Information Resources and Technology Management

(IRTM)

FWS AGENCY SPECIFIC REQUIREMENTS FOR IT INFRASTRUCTURE

March 2024 Version 2.0

Document History:

Document Version	Date	Editor	Description of Revision(s)
2.0	March 2024	Jonathan Mitchum	Added to Table 1 • TIA-222 • TIA-322 • OSHA 1910.97 • Motorola R56 Modified the copper requirement for interbuilding runs. Included exterior building terminations for RF cables should be performed IAW Motorola R56, or as near as possible. Added terminations and connecting hardware, interbuilding entrance terminals (Circa Telecom 1880ENS1-25) to meet NEC. Modified guidance to reflect that 66 blocks are should only be used for cross-connect fields at Telco and interbuilding demarcs. Removed guidance that radio antenna leads shall not be installed in a TR/ER/EF. Added section for proper identification and labeling of RF cables. Added details for testing and reliability of RF cables.

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1.0 – General Information

Contractor

The Contractor shall provide and install a telecommunications distribution system meeting all applicable product and installation standards at time of installation. This system shall comprise: all entrance and inter-building cabling, telecommunications rooms (TR) and enclosures, equipment rooms (ER), entrance facilities (EF), backbone and horizontal cabling, terminations, and interfaces and, the associated connecting hardware, telecommunications infrastructure grounding and bonding, conduit, protective devices, firestop system, and other items as specified or required. This system shall support data applications.

The Contractor shall comply with the provisions of NEC, state codes, local codes, requirements of authorities having jurisdiction, manufacturer's requirements, the standards listed in Table 1: *Codes and Standards*, and these Specifications. The most current edition of codes/standards at time of installation applies. When there is a conflict the more stringent requirement applies.

If this construction is an office or building renovation, the contractor will be responsible for removal or demolition of the existing data and voice cabling from the ceiling and walls of the building. The old cabling creates an excess fire fuel load and, in some instances, may be a toxic hazard during a fire. This will decrease the liability of the U.S. Fish and Wildlife Service and the building owner in the event of a fire. Removal and demolition also reduce the weight on the cable trays and support system and decreases the chance of having the old cabling becoming a conductor for interference with the data and radio systems that remain in the office.

The Contractor provided telecommunications grounding and bonding system shall be installed by a licensed electrician.

Definitions

Telecommunications Architectural Spaces

Telecommunications Room (TR)
An enclosed space used exclusively for housing telecommunications equipment, cable terminations, cross-connection cabling, and interconnection to work areas. The TR is considered *floor serving*, opposed to building or campus-serving.

Any additional TR requirements specified elsewhere in this Agency Specific Requirements (ASR) shall contain the horizontal cross-connects to the main backbone cabling and to intermediate cross-connects to other TRs.

Telecommunications Enclosure (TE)
1. A case or housing, for telecommunications equipment, cable terminations, and cross-connect cabling.
2. A telecommunications space generally considered a *floor or tenant-serving* space smaller than a TR, providing a connection point between backbone and horizontal cabling.

Telecommunications Equipment Room (ER)
A centralized *building or campus serving* space used exclusively for telecommunications and/or computer equipment that usually houses a main or intermediate cross-connect.

Entrance Facilities (EF)
1. A secured, accessible entrance to a building for public and private network service cables, including connections/demarcation points to access provider, campus distribution, interexchange

common carrier, the central station system for fire or burglar alarms, community antenna television (CATV) and closed-circuit television.
2. A *building or campus serving* space/facility that provides all necessary mechanical and electrical services, for the entry of telecommunications cables into a building. See 3.01

NOTE: In a **single** tenant building, any or all the EF, ER or TR functions may alternately be provided by a single room. These spaces may not contain a central station system for fire or burglar alarms, community antenna television, or closed-circuit television. These systems must be in a separate secure room as specified in ASR.

Demarcation Point
1. A point where the operational control or ownership changes.
2. The point of interface between access providers and customer facilities.

Network Interface (NI)
An FCC-registered device that provides an identifiable separation point between the access provider circuit and the premises switch or cabling.

Work Area (WA)
Building space where occupants interact with their telecommunications equipment, including systems furniture cubicles. The number of work area telecom outlet boxes shall be determined based on one (1) multi-port per fifty (50) square feet of rentable space.

Cabling Systems
The cables shall support voice and data systems in a single wiring grid (Do Not Separate voice and data cabling or patch panels). Optional cables will be required for radio and/or video if requested specifically in the ASR specifications.

Backbone Subsystem
Main backbone pathway or cable in a star topology providing interconnection between TRs, TEs, ERs, and the EF within or between buildings.

Horizontal Subsystem
Horizontal pathway or cable between and including the telecommunications outlet/connector in the work area and the horizontal cross-connect in the TR.

Firestop system
A specific installation consisting of fire-rated materials that fill the opening in a wall or floor assembly of, around and between any items that penetrate the wall or floor, and any termination devices along with their means of support.

Telecommunications Grounding and Bonding System
Grounds and bonds the telecommunications infrastructure. Complete definitions may be found in NEC and the ANSI/TIA-607-D Standard.

Telecommunications Main Grounding Busbar (TMGB)
A busbar placed in a convenient and accessible location and bonded, by means of the bonding conductor for telecommunications, to the building service equipment (power) ground and located near the building electrical service entrance.

Telecommunications Grounding Busbar (TGB)
A common point of connection for the telecommunications system and equipment bonding to ground and located in the telecommunications room or equipment room.

Telecommunications Bonding Backbone (TBB)
A conductor that interconnects the TMGB to the TGB.

Telecommunications Infrastructure
1. A collection of telecommunications components, **excluding network and telephone equipment**, providing the basic support for the distribution of all information within a building or campus.
2. 2. A substructure of a system used to support the cable system being installed.

Service Provider
1. A company (e.g., a telephone / internet company), that provides a circuit path between a service provider and the client user. An access provider can also be the service provider.
2. The operator of any facility that is used to convey telecommunications signals to and from customer premises.

Connecting Hardware
Devices providing mechanical cable terminations referring to cross-connects and mechanical connection hardware

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Cross-Connects
A device enabling the termination of cable elements and their interconnection, and/or cross-connection, primarily by means of a patch cord or cross-connect jumper.

a. **Main cross-connects (MC)**
A cross-connect for first level backbone cables, entrance cables, and equipment cables.

b. **Intermediate cross-connects (IC)**
A cross-connect between first level and second level backbone cabling. Note: only one IC is allowed between a HC and the MC.

c. **Horizontal cross-connect (HC)**
A cross-connect of horizontal cabling to other cabling, e.g., horizontal, backbone, or equipment.

Pathway
1. The vertical and horizontal route of the telecommunications cable.
2. A facility for the placement of telecommunications cable.

Cable Trays and Wire/Pathways
Prefabricated structures used within commercial buildings for pathways of telecommunications cabling. These systems are placed and routed throughout all parts of the building, including access floors and ceiling pathways.

Copper Cable Over Voltage Surge Protection Devices
An over voltage protector featuring metallic electrodes that discharge in a gas atmosphere within glass or ceramic envelope. This type of protector does not require replacement each time it discharges.

Building Entrance Protector (BEP)
A device used for the termination, protection, and distribution of the cable pairs entering or leaving the building.

Codes and Standards

The following standards, as updated, are the applicable specifications for Communications Wiring and

may be used for further clarification. The Contractor is responsible for knowledge of and adherence to the following applicable codes and standards:

Table 1: Codes and Standards

REFERRED TO AS	DOCUMENT TITLE
TIA-568-C.0	Generic Telecommunications Cabling for Customer Premises, Telecommunications Cabling System Structure, Cabling Installation Requirements, Cabling Transmission Performance & Test Requirements, Annex: A,B,C,D,E,& F.
TIA-568-C.1	Commercial Building Telecommunications Cabling Standard. ANSI/TIA-942 & ANSI/TIA-1005.
TIA-568-C.2	Balanced Twisted-Pair Telecommunications Cabling & Components Standard, Annex A,B,C,D,E,F,G,H,I,J,K,L, & M.
TIA-568-C.3	Optical Fiber Cabling Components Standard, Cable, Connecting Hardware, Patch cords & transitions (cassettes & breakout cables), Annex A.
TIA-569-C TIA-569-C-1 TIA-569-C-ERTA	Telecommunications Pathways and Spaces
TIA-606-B	Administration Standard for Telecommunications Infrastructure
TIA-607-B TIA-607-B-1 TIA-607-B-2	Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
TIA-455-C	General requirements for standard test procedures for optical fibers, cables, transducers, sensors, connecting and terminating devices, and other fiber optic components
TIA TSB-153	Static Discharge Between LAN and Data Terminal Equipment
TIA TSB-155-A	Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T
TIA TSB 162-A	Telecommunications Cabling Guidelines for Wireless Access Points
TIA/EIA TSB 184	Guidelines for supporting Power Delivery over Balanced Twisted Pair Cabling
TIA-758-B	Customer-Owned Outside Plant Telecommunications Infrastructure Standard
IEEE	The Institute of Electrical and Electronics Engineers
ANSI/TIA/EIA 598D	Optical Fiber Cable Color Code
NEC	National Electric Code, 2020 or latest version
NFPA	National Fire Protection Association
NESC	National Electric Safety Code, latest version
NEMA VE-1	National Electrical Manufacturers Association, Metal Cable Tray Standards, 1998
NEMA VE2-2001	National Electrical Manufacturers Association, Cable Tray Installation Guidelines
REA 345.52	Rural Electrification Agency Standard (January 16, 1980)
PE-89	Rural Electrification Agency Standard PE-89 (October 30, 1985)
ISO/IEC 8802-3	ANSI/IEEE 802.3 series of standards
BICSI TDM	Telecommunications Distribution Methods Manual, Eleventh Edition 2006 or latest Edition.
TIA-222 Rev I	Structural Standards for Antenna Supporting Structures, Antennas, and Small Wind Turbine Support Structures
TIA-322 Rev A	Loading, Analysis, and Design Criteria Related to the Installation, Alteration, and Maintenance of Communication Structures
OSHA 1910.97	Nonionizing Radiation
Motorola R56	Standards and Guidelines for Communications Sites

2.0 - Products

All materials and equipment furnished and installed shall be of the highest quality, new, and meet the standards of EIA/TIA, IEEE, UL, NFPA, and NEC and shall bear their label wherever standards have been established and label service is available.

Backboards

The backboards for the TRs, ER, EF termination devices shall be 20 mm (¾ in) thick, type ACX fire retardant plywood, covered with two coats of fire-retardant paint, and installed 8 inches AFF, 2.4 m (8ft) high.

Equipment Racks

Shall meet ANSI/EIA/TIA-310-D.

Open Frame
19" equipment rack, 72-84" high, with a flange base, standard channel depth, mounting rails drilled front and back and tapped to EIA standards.

- **Standard Solution:** Floor Mount – 2 Post – 45U
  - **Part Number:** SR2POST
  - **Dimensions:** Height: 84" Width: 22" Depth 14"

Quad Racks
Tapped to EIA standards.

- **Standard Solution**: Tripp-Lite Floor mount – Open- 42U
  - **Part Number**: SR42UBEXPND
  - **Dimensions**: Height: 78.5" Width: 24" Depth 43"

Quad Rack with Doors
Tapped to EIA standards.

- **Standard Solution:** Floor Mount – Enclosed – 42U
  - **Part Number:** SR42UB
  - **Dimensions:** Height 78.5" Width 24" Depth 45"

Wall Mounted Racks

- **Standard Solution:** Wall Mount – Enclosed – 15U
  - **Part Number:** SRW15US
  - **Dimensions:** Height: 31" Width: 24" Depth 22"

Equipment rack specifications shall be submitted by the Contractor for approval by the ***Contracting Officer prior to purchase and installation.***

Grounding

Grounding Kit
Contains a busbar, busbar insulators and standoff brackets, and mounting equipment. Bolts shall be listed for grounding and bonding.

1. **TMGB**
   Shall be predrilled copper, ¼" thick, 4" wide, and 20" long (minimum size).

2. **TGB**
   Shall be predrilled copper, ¼" thick, 2" wide, and 12" long.

3. **Isolated Ground Bar**
Square D #PK15GTA-FT with a #PKGTAB insulator kit or equivalent.

4. **TBB**
Shall be insulated copper conductor.

Copper Wire and Cables

Cabling within ceilings used as a plenum for environmental air must conform to NEC fire ratings and be blue in color, or a color agreed upon by the Contracting Officer's Authorized Representative. The insulation and jacket types shall be CMP for Communications plenum, CMR or CMP for riser. Under-carpet wiring and flat wiring are not allowed.

Horizontal Cabling
New installations consist of 4-pair, Category 6A (CAT6A) or better, unshielded twisted pair (UTP), solid copper wires. Cabling to facilitate the connections to Wi-Fi access points in the ceiling or on the wall shall be the same as for all other Horizontal cabling.

Backbone Cabling
A copper inter and intra building backbone for digital applications, paging, analog applications requiring low voltage, and other miscellaneous uses.

Intra building
Shall be twenty-four 4-pair CAT6A or better cables terminated to a 24-port patch panel in the racks.

Under Ground Inter Building
Shall be 24AWG 25-pair direct cable (Superior Essex PE89-25P) for interbuilding runs less than 1000 feet, or 22AWG 25-pair direct burial cable (Superior Essex 20-062-05) for runs longer than 1000 feet.

Fiber Optic Cables

All fiber optic cables, equipment, and terminations shall comply with ANSI/EIA/TIA specifications. The insulation and jacketing for fiber optic cables shall be type OFN, OFNG for general wiring, type OFNP for plenum applications, and type OFNR or OFNP for riser applications. Cables, LC connectors, and equipment shall be approved for the location installed.

Horizontal Cabling
Fiber optic horizontal cabling, (from TR to WA) if required, will be identified in the ASR and shall consist of 6 pair 50/125 µm multimode OM4 or better fiber strands.

Backbone Cabling

Intra building
New installations shall consist of a minimum of twenty-four, 50/125 µm multimode fiber strands, unless otherwise specified in the ASR. During discussions, the Lessor and the FWS Telecommunications Subject Matter Expert shall discuss the type of cabling which will be required for networking equipment.

Under Ground Inter Building
New installations shall consist of a minimum of twenty-four, 50/125 µm single mode fiber or better fiber strands. Cable, corning (OSP) Outside plant cable loose tube pick filled, listed for direct burial cable. Can be installed in non-conductive conduit but can only have two 90-degree sweeps. If more turns are required, Hand Holds (HH) or

Manholes (MH) must be installed in accordance with the BICSI TDMM. Termination of Fiber Cable will be in 19-inch rack mountable LIU's, using LC connectors.

Exterior Building Terminations

Exterior Wall
Two 4-pair CAT6A or better cables shall be installed from the patch panel to the exterior termination point in the building. Termination on the exterior wall shall consist of commercial-grade stainless steel water-resistant wall plate and Cat6A commercial-grade outdoor shielded panel mount keystone jack with dust cap.

Exterior RF Terminations
Exterior Building Terminations for RF cables should be performed IAW Motorola R56, or as near as possible. Project Managers should consult with the Radio Team for site specific requirements.

Wireless Bridge
Two 4-pair CAT6A or better cables shall be installed from the patch panel to the exterior termination point in the building. Termination on the exterior wall shall consist of commercial-grade stainless steel water-resistant wall plate and Cat6A commercial-grade outdoor shielded panel mount keystone jack with dust cap. Both cables shall be installed with an ethernet surge protector that is grounded and installed by a certified electrician.

Exterior Post
Shall be CAT6A outside plant (OSP) type cable, shielded, twisted pair, 24 AWG solid copper, moisture resistant filled and listed for direct burial or installation in underground conduit. Both cables shall be installed with an ethernet surge protector that is grounded and installed by a certified electrician. Termination shall be specified by the Contracting Officer to meet the individual application needs.

Terminations and Connecting Hardware

Intra Building Cable Protector
Shall meet the specifications of the Building Entrance Protector (BEP), or equivalent.

Under Ground Inter Building Entrance Terminals
Circa Telecom 1880ENS1-25 to meet NEC.

Copper Cable Over Voltage Surge Protection Devices
Industry standard 5-pin gas or solid-state modules that fit the BEP.

66 Block
CAT6A or better, 25 or 50 pair capacity with stand-off brackets. These should only be used for cross-connect fields at Telco and interbuilding DEMARCs.

110 Block
CAT6A or better, T568A wiring, with jacks.

CAT6A Patch panels
Shall be standard 19-inch rack mountable modular T568A, minimum 24 port and maximum 48 port; and include front, side, and rear cable management, icon label holders, designation labels, cable ties, mounting hardware.

- **Standard 48 Port Rack Mount Solution:** Tripp-Lite – Patch Panel- 48 Port

- **Part Number:** N252-048

- **Standard 24 Port Rack Mount Solution:** Tripp-Lite – Patch panel – 24 Port
  - **Part Number:** N252-024

Horizontal Cable Management Panels
Must be approved by Contracting Officer.

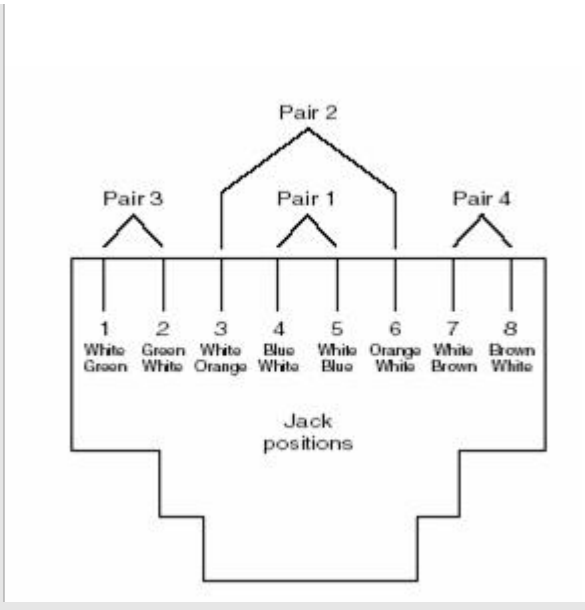
Fiber Optic connectors
Shall be LC style connectors.

Fiber Optic LIU
Shall be standard 19" rack mountable with LC style connectors, fiber managers, port designation labels, strain relief hardware, cable ties, and mounting hardware.
Fiber Optic Wall Mount Unit
A wall mounted unit may be used if approved by the Government.

Work Area/Wi-Fi Telecommunications Outlet/Connectors
Work Area (WA) and Wi-Fi telecom outlet/connectors shall be CAT6A, 8-pin modular T568A (Figure 1: Telecomm Outlet/Connector Specifications). Jack color shall be consistent with other plate colors, icon colors shall be coded to represent the following applications (or colors agreed upon by the Contracting Officer's Authorized Representative):

- Government Data – Blue
- Radio – Yellow
- Public Data – Red

FIGURE 1: TELECOMMUNICATIONS OUTLET/CONNECTOR SPECIFICATIONS



Eight Position Jack Pin/Pair Assignments
Illustration is a front view of the connector
T568A

COLOR CODES

Conductor	Color Code	Abbreviation	Pin Number
Pair 1	White-Blue	W-BL	5
(NOTE 1)	Blue	BL	4
Pair 2	White-Orange	W-OR	3
(NOTE 1)	Orange	OR	6
Pair 3	White-Green	W-GR	1
(NOTE 1)	Green	GR	2
Pair 4	White-Brown	W-BR	7
(NOTE 1)	Brown	BR	8

NOTE 1: A white marking is optional.

Outlet Box
Wall outlet boxes shall be no smaller than 50 mm (2") wide, 75 mm (3") high, 64 mm (3½") deep, and have the capability to accommodate one or two 21 mm (¾" trade size) conduits.

Work Area Faceplates
Wall faceplates shall fit the installed outlet box, 2-4 ports, flush mountable, with label designations and covers, icons, and dust covers for unused ports.

FIGURE 2:

2 PORT FACEPLATE CABLE LOCATION **4 PORT FACEPLATE CABLE LOCATION**

Training, Conference, Interview and Equipment Rooms
Faceplates shall fit the installed outlet box, 2 port, flush mountable, with label designations and covers, with an option for dust covers for unused ports.

Systems Furniture Faceplates
Shall fit the furniture. The contractor shall coordinate with the locations systems furniture point of contact to determine if faceplates are included. The contractor shall provide the faceplates if they are not part of the systems furniture package and shall be the type recommended by the systems furniture vendor.

Cross-Connect / Patch Cords

Government shall supply copper and fiber patch cords.

1. Required in the TRs to cross connect the voice/data equipment to the appropriate patch panel
2. Required in the WA between the outlet box and equipment.

Wireways

Conduit
Recommended conduit: Intermediate Metal Conduit (IMC), Rigid Metal Conduit (RMC), Rigid Nonmetallic Conduit (RNC), Nonmetallic Underground Conduit with Conductors (NUCC, Electrical Metallic Tubing (EMT), Electrical Non-Metallic Tubing (ENT). Refer to Section 3.08 D. Conduit Sizing for requirements.

Cable Trays
Includes listed factory manufactured tees, crosses, risers, elbows and other fittings of the same material as the main sections. Materials may be any of the following:
1. Galvanized steel
2. Steel with factory applied paint
3. Aluminum alloy 6063-T6 with compatible alloy for parts

Wire Basket Support System
Listed straight sections of continuous wire mesh, field formed horizontal and vertical bends, tees, dropouts, supports and accessories. Cooper B-line Wire Basket Runway or equivalent.

Innerduct Tubing
HDPE (high density polyethylene) designed for inside building installation of fiber-optic cables.

Wire Management Hardware
Cable hooks, wire ties and mounting bases, brackets, clips, and other similar devices to provide support or bundling for cables shall be screw or otherwise permanently mounted. Glue mounted devices are not allowed.

Firestopping

Selected systems shall meet the hourly time delay ratings recommended for each fire-rated floor, wall, or other partition of building constructions; and be appropriate for each type of telecommunications penetrations per NEC and the additional requirements in ANSI-J-STD-607-A.

3.0 - Execution

Entrance Facility

One Entrance Facility (EF) is required per site. If the entrance facility is separate from the ER, it shall be 8'x 8' minimum, and sized upward according to the applications supported according to TIA-569-C and meet the TR requirements. If office space is multi-tenants, then a single EF must be provided and separate from the Government's ER.

Service Provider/Telephone Company Interface – The Contractor is required to coordinate, with the Service provider, copper telecommunication line installation, termination and identification. The copper telecom lines shall be terminated on a BEP if required by code.

Access to the building electrical ground must be provided, by the contractor, within 1.5 (5 ft) of the OSP conductive cable terminations in the EF. The access provider will make cable metal sheath (bond and ground) connections to the provided electrical ground.

Equipment Room

Recommended 10 ft x 11 ft and capable of serving different types of telecommunications applications and include space for environmental control equipment, power distribution/containers, and uninterruptible power supply (UPS) system, and accommodate the telecommunications rack and equipment clearance space requirements. This space requirement does not include the footprint of the door that must swing inward to secure the hinge pins. ER sizes are specified in the design phase. If this room is sized in the SFO, the sizing in the special requirements section will override this section.

Horizontal, backbone, and entrance wiring systems; patch panels; equipment racks; and cross-connect blocks shall be arranged logically in the ER. Allow for natural wiring progression, and growth, minimal wire crossing, and easy access to each component for testing and facilitating moves, additions, and changes.

Equipment racks must be bolted to the floor by means of Unistrut or concrete lag bolts and shall have ladder rack raceway anchored to the top of the equipment rack with a bracing kit and anchored to the wall(s) with a wall angle support kit. Allow for 40” wide, 40” depth, and 7.5 ft high for each equipment rack. Provide space for an aisle of at least 3 ft wide in the front and in the rear of the space allocated for each equipment rack or cabinet. Equipment rack mounting must meet seismic requirements.

The telecommunications connecting hardware shall be rack or wall mounted according to individual site requirements, see Section 2.

Multi-Tenant Buildings

Government TR/ER shall not be shared with other tenants or federal partners or used for any purpose other than a telecommunications facility.

Proximity to Electrical Power Service and EMI Sources

Equipment with potential sources of EMI shall be located no closer than 10 ft to the TR/ER.

Heating, Ventilating, and Air Conditioning (HVAC)

Shall be installed and function properly 24 hours per day, 365 days per year, temperature 64º F to 75º F, and relative humidity 30% to 55% connected to the emergency power source, if required. See requirements elsewhere in this Agency Specific Requirements (ASR) for the BTUs. HVAC sensors shall be in the ER and placed 1.5 m (5 ft) AFF.

Ceiling Height

3 m (10 ft) above finished floor, no false ceilings.

Doorways

Install fully opening, lockable, removable doors that are at least 3.0 ft wide and 7.0 ft tall. The hinges shall be so that the pins are inside the TR door. When necessary, double doors are to be installed side to side and be removable. Door sills and center posts are not allowed.

Floor Requirements

Shall be non-conductive vinyl or ceramic tile and shall be installed with the appropriate non-conductive adhesive and grout. Floor loading TR: a minimum 50 lbf/ft². Floor loading ER: a minimum of 100 lbf/ft² to 250 lbf/ft².

Electrical Power

Follow the latest NEC code and reference BICSI TDM, include provisions for UPS power draw during recharge cycles. Consult a qualified electrical engineer for design and implementation.

Backboards

Shall be installed 8" AFF, with C side facing the wall. Support devices are required above and below termination devices to support the cross-connects. Install a TGB Ground Kit on one of the backboards in each TR. (See Section 3.08 *Protection from Physical Damage, sub sections: B. Pathways and C. Required Conduits.*)

Equipment Racks

The telecommunications connecting hardware shall be floor or wall rack mounted according to individual site requirements, see section 2.03. Equipment rack mounting must meet seismic conditions.

Floor mount equipment racks must be bolted to the floor by means of Unistrut or concrete lag bolts and shall have a 12" ladder rack cable tray; with 12" rung spacing; anchored to the top of the equipment rack with a bracing kit and anchored to the wall(s) with a wall angle support kit. Allow for 40" wide, 40" depth, and 7.5 ft high for each equipment rack.

Provide space for an aisle of at least 3 ft wide in the front and in the rear of the space allocated for each floor mounted equipment rack or cabinet. Provide space for an aisle of at least 3 ft wide measured when the rack is opened to allow access to the rear of each wall mounted equipment rack.

Telecommunications Rooms

TRs shall be designed and located so that no wire run from a TR to a work area telecom outlet is more than 90 meters ***(295 ft)***. Contractor located TRs shall be in the core of the building, adjacent to, or in the core of the area served by that TR. The room requirements shall meet Section 3.02. Climate control shall be to standard office temperatures.

Telecommunications Room Sizing/Number Required

TRs shall be provided on each floor unless otherwise permitted, according to Table 2: *TR Sizing*. Additional TRs shall be provided when the floor area served is greater than 1000 m2 (10,000 sf), or the distribution distance to the work area exceeds 90 m (295 ft).

Service Area		Closet Size	
m²	ft²	mm	ft
1000	10,000	3000 x 3400	10 x 11
800	8000	3000 x 2800	10 x 9
500	5000	3000 x 2200	10 x 7
under 500 (small buildings only)	< 5000	2440 x 2440 min. walk-in closet	8' x 8' minimum

Table 2: TR Sizing
(EIA/TIA 569 Table 7.2-1 Modified)
Maintain working space and clearances per NEC.

Grounding

Grounding shall be in accordance with NEC, local codes, and the additional requirements in ANSI/TIA-

607-D and installed by a licensed electrician. When there is a code conflict the most stringent requirement shall be followed.

TGMB
Install within 5 feet of the main electrical service of any building with more than one TR. Bond to the electrical service with a TBB. The TGMB and TBB's shall be protected from damage, tampering and the weather.

TGB
Install one in each TR on one of the backboards. Ground to the TGMB if installed for this building or directly to the main electrical service for the building when a TGMB is not installed with a TBB.

TBB
Minimum #6 AWG up to maximum 3/0AWG, size according to NEC grounding electrode conductors and any additional requirements in TIA-607-B.

Where there is a load center co-located in the same room as telecom equipment, this load center shall be bonded to the ground bar in addition to the load center's normal grounding path.

All protection devices, frames, racks, cabinets, and telephone and data equipment shall be bonded to the TGB according to NEC, and the additional requirements in TIA-607-D. When compatible or more stringent than code, follow grounding instructions of the equipment manufacturer.

Grounding paths to the ground bar shall be kept short, (under 1 meter (3.3 ft), install additional isolated ground bars as needed). **Do not form ground loops**.

Copper Wire and Cables

Horizontal Cables
All wiring and wiring component installation shall meet the requirements of ANSI/TIA/EIA and BICSI TDM, CAT6A installation procedures, and all applicable manufacturer installation requirements. The maximum cable length between the TR to WA telecom outlet box shall not exceed 90 m (295 ft). Cabling to facilitate the connections to Wi-Fi access points in the ceiling or on the wall shall be the same as for all other Horizontal cabling. Refer to Section 3.09 *Identification, Labeling, and Documentation Requirements* for labeling instructions.

Two (2) continuous (no splicing allowed), horizontal cables shall be installed to each WA and Wi-Fi telecommunications outlet box from the serving TR.

Voice, radio, and data cables shall not be placed in the same conduit or raceway with electrical power distribution components according to NEC.

Each WA or Wi-Fi cable shall be terminated on a separate T568A telecommunications outlet/connector, and on the serving TR, CAT6A patch panel, at the other end.

Work Area Telecommunications Wall Outlet Box
Shall be located as identified in the design layout. The work area telecommunications outlet box should be located within 1 m [3 ft] of an electrical outlet and installed at the same height if appropriate. The telecom outlet boxes shall be located and recessed in the wall, floor, or power pole so that a faceplate can be flush mounted. Wi-Fi outlet boxes can be mounted above the drop ceiling or flush with the ceiling tiles or hard ceiling.

Furniture Systems Horizontal Pathways

The contractor shall install all wire and cables in furniture systems per EIA/TIA-569-C, Furniture Pathways and Spaces. A minimum of Two (2) CAT6A connections are required in each workstation.

The Government will install all cross-connect cables for voice, fax, radio and data application.

Backbone Cable

Intra Building

Install a minimum of twenty-four 4 pair CAT6A cables and terminate them on a 24-port patch panel or greater. Backbone cables shall extend from the ER to TRs in a physical star topology. Each TR is wired to the ER main cross-connect or to an intermediate cross-connect then to a main cross-connect. No more than two hierarchical levels of cross-connects are allowed in the backbone wiring. CAT6A cables to be used for local area network connections shall terminate on CAT6A patch panels mounted on an equipment rack. CAT6A cables to be used for other digital applications, paging applications, analog applications requiring low voltage shall be terminated on a 66 block, with stand offs.

Underground Inter Building

Install one approved 24AWG 25-pair direct cable (Superior Essex PE89-25P) for interbuilding runs less than 1000 feet, or one approved 22AWG 25-pair direct burial cable (Superior Essex 20-062-05) for runs longer than 1000 feet. The cable pairs must be terminated at each end on a Circa Telecom 1880ENS1-25 to meet NEC. Install the over voltage surge protection device for each pair entering or leaving the EF.

Fiber Optic Backbone Cable

Install fiber optic backbone cables for inter-building and for all intra-building connections between TR's, ER and EF.

Fiber optic, backbone cables shall extend from the ER in a physical star topology. Each TR is connected to the ER via a main cross-connect or an intermediate cross-connect then to a main cross-connect. No more than two hierarchical levels of cross-connects are allowed in the backbone cabling.

Terminations

Install specified connectors on all fiber strands when installing fiber optic cable.

Light interface units (LIU) or termination enclosures shall be installed at each TR as required for terminations. The recommended 3 m (10 ft) slack for fiber optic cables will be stored in an extended loop or in a figure-eight.

The Government will install all fiber optic cross-connect cables.

Protection from Physical Damage

The cable network shall be structured and equipped in accordance with NEC and EIA Standards to minimize vulnerability. All wire and cable shall be routed away from potential sources of mechanical and electrical damage or interference. All exposed interior and exterior cables shall be protected from physical damage by installing it in the conduit type required by NEC.

Support

Telecommunications wiring shall be secured and supported using cable trays or J-hooks. If J-hooks are used, the cabling shall be supported between 48 and 60 inches off-center. The cabling will be supported not more than 6 inches (150 mm) from equipment racks, frames, and terminals. Attic joists, suspended ceiling panels, duct work and other similar items are not allowed for cable support.

Support devices are required above and below termination devices to support the cross-connects.

These support systems shall contain only telecommunication cable; electrical cable is not allowed to be placed in the same systems.

Pathways

Provide cable trays or wire basket support systems above the ceiling or below the floor for telephone and data cabling for all main corridors ***(implied corridors in open office areas and/or partitioned corridors)***, i.e., from TRs and ERs to the work areas and sized in accordance with NEC, TIA 568-C and TIA-569-C specs and NEMA VE-2. The system is for exclusive use by Government and shared partners. The type and location of wire ways shall be determined during the building design in accordance with NEC and the additional requirements of NEMA VE-1.

The tray/basket type support capacity shall be determined in accordance with the manufacturer's maximum recommended load capacity. A 50% fill capacity shall not be exceeded, and cables shall be stacked no higher than 6".

If the pathway is in the ceiling, allow for 12" of clear vertical space above the tray/basket type systems and 6 inches between the suspended ceiling and the cabling pathways. Ceiling tiles shall not be placed higher than 11 ft AFF. If the building does not have a T-bar grid suspended acoustical ceiling with access to plenum and trays, a minimum of one access point per room must be provided.

Bond metal pathway systems to the telecommunications grounding and bonding system. Space at least 12" from trays of other systems. Access must be provided between floors for the connection of the support system. The horizontal pathway placement shall be coordinated between the various trades that use the space.

Pathways other than main corridors (auxiliary runs) – When using J-hooks, the internal diameter shall be no larger than 2 inches. Installation and fill ratio must adhere to manufacturer's guidelines.

Required Conduits

Off premise entrance conduit shall include at least two 100 mm (4 in) RSC per building stubbed out from the EF for telephone entrance, etc., NEC Section 8. Sharing entrance facility conduit with separate providers is not allowed.

Provided the cables and radio equipment are installed correctly and the cables have adequate separation (min 12" is typical), Radio frequency (RF) interference should not occur. Radio antenna lead locations will be identified in the ASR.

Innerduct tubing shall be installed in each backbone pathway where fiber optic is used and sized to accommodate the BICSI TDM recommended fill capacity.

A ¾" conduit minimum shall run from each telecom work area outlet box, through the wall, to

accessible locations above the ceiling or below the floor. The conduit shall terminate horizontally, above or below all obstructions and readily accessible, directed toward the horizontal pathway. Size this conduit for the installed horizontal cables plus 2 spare uninstalled cables.

All exposed cables shall be protected from physical damage by installing in an approved wire way.

Conduit Sizing

Backbone and inter building conduits shall be sized to include 25 to 30 percent spare capacity for future cables. Conduits shall be sized according to ANSI/TIA/EIA 569 as depicted in Table 3: *Conduit Sizing*, unless a larger size is specified. Minimum 4" conduit required between buildings.

Conduit			Number of Cables or Wires									
Internal Diameter		Trade Size	Wire O.D. mm (in)									
mm	(in)		3.3 (.13)	4.6 (.18)	5.6 (.22)	6.1 (.24)	7.4 (.29)	7.9 (.31)	9.4 (.37)	13.5 (.53)	15.8 (.62)	17.8 (.70)
15.8	0.62	1/2	1	1	0	0	0	0	0	0	0	0
20.9	1.82	3/4	6	5	4	3	2	2	1	0	0	0
26.6	1.05	1	8	8	7	6	3	3	2	1	0	0
35.1	1.38	1-¼	16	14	12	10	6	4	3	1	1	1
40.9	1.61	1-1/2	20	18	16	15	7	6	4	2	1	1
52.5	2.07	2	30	26	22	20	14	12	7	4	3	2
62.7	2.47	2-1/2	45	40	36	30	17	14	12	6	3	3
77.9	3.07	3	70	60	50	40	20	20	17	7	6	6
90.1	3.55	3-1/2	-	-	-	-	-	-	22	12	7	6
102.3	4.02	4	-	-	-	-	-	-	30	14	12	7

Table 3: Conduit Sizing (TIA 569-C)

Conduit Installation

All conduit installations shall meet NEC and the additional requirements in the BICSI TDM manual and shall be bonded and grounded according to ANSI J-STD-607-A. Changes in direction shall be sweeping bends or pull boxes. Maximum of 30 m (100 ft) between pull boxes where installed above ground.

Minimum burial depths shall be per NEC Chapter 3. A pull cord shall be installed in all backbone and innerduct tubing.

Identification, Labeling, And Documentation Requirements

A numbering system shall be used for the wiring, in which a single sequence of numbers does not serve more than one office number. This numbering system shall consist of a unique telecommunications outlet/connector numbering plan. The numbering system shall be consistent throughout the building or campus.

All termination devices shall be stenciled and labeled in accordance with ANSI/TIA/EIA606-A standard.

The horizontal cable from the telecom outlet box to the TR shall be labeled with identical information at each end.

RF cables shall be marked with rings of 3-4 wraps of colored ¾" electrical tape (e.g. Scotch 35). Marking tape shall be applied within 6" of the indoor terminal connector and every 10 feet thereafter. If the final mark is more than 3 feet from the outdoor terminal connector, a mark shall be applied within 6" of that connector, as well. Marking colors shall be Red for VHF band, Yellow for UHF band, Blue for 800MHz band, and Green for any frequency above 1GHz. In cases where more than one cable for a band exists, additional rings of the appropriate color spaced 2" apart shall be applied (2 for second cable, 3 for third, etc.) Cables shall also be tagged with information for their associated antennas. Tags shall contain the antenna type and location on the tower (side/leg & height).

Upon completion of the installation, wire and cable plans shall be prepared and posted in each Telecommunications Room. Within thirty (30) days after occupancy, Contractor must provide the Contracting Officer with as-built drawings to a scale of 1/8" equals one foot on via digital means (flash drive, email) to the Contracting Officer. As built drawings must identify all wire and cable, including cable tray layouts.

Testing and Reliability

The contractor shall test the system in the presence of the Contracting Officer or other agency representatives. Tests shall be made of each cable segment with copper and fiber optic certifying devices (tester), a printout of each cable segment shall be given to the Contracting Officer. All certification data will be provided to the Contracting Officer digitally (flash drive, email).

The CAT6A cable system shall be certified to meet the ANSI/TIA/EIA568C.0, Transmission Performance Specifications for 4-pair CAT6A cabling. All grounds, opens, shorts or other cable or connecting component defects shall be rectified and certified at no extra cost to the agency before acceptance.

Fiber Optic cable shall be certified to meet the Fiber Optic Test Procedure (FOTP) Standards developed and published by the Electronic Industries Association (EIA) under the EIA's RS-455 series of standards, for the type of fiber optic cable installed.

RF cables shall be tested with a suitable antenna analyzer (e.g. Bird Sitehawk, Anritsu Site Master). Markers shall be set at site specific frequencies and measurements displaying either SWR or Return Loss shall be captured by screenshot or suitable jpeg output file showing the waveform and the values at each marker. Acceptable measurements shall be ≤ 1.5:1 for SWR or ≤ -14dB for Return Loss. Any cable not passing acceptance shall be corrected. All certification data will be provided to the Contracting Officer digitally (flash drive, email).

Firestopping

The methods, materials, and considerations for reestablishing the integrity of fire-rated architectural structures and assemblies, required by building codes must be observed when these barriers are penetrated by cables, pathways, or other penetrating elements.

Coordinate each firestop selection with adjacent work for dimensional or other interference and for feasibility. In areas accessible to the public and other finished areas, firestop systems work shall be selected, installed, and finished to the quality of adjacent surfaces of building construction being penetrated.

Use materials without irritating or objectionable odors when firestopping is required in existing buildings and areas that are occupied.

Provide damming materials, plates, wires, restricting collars, and devices necessary for the installation of firestopping. Remove combustible installation aids after firestopping material has cured.

All firestops shall be installed in accordance with the manufacturer's instructions in order to maintain the specific rating assigned.

Firestopping must be inspected by the local Fire Marshall and verified by the Contracting Officer or other designated Government representative. If firestopping is exposed for inspection as directed by the inspecting authority to permit his or her inspection, reinstall new firestopping and restore work where removed for inspection. This requirement exists because firestopping is often installed when an inspecting official is not available.