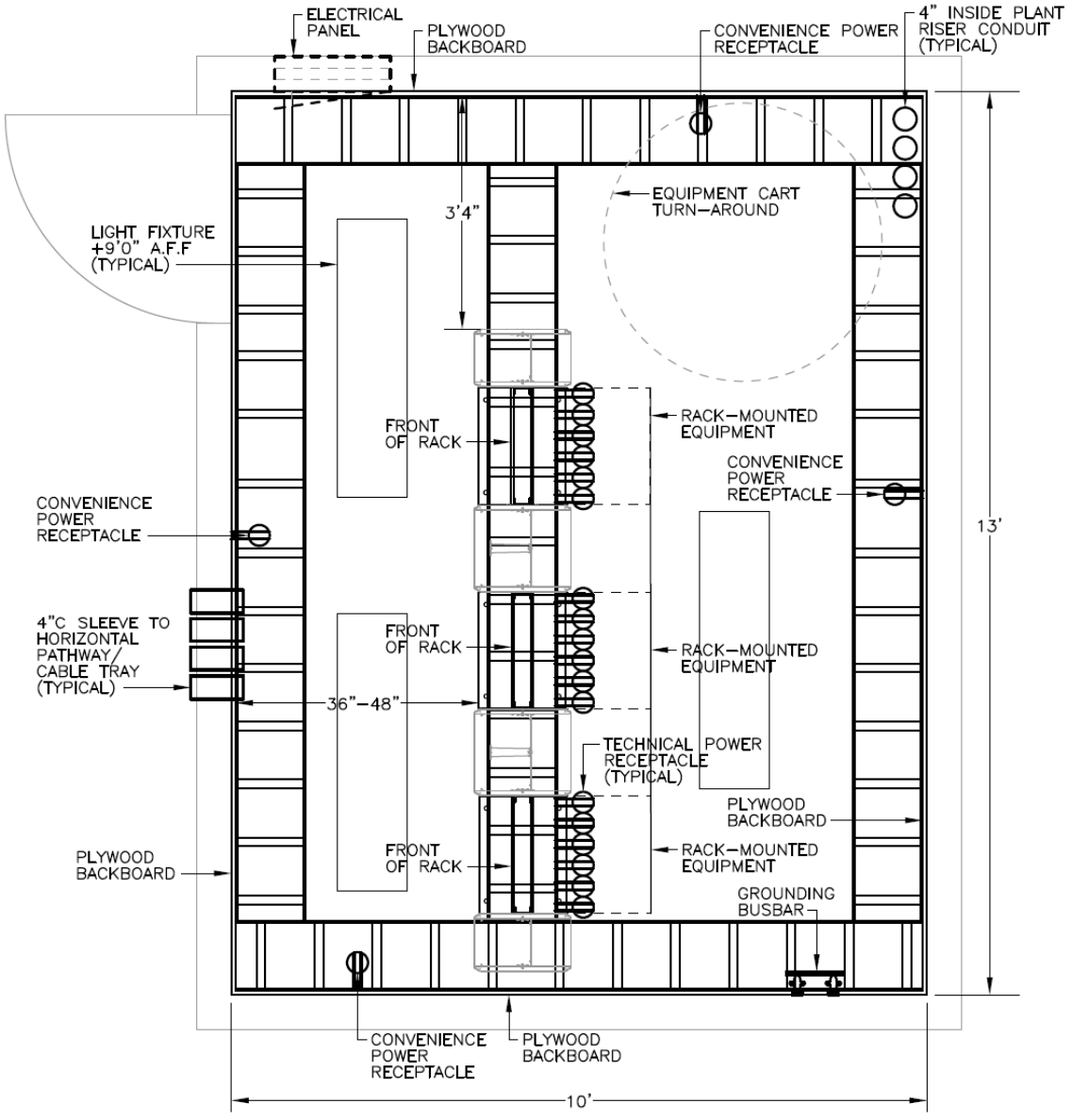
FIGURE 37: TWO-RACK ROOM



6.2.3 Three-Rack Room

A three-rack room is intended only for applications with 769 to 1,152 horizontal cables. For applications with more than 1,152 horizontal cables, provide additional telecommunications rooms (two or three racks).

FIGURE 38: THREE-RACK ROOM



10' x 13'
(INTERIOR DIMENSIONS)
NOT TO SCALE

6.2.4 Wall-Mounted Cabinet

A wall-mounted cabinet solution is intended only for small field office applications requiring no more than 96 network switch connections (two 48-port switches).

Below are plan view and wall elevation drawings of this application.

FIGURE 39: WALL-MOUNTED CABINET PLAN VIEW

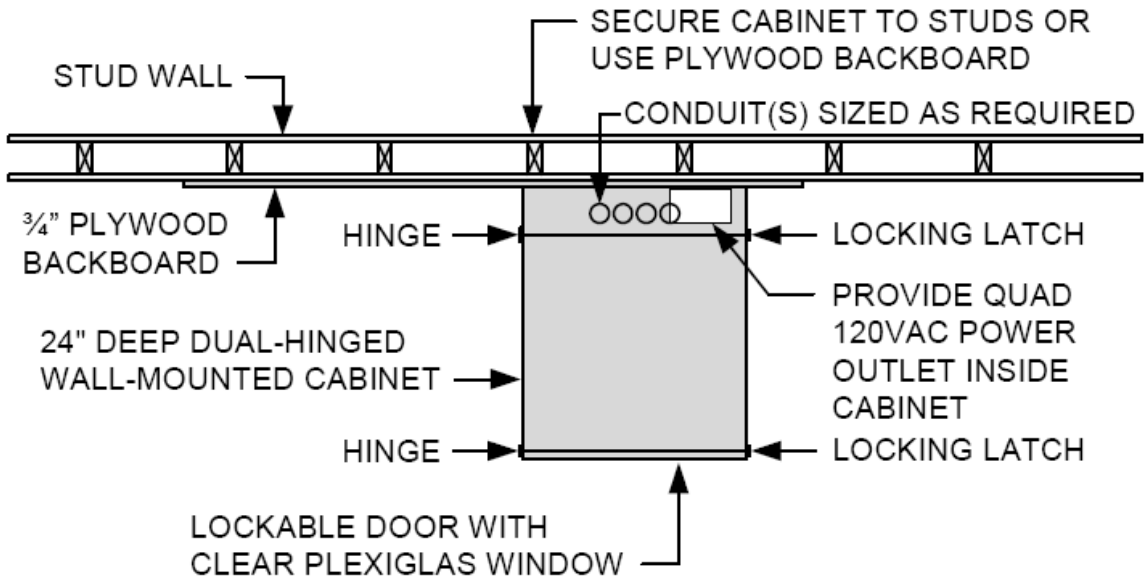
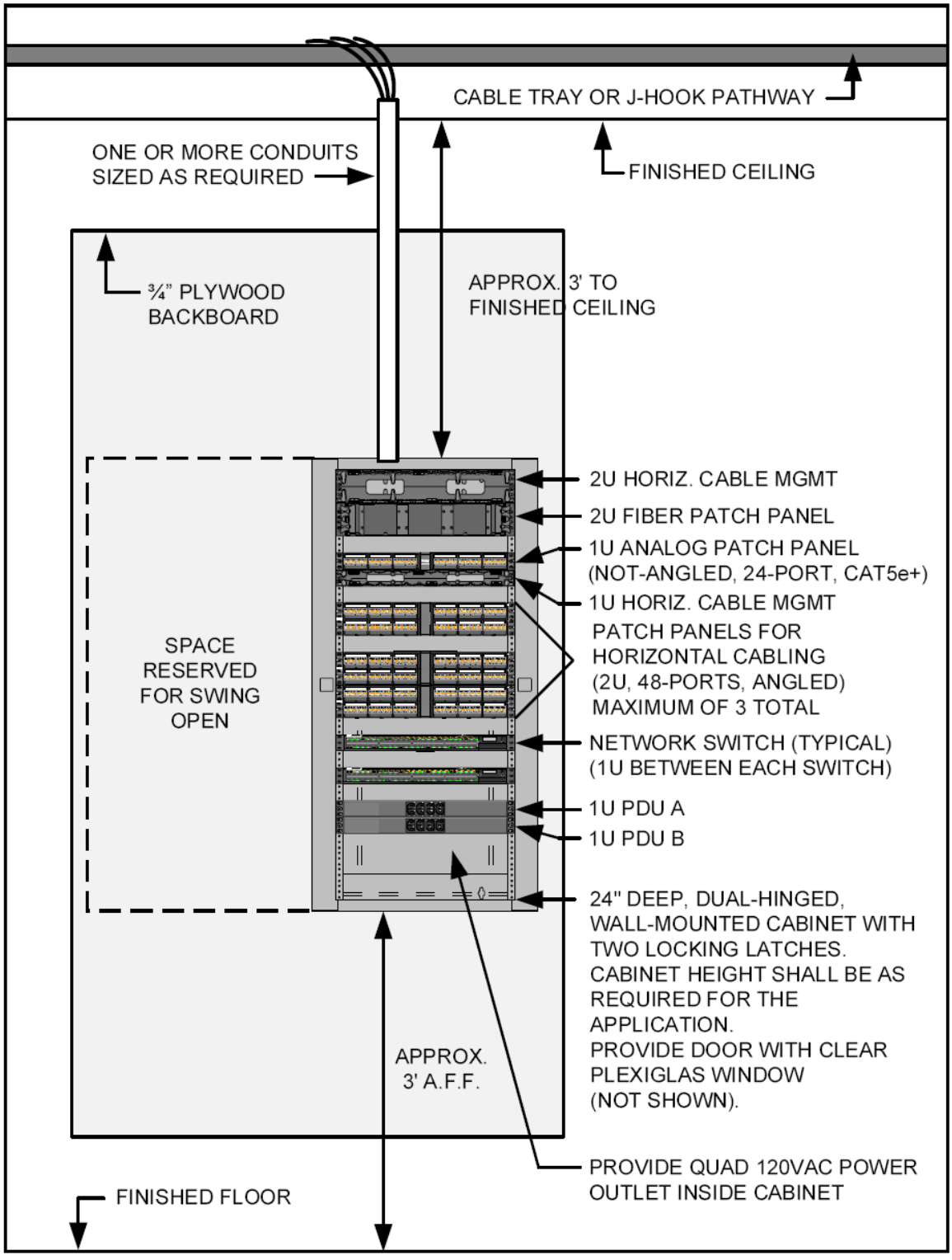


FIGURE 40: WALL-MOUNTED CABINET ELEVATION

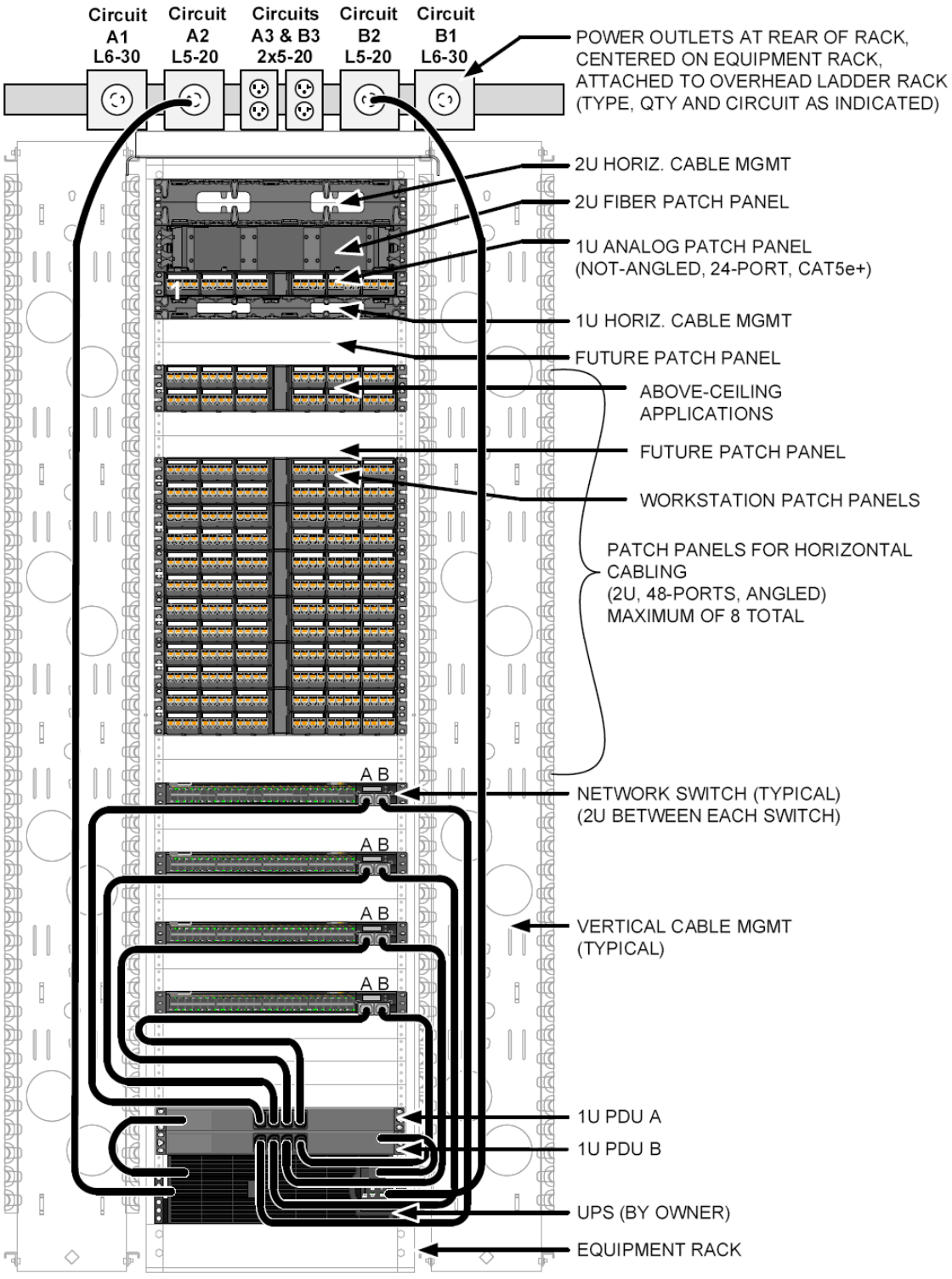


6.3 Sample Rack Elevation Detail

This page shows a sample scaled rack elevation detail. The Designer shall provide similar information for each new or existing telecommunications rack, showing new and existing equipment rooms affected by the project.

This information shall be provided either as a portion of the Project Manual or on the drawings, and shall be considered part of the Construction Documents.

FIGURE 41: SAMPLE RACK ELEVATION DETAIL

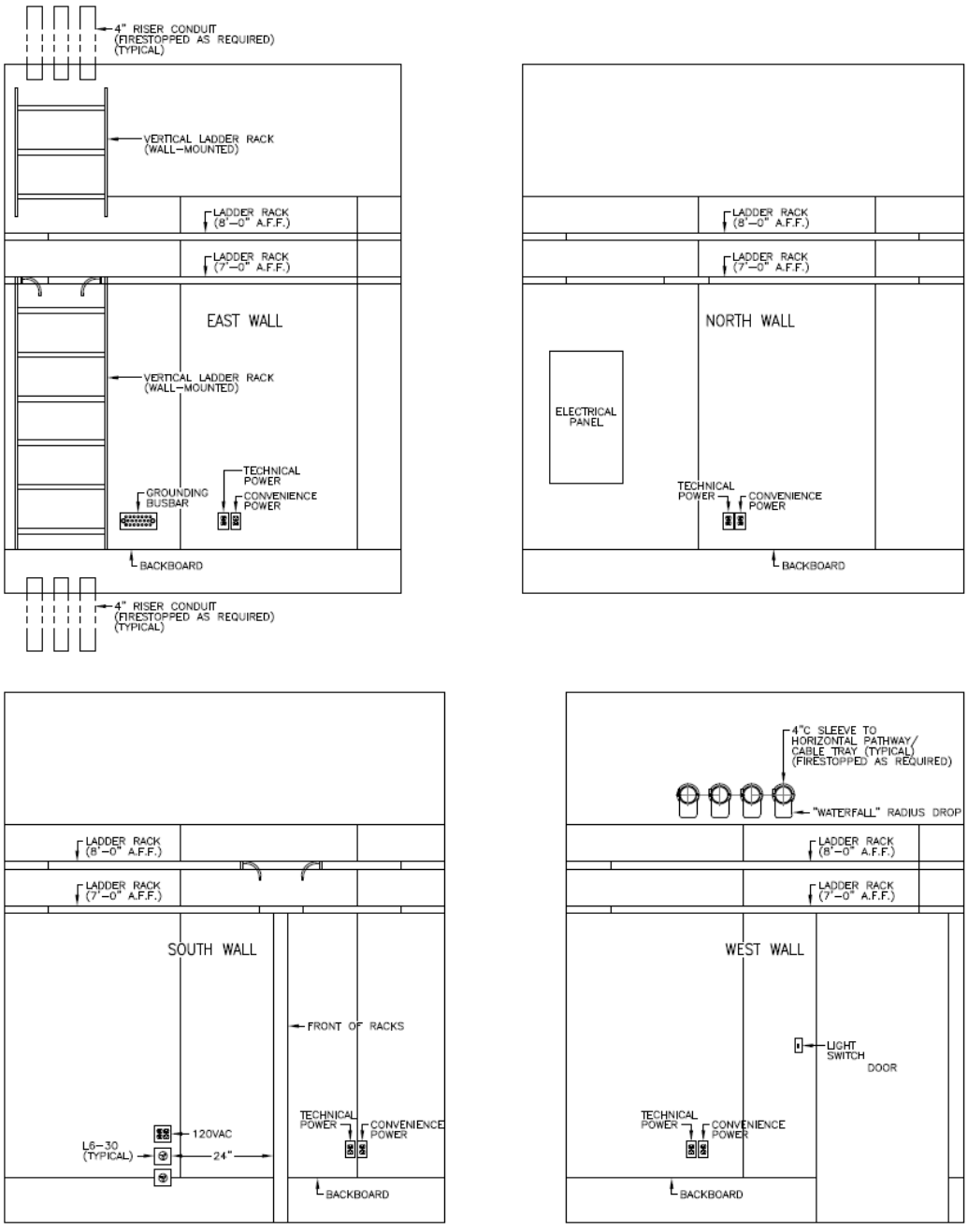


6.4 Sample Wall Elevation Detail

This page shows a sample scaled wall elevation detail. The Designer shall provide similar information for each new or existing telecommunications room wall, showing new and existing equipment room affected by the project.

This information shall be provided either as a portion of the Project Manual or on the drawings, and shall be considered part of the Construction Documents.

FIGURE 42: SAMPLE WALL ELEVATION DETAIL



6.5 Sample Fiber Optic Link-Loss Budget Analysis

The following is a sample Fiber Optic Link-Loss Budget Analysis that the Designer shall use for each new fiber optic cable designed in the project. The Designer shall submit the completed link-loss budget analyses to GSA in both electronic and paper forms. Upon request, GSA will provide an electronic spreadsheet of this form to be used as a template.

FIGURE 43: SAMPLE FIBER OPTIC LINK-LOSS BUDGET

Cable ID: **Enter Cable ID Here**
From: **Enter MDF/Building Name Here**
To: **Enter IDF/Building Name Here**

	# of MM Strands
	# of SM Strands

			MM 850		MM 1300		SM 1310		SM 1550	
Passive Cable System Attenuation										
Fiber Loss at Operating Wavelength	Cable Length (in kilometers)									km
	x Attenuation per km	x	3.75	x	1.5	x	0.5	x	0.5	dB/km
	= **Total Fiber Loss**		0.00		0.00		0.00		0.00	dB
Connector Loss	Number of Connector Pairs		2		2		2		2	pairs
(Excluding Tx & Rx Connectors)	x Individual Connector Pair Loss	x	0.75	x	0.75	x	0.75	x	0.75	dB/pair
	= **Total Connector Loss**		1.50		1.50		1.50		1.50	dB
Splice Loss	Number of Splices									splices
	x Individual Splice Loss	x	0.30	x	0.30	x	0.30	x	0.30	dB/splice
	= **Total Splice Loss**		0.00		0.00		0.00		0.00	dB
Other Components Loss	**Total Components Loss**									dB
Total Passive Cable System Attenuation	Total Fiber Loss		0.00		0.00		0.00		0.00	dB
	+ Total Connector Loss	+	1.50	+	1.50	+	1.50	+	1.50	dB
	+ Total Splice Loss	+	0.00	+	0.00	+	0.00	+	0.00	dB
	+ Total Components Loss	+	0.0	+	0.0	+	0.0	+	0.0	dB
	= **Total System Attenuation**		1.50		1.50		1.50		1.50	dB

			MM 850		MM 1300		SM 1310		SM 1550	
Link Loss Budget										
From Manufacturer's Specifications	Average Transmitter Output		-18.0		-18.0		-18.0		-18.0	dBm
	Receiver Sensitivity (10^{9} BER)		-31.0		-31.0		-31.0		-31.0	dBm
System Gain	Average Transmitter Power		-18.0		-18.0		-18.0		-18.0	dBm
	- Receiver Sensitivity	-	-31.0	-	-31.0	-	-31.0	-	-31.0	dBm
	= **System Gain**	=	13.00	=	13.00	=	13.00	=	13.00	dB
Power Penalties	Operating Margin		2.0		2.0		3.0		3.0	dB
# of Fusion Splices / Loss per Splice	+ Receiver Power Penalties	+	0.0	+	0.0	+	0.0	+	0.0	dB
2 x 0.3 =	+ Repair Margin	+	0.6	+	0.6	+	0.6	+	0.6	dB
	= **Total Power Penalties**	=	2.60	=	2.60	=	3.60	=	3.60	dB
Link Loss Budget	System Gain		13.00		13.00		13.00		13.00	dB
	- Power Penalties	-	2.60	-	2.60	-	3.60	-	3.60	dB
	= **Total Link Loss Budget**	=	10.40	=	10.40	=	9.40	=	9.40	dB

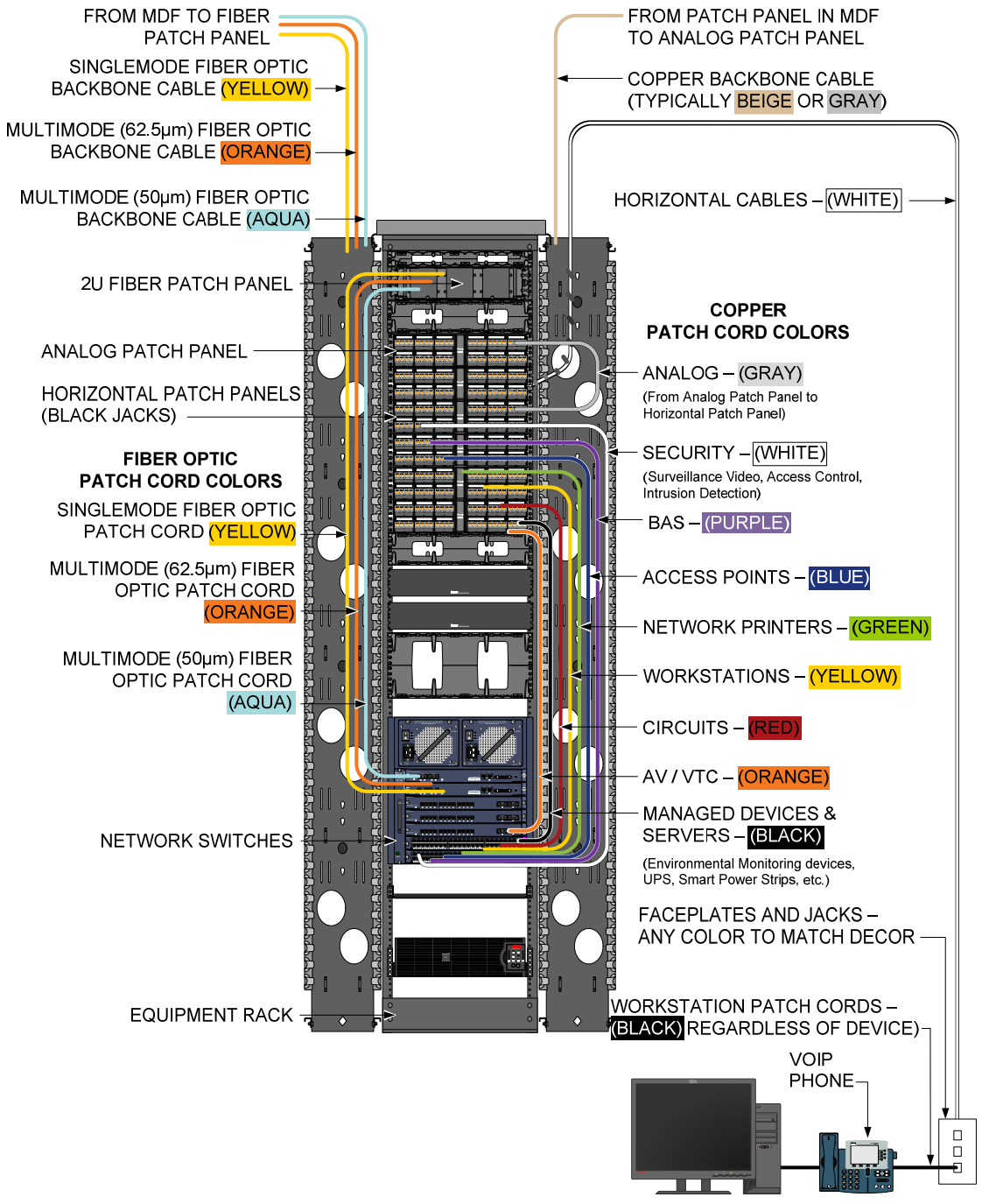
			MM 850		MM 1300		SM 1310		SM 1550	
Performance										
System Performance Margin	Link Loss Budget		10.40		10.40		9.40		9.40	dB
	- Passive Cable System Attenuation	-	1.50	-	1.50	-	1.50	-	1.50	dB
	= **System Performance Margin**	=	8.90	=	8.90	=	7.90	=	7.90	dB

Users of this spreadsheet shall verify prior to use that the parameters and calculations are appropriate for the project, equipment, and materials that are used. GSA is not responsible for errors or omissions resulting from the use of this spreadsheet.

6.6 Cable Color Scheme

The following graphic depicts the approved cable color scheme for GSA projects:

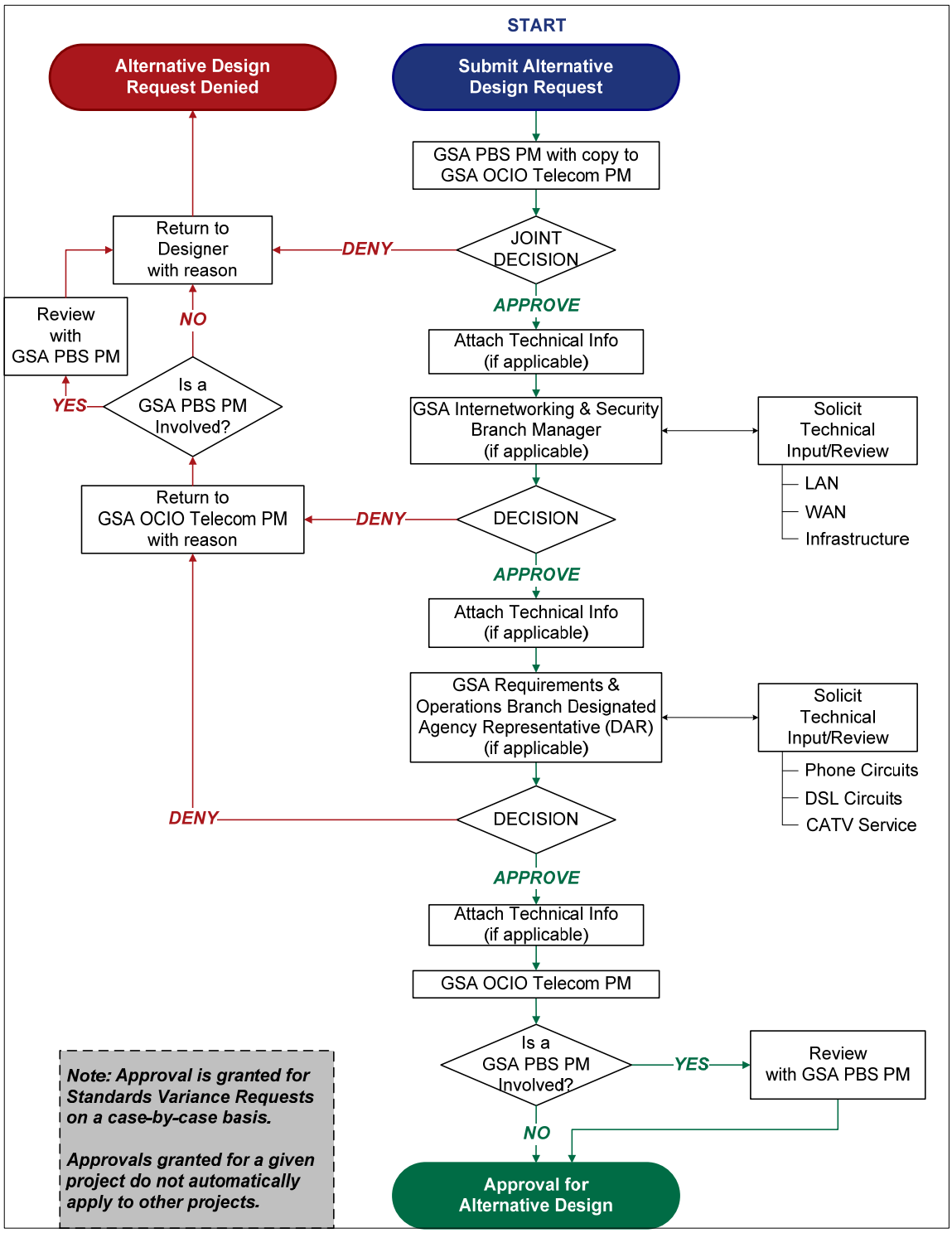
FIGURE 44: CABLE COLOR SCHEME



6.7 Standards Variance Request Approval Process

The flow chart on the following page describes the approval process that will be followed as GSA considers Standards Variance Requests:

FIGURE 45: STANDARDS VARIANCE REQUEST



6.8 Glossary

Analog

Analog comes from the root word “analogous,” which means “similar to.” In telecommunications, analog is a way of sending signals—voice, data, or video—in which the transmitted signal is analogous to the original signal. In other words, if you spoke into a microphone and saw your voice on an oscilloscope and compared it with the same voice as was transmitted on the phone line and viewed on an oscilloscope, the two signals would look the same. See Digital.

AWG (American Wire Gauge)

The standard measuring gauge of the diameter of copper wires in telecommunications and electrical cables.

Backboard

A plywood sheet mounted to the wall where telecommunications distribution equipment is installed.

Backbone Cabling

A major service cable that is used to interconnect various buildings on a campus, connect equipment rooms to telecommunications rooms within a building, or connect one telecommunications room to another within the same building. Backbone cables are typically large-capacity (high pair-count) copper cables, or fiber optic cables.

Bend Radius

The maximum radius that a cable can be bent to avoid physical or electrical damage or cause adverse transmission performance.

Bonding

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

Bus

An electrical connection which allows two or more wires to be bonded together.

Busbar

A copper bar, drilled and tapped, to allow the bonding together of wires or cables.

Cable Pair

Each telecommunications circuit is made up of two copper wires, or a pair of wires. Traditional analog telephone service uses one pair of wires. Some modern digital telephone systems and most computer networks operate over two or four pairs of wires. The ANSI/TIA/EIA-568-C standard requires a four-pair cable to each work area modular jack.

Cable Plant

A term which refers to the physical connection media such as optical fiber cable or copper cable. See Telecommunications Infrastructure.

Cable Pull Tension

Stated by the manufacturer as the maximum limit at which the cable’s performance characteristics are

altered, experiencing electrical or mechanical degradation. Also known as maximum recommended installation load (MRIL).

Cable Tensile Strength

The limit point where the cable is pulled apart.

Change Order (CO)

Change Orders document the modifications to an existing contract. The change order procedure can be initiated by the Owner, Contractor, or the A/E. The A/E will generally start the process using the Change Order/Change Order Proposal form.

CATV (Community Antenna Television)

Commonly referred to as "cable TV." In the traditional sense, CATV is a master antenna that receives television signals, and distributes the signal over cables to a limited geographical area, such as a campus, or neighborhood (community). Most GSA facilities receive cable TV service from a local service provider for a subscription fee.

CCTV (Closed Circuit Television)

CCTV is a system where one or more cameras send television signals to television monitors at another location in the same building or campus.

Cross-connect (XC)

A cross-connect, or cross-connection, is a termination junction point where individual cable pairs from two different cables are connected together with jumper wires. An XC is intended to be easily reconfigured, as opposed to a cable splice which is permanent.

Data Services

Data service generally refers to the computer network. For future planning purposes, data shall be considered to be any information that is transferred in digital form. Advances in technology are blending together traditional voice, data, and video services. Eventually, a single telecommunications system may process all forms of telecommunications (voice, data, and video) over a common infrastructure.

Demarc

The point of demarcation between the service provider and the customer. The demarc is a cable termination block with an orange cover where the service provider's cable terminates. The services are then cross-connected to the customer's cable for distribution throughout the facility. See Telecommunications Service Entrance Facility.

Digital

In telecommunications or computing, digital communication is the use of a binary code to represent information. In binary code, the information is represented by a series of "on" or "off" states (a signal, or an absence of a signal). Analog signals—like a voice—are encoded digitally by sampling the voice analog signal many times a second and assigning a number to each sample. During transmission, the signals will lose strength and progressively pick up noise or distortion. In analog transmission, the signal (along with any noise that is picked up) is simply amplified to maintain the proper signal strength at the distant end. In digital transmission, the signal is regenerated, cleaning off any noise, and restoring the signal to its original form. Then the signal is amplified and sent to the destination. At the destination, the digital signal is again regenerated, and restored to its original form for processing. See Analog.

Electromagnetic Interference (EMI)

Electromagnetic interference is a signal distortion directly related to a foreign signal being imposed through coupling onto a transmission path to which the foreign signal is not physically connected.

Entrance Facility (EF)

See Telecommunications Service Entrance Facility (EF).

Facility Control and Monitoring

It is becoming increasingly common for heating, ventilation, air conditioning, power distribution, and water distribution systems to be computer-controlled. These computer-controlled systems can be networked on the same LAN, or on the same telecommunications infrastructure, as the traditional data services.

Ground

A conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of the earth.

Grounding, Bonding, and Electrical Protection

Proper grounding and bonding serves three very important purposes. First, to safeguard life, the ground connection insures that voltages from a malfunctioning system are routed directly to ground to prevent an electrocution hazard to people who may come in physical contact with the system. Secondly, from a telecommunications standpoint, grounding and bonding of telecommunications equipment and systems is an important measure for controlling electromagnetic interference (EMI). Ungrounded systems can pick up energy radiated from another electrical source, such as a large electric motor, arc welder, or large copy machine. If this energy is absorbed into the telecommunications system, it can result in annoying interference on the signal, or at worst, corruption and loss of critical data. Thirdly, the telecommunications ground may be used as a reference voltage for electronics equipment. The telecommunications ground potential must be consistent to insure reliable system performance.

Grounding Electrode

The metallic component that is placed in the earth to form the electrical connection with the earth. A grounding electrode is usually a metal rod at least eight feet long driven into the earth. Refer to NFPA 70, Article 250, Part H for acceptable electrical service grounding electrodes.

Handhole

A small cast concrete box placed in an outside plant conduit run as an access point to facilitate pulling cable into the conduit.

Headend

In a CATV system, the headend is a term that refers to the electronics equipment that receives the television signals from the antennas, and distributes them over the copper and/or fiber optic cables.

Horizontal Distribution Cabling (HDC)

The cable that routes from the telecommunications room to the work area. Generally, these cables are routed horizontally on the same floor of a building, as opposed to a backbone or “riser” cable that may route vertically in a building. Occasionally, a telecommunications room will also serve the floor above and/or below. In this case, the cables routing from the telecommunications room to a work area on the floor above or below are still considered to be horizontal distribution cabling.

Identifier

A unique descriptive name or number that identifies a specific telecommunications infrastructure component.

Infrastructure

The ISP and OSP pathways, spaces, cable plant, and associated electronic devices comprising the low voltage signaling systems including but not limited to voice, data, building controls, security etc.

Inside Plant (ISP)

That part of the telecommunications infrastructure that is contained within a building.

Intermediate Cross-connect (IC)

A point where a backbone cable originating from the Main Cross-connect (MC) is cross-connected to another backbone cable routing to the final destination. The IC is usually located in a Telecommunications Room. The IC was previously referred to as the Intermediate Distribution Frame (IDF).

Intermediate Distribution Frame (IDF)

An obsolete term referring to the Intermediate Cross-connect (IC).

Jack (or Outlet Jack)

A wiring device used to terminate horizontal distribution cable, normally housed in an outlet box. See Modular Jack.

Jumper Cord

A short length of telecommunications cable with modular plugs on each end directly connecting two electronics devices in the Telecommunications Room or Equipment Room.

Jumper Wire

A short length of wire used to route a circuit by linking two cross-connect points.

Local Area Network (LAN)

The network that interconnects all data services for a building or campus. There may be one or more LANs in any given building or campus.

Local Exchange Carrier (LEC)

The local telephone company.

Maintenance Hole (MH)

A concrete box placed in an outside plant conduit run as an access point to facilitate pulling cable into the conduit. Maintenance holes are large enough for a service technician to enter and work on the cabling. OSHA regulates the safety aspects of working in maintenance holes. GSA has policies governing work in maintenance holes. “Manhole” is an obsolete term. See Handhole.

Main Cross-connect (MC)

The point where all telecommunications services are cross-connected to the building or campus backbone cables for distribution to other buildings, and ultimately, to the users’ work areas. The MC is usually located in the Main Telecommunications Equipment Room (ER).

Main Distribution Frame (MDF)

An obsolete term referring to the Main Cross-connect (MC).

Main Telecommunications Equipment Room (ER)

The Main Telecommunications Equipment Room is the central location on a campus or in a building where the major telecommunications equipment is located. The ER typically contains the telephone switching system and the data center with computer servers and network equipment.

Maximum Recommended Installation Load (MRIL)

Stated by the manufacturer as the cable strength or maximum cable pull tension. It is based on the conductor strength within the cable sheath.

Modular Jack (or Port, or Outlet Jack, or Outlet Connector)

A “female” telecommunications connector that accepts a mated male modular plug, used to terminate horizontal distribution cable at the work area, normally housed in an outlet device box. The jack will accept the modular eight (8)-position, eight (8)-conductor plug that is normally installed on the end of a patch cord or equipment cord.

Modular Plug

A “male” telecommunications connector that is inserted into a mated female modular jack.

MPOP

Minimum-Point-of-Presence. A policy statement, where it is generally the service provider’s policy to locate the Point-of-Presence (POP) the minimum distance possible in from the street. The service provider usually prefers the POP to be at the street. However, the customer usually prefers the POP to be in the Equipment Room. See POP, Demarc, and Telecommunications Service Entrance Facility.

NEMA

National Electrical Manufacturers Association.

Outlet Box

An enclosure mounted in the wall, or surface-mounted on a wall, floor, or furniture, into which a modular jack may be installed.

Outlet Connector

See Modular Jack.

Outside Plant (OSP)

The part of the telecommunications infrastructure that is outside a building. OSP usually refers to an underground conduit system, direct buried cable, or aerial cable.

Patch Cord

A short length of telecommunications cable with modular plugs on each end used to connect between a modular jack and a work area device such as a telephone or computer, or to connect between a patch panel and an electronics device in the Telecommunications Room or Equipment Room. A similar cord directly connecting two electronics devices is called a jumper cord.

Patch Panel

A panel mounted in an equipment rack in the Telecommunications Room or Equipment Room containing modular jacks. The telecommunications room or ER end of the horizontal distribution data cable is terminated at the patch panel. Patch cords are used to connect work area devices to network switches located in the telecommunications room or ER.

Pathway (or Cable Pathway)

A raceway, conduit, sleeve, or reserved location for the placing and routing of telecommunications cable.

PBX

Private Branch eXchange. A large, full-featured telephone switching system that usually serves a large building or campus.

POP

Point-of-Presence. The physical location where a service provider delivers telecommunications service. See MPOP, Demarc, and Telecommunications Service Entrance Facility.

Port

See Modular Jack.

Primary Protector (or Protector Block, or Protector Panel)

A device interconnected to the telecommunications service provider's access line, or to each end of an outside plant campus distribution copper cable, to protect the connected equipment and personnel from over-voltage and/or over-current conditions. Hazardous voltages and currents are shunted to ground through the protector block.

Pullbox

A box, located in an inside plant cable pathway, intended to serve as an access point to facilitate pulling cable through the conduit.

Registered Communications Distribution Designer (RCDD)

An internationally recognized professional designation presented by BICSI to its members that have proven their ability through on-the-job experience and having passed a thorough exam.

Radio Frequency Interference (RFI)

A signal distortion directly related to a foreign radio signal being imposed through coupling onto a transmission path to which the foreign radio signal is not physically connected.

Raceway

A metal or plastic channel used for loosely holding telecommunications or electrical cables. See Pathway.

Riser Cable

An obsolete term referring to backbone cable.

Router

A device that connects two networks and routes data traffic between them.

Security Systems

Systems such as intrusion alarms, remote door locks, and magnetic strip identification cards which may be computer-controlled and networked. Some new technology employs biometric systems that scan the retina of the eye, or make an optical image of the fingerprint, and compare that image to a computer database as a means of identification. Many of these systems have proprietary components, but many can be networked on the common telecommunications infrastructure and shall be taken into consideration in any design.

Service Provider

The company or utility that provides telecommunications services to a customer.

Sneak Current

Unwanted but steady currents that seep into a communication circuit. These low-level currents are insufficient to trigger electrical surge protectors and therefore are able to pass them undetected. They are usually too weak to cause immediate damage, but if unchecked will create harmful heating effects. Sneak currents may result from contact between telecommunications lines and AC power circuits or from power induction, and may cause equipment damage due to overheating.

Splice

A permanent joining of conductors from separate cables.

Splice Box

A box, located in a pathway, intended to house a cable splice.

Splice Closure

A device used to enclose and protect a cable splice.

Star Topology (or Star Distribution)

A cabling topology where all telephones and computers in a given area are wired directly to a central service location in the telecommunications room. Star topology is the standard wiring topology for the GSA.

Sweep

A conduit bend that meets ANSI/TIA/EIA-569-C bend-radius requirements forming a gentle arc rather than a sharp bend.

Switch

An electronic device that interconnects networked data devices (computers) through port-to-port switching.

Telecommunications

Any transmission, emission, or reception of signs, signals, writings, images, and sounds, or information of any nature by wire, radio, visual, or other electromagnetic systems.

Telecommunications Bonding Backbone (TBB)

The grounding conductor (cable) that interconnects the Telecommunications Main Grounding Busbar (TMGB), Telecommunications Grounding Busbars (TGB), various telecommunications equipment, equipment racks, and cable shields to the building's electrical service grounding electrode.

Telecommunications Room (TR)

A location in each building, or each floor of a building, where backbone cables transition to horizontal distribution cables. The TR may also contain certain items of network electronics equipment, such as hubs or routers. A large building, with large floors, may have multiple TRs on a floor. Depending on the size of the building, a TR may be a separate room, or it may be simply be a cabinet containing telecommunications equipment.

Telecommunications Grounding Busbar (TGB)

In buildings with multiple Telecommunications Rooms, each telecommunications room is equipped with a TGB. All of the TGBs in the building are bonded to the Telecommunications Main Grounding Busbar (TMGB) by the Telecommunications Bonding Backbone (TBB).

Telecommunications Infrastructure

The pathways, spaces, and cabling necessary to support the signaling between telecommunications devices. The infrastructure must be designed to support the known present, and reasonably certain future, signaling requirements of the telecommunications systems. With the rapid advances in telecommunications technology, the telecommunications cabling will likely require replacement or upgrade several times over the life of a building, with an average life expectancy of 8 to 15 years. Therefore, the design of the pathways and spaces has a major impact on the cost of future cabling upgrades.

Telecommunications Main Grounding Busbar (TMGB)

A busbar placed in a convenient and accessible location in the Entrance Facility (EF), Equipment Room (ER), and all Telecommunications Rooms. All telecommunications equipment, equipment racks, protector blocks, metallic cable shields, and exposed non-current-carrying metal parts of information technology equipment are bonded to the TMGB, which is then bonded by means of the Telecommunications Bonding Backbone (TBB) to the main electrical service grounding electrode.

Telecommunications Service Entrance Facility (EF)

The point where the telecommunications service enters the customer's property. The EF may contain electronics equipment and line protection equipment required by the service provider. The EF may be combined with the Main Telecommunications Equipment Room, or the EF may be an outdoor pedestal or cabinet near the street. See also Demarc, POP, and MPOP.

Termination Field

A space on the plywood telecommunications backboard where termination hardware is mounted. The termination field is arranged into areas where different types of cables are terminated based on their purposes and uses.

Termination Hardware

Any device used on the end of a cable to connect or cross-connect cables to other cables, or to telecommunications equipment.

Uninterruptible Power Supply (UPS)

A device used to temporarily supply power during a utility power outage and to stabilize power to its load when utility power experiences anomalies. UPSs include flywheel equipment as well as traditional battery-backed equipment.

Voice Services

Communications supported by the telecommunications infrastructure, including telephone services, either directly from the Local Exchange Carrier (LEC), or from a GSA-owned telephone system, voice mail

services, intercom and paging services, and some radio systems. Fax services and individual computer modems usually operate over the voice system.

Voice-Over-IP (VOIP)

Modern telephone equipment carries audible voice signals through the data network via Ethernet data packets, compared with traditional analog and digital telephone systems that require circuit connections or proprietary digital signaling.

Voice Switch

An electronic device that establishes or disestablishes circuits between telecommunications systems or devices.

Wireless Access Point (WAP)

A device typically mounted at the ceiling to provide wireless networking services for use with portable devices such as tablets, notebook computers, and smart phones.

Work area

The location where telecommunications service is provided for people to use. This is the area where a computer, telephone, or other telecommunications device is located and where people will use these tools to do work.

This page intentionally left blank

7 Index