

Networking & Telecommunications Design Standards

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INFORMATION TECHNOLOGY
COLORADO STATE UNIVERSITY

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1 Introduction

1.1 General intent

This document provides design specifications for voice, video and data communications infrastructure at Colorado State University (CSU), otherwise referred to as the University. Enterprise Application and Infrastructure Networking & Telecommunications Services, oversee data/voice/video infrastructure design, construction, installation, operation, maintenance, upgrades and monitoring for CSU sites.

While various construction challenges may dictate modifications to these specifications, any modifications require written approval by Networking & Telecommunications.

Changes to these specifications, with or without written approval, may incur time and materials charges for any subsequent support of the facility and its installed data/voice/video infrastructure.

1.2 Teams Involved in Design Process

Several teams are responsible for the communications infrastructure and should be involved in the design process. These include 1) Telecommunications for the physical Infrastructure, 2) Networking and Security Operations for the network equipment and video and 3) Classroom Support Services for classrooms. Contacts for these units are given below.

Table 1. Contacts

Team	Name	Role	Phone
Enterprise Applications & Infrastructure	Jason Huitt	Director of Networking & Telecommunications	(970) 491-2511
Telecommunications Projects	William Tremelling	Team Lead	(970) 491-3839
Classroom Support Services	Jamie McCue	Interim Team Lead Classroom support	(970) 491-4147
	Allen Sneesby		(970) 491-6038

The Telecommunications Projects Team Lead is to be involved in all phases of design and construction along with any time questions arise during the project.

1.3 Applicable Standards

This document provides interpretation of the standards referenced in the previous paragraph and provides additional detail, in some cases superseding those standards. Where Systemax guidelines differ from ANSI/TIA standards, the Systemax guidelines supersede the ANSI/TIA standard. Should the contractor require additional interpretation of these design guidelines, the contractor shall contact the designated University representative (Table 1)

Telecommunications physical infrastructure as defined by the American National Standards Institute/Telecommunications Industry Association, or ANSI/TIA, consists of seven elements: 1. Horizontal Infrastructure; 2. building main telecommunications room or Main Distribution Frame (MDF); 3. backbone cabling; 4. Intermediate Distribution Frames (IDFs); 5. Entrance facility (EF); 6. Outside plant; 7. Networking equipment required to provide data/voice service for the building. Also included are basic specifications for the delivery of broadband television services via a hybrid single-mode fiber optic and coaxial cable system.

In general, the following standards at a minimum shall be observed for telecommunications infrastructure and are incorporated herein by reference:

- ANSI/TIA 568-2017 Commercial Building Telecommunications Cabling Standard
- ANSI/TIA 758-B-2012
- ANSI/TIA 569-2012 Commercial Building Standard for Telecommunications Pathways and Spaces
- ANSI/TIA 607-A-2014 Commercial Building Grounding and Bonding Requirements for Telecommunications
- NEC-2017
- BICSI DD 120-Grounding Fundamentals for TELCO Facilities Chapter 4 Telecommunications Systems Grounding (as reference)
- IEEE 802.3-2006
- Systemax Structured Cabling System (SCS) standards
- TDMM BICSI 14th Edition volumes one and two
- BICSI ITSM 8th Edition

This document interprets the standards referenced in the previous paragraph and provides additional detail, in some cases superseding those standards. Where Systimax guidelines differ from ANSI/TIA standards, the Systimax guidelines supersede the ANSI/TIA standard. Should the contractor require additional interpretation of these design guidelines, the contractor shall contact the designated University representative (Table 1).

Table 2. Standards Hierarchy

System	Purpose	Substitutions
ANSI/TIA/NEC/BICSI	Grounding, Bonding, and Fire-stopping	None
Corning	Fiber Optics Glass	None
Systimax Structured System (SCS)	Category 5e, 6, 6a Copper Cabling	None
ANSI/TIA	Data	None
ANSI/TIA	Voice	Must be pre-approved in writing

1.4 General Guidelines

Integral to the telecommunications infrastructure in buildings is to secure communications rooms, consisting of the MDF and, generally, one or more IDFs. These rooms must be secure, environmentally conditioned, and clean before Telecommunications can work in them, especially as fiber must be terminated in these rooms. Expensive and delicate networking devices that require environmental conditioning are also housed in these rooms. The MDF and IDFs shall be completed including environmental conditioning early in the project timetable. All penetrations shall be completed and sealed (e.g., capped) before Telecommunications work can continue in these environments.

1.5 Equipment and Materials Specifications

Check with Telecommunications Contact, Table 1, to ensure use of the latest materials list.

Note that there are some materials for which no substitutions are allowed. Where substitutions are allowed, these must be pre-approved in writing in an addendum prior to the final design bid. Questions about substitutions of these materials should be referred to the University designated representative (Table 1 Contacts)

1.6 Contractor Certifications

CSU requires contractors to be a Systimax Solutions Premier or Select Installation Partner and listed on commscope.com. Approval of certification must be submitted to Networking & Telecommunications. In addition, Networking & Telecommunications requires that contractor provide Technicians and Installers certified by the Building Industry Consulting Service International, Inc. (BICSI) permanently assigned for the duration of the CSU project. Networking & Telecommunications requires a minimum of one (1) BICSI certified technician and a ratio of one (1) BICSI certified installer to three (3) installation workers.

Please refer to Table 1 Contacts for the Networking & Telecommunications contact person for questions regarding this section.

1.7 Exceptions

Any exceptions to these standards are to have documented approval by Networking & Telecommunications or may incur additional charges to address any labor or material necessary to address the changes.

2 Horizontal Infrastructure

2.1 General Provisions

Systemax Structured Cabling System (SCS) Category 6a cable, connectors, and fixtures shall be used for horizontal data cabling. Data cable runs shall be strictly limited to 90 meters in total length, according to standards. IDFs are to be located to maintain less than a total 90-meter cable run. All cabling is to run to same floor communication room.

Per Systemax cabling warranties no cabling is permitted to be painted, it is a violation to do so and subject to be replaced at contractor or project's expense.

2.2 Cable Colors

The following is the color standard for all horizontal cables on campus. Cat 6A cabling is the standard in all new construction. Remodels use of Cat6A will be evaluated on a case-by-case basis. Exceptions to this as granted only by the Vice President of Information Technology.

Table 3 Cable Color

	Cat. 5e plenum (installed only at direction of VP of IT)	Cat. 5e non-plenum (installed only at direction of VP of IT)	Cat. 6 plenums (installed only in legacy locations)	Cat. 6 non-plenums (installed only in legacy locations)	2091b Cat. 6a plenum	Cat. 6a non-plenum
Cable	Orange	Gray	White	Yellow	White	Blue
Jack	Orange	Orange	Red	Red	Blue	Blue

Cat. 3 (no longer being installed) data jacks are Ivory.

2.3 Plenum Spaces

Plenum cabling or conduit shall be used in plenum spaces, this includes under floor space. Contractor shall determine prior to work being started, in consultation with CSU Telecommunications and CSU Facilities, whether the space is a plenum space.

2.4 Underground Cable

All cable placed in raceways installed underground shall be rated for wet locations.

- Making sure that equipment is protected with proper grounding and surge protection.

2.5 Patch Cords

The following is the standard color code for patch cords.

- Data - Red/Gray
- VoIP - White
- Security Cameras, Card Key, Meters, EMS, Facilities - Green
- Wireless -Yellow
- A/V - Violet
- Switch to Switch Link - Orange
- Department Specific - Light Blue

Patch cords must be of proper length to eliminate "Jump Rope" and "Banjo" style of patching.

2.6 Asbestos

Buildings to be wired shall be inspected by CSU Environmental Health Services for Asbestos Containing Material (ACM). Where ACM exists, the University will decide whether to abate the asbestos or circumvent the asbestos by, for example, installing telecommunications infrastructure under the ceiling tiles.

2.7 Conduit

Please refer to Building Industry Consulting Services International (BICSI) Telecommunications Distribution Methods Manual 14th Edition, Section 2 – Horizontal Pathway Systems, Chapter 5 – Horizontal Distribution Systems, and Telecommunications Distribution Methods Manual v. II, Appendix A – Codes, Standards and Regulations, p. A7-A8 for details on the installation of conduit.

All conduits shall be in a minimum of 1" EMT unless noted otherwise by Networking & Telecommunications. All conduits are to be supplied with a pull string from the electrical contractor.

Conduit capacity shall be as follows: For a 1" conduit a maximum quantity of 3 Cat6a cables with a single gang "p" ring. Quantities greater than this will require a double gang "p" ring and an additional 1" or upsizing to 1.25" conduit stubbed to cable tray with a maximum of 6 cables per location.

All conduits are to be routed continuously to nearest cable tray or MDF/IDF if no cable tray is present.

All one (1") inch Conduits installed to the cable tray will require Bonding and grounding connection at each run to the cable tray. If there are multiple conduits in one area, they can be bonded to a single point to the tray bond with a 12 gauge or larger conductor attached to a bond bushing and connector.

When utilizing multiple 2" conduit runs, no more than 5 (five) 1" conduits shall be run to a common 18" x18" j-box. More than 5 (five) 1" conduits will require an additional 2" conduit "homerun" feed.

Table 4 Conduit Fill Capacity

Number of Cables	Percentage Fill
1	53%
2	31%
>2	40%

2.8 Installation of Cable Trays

Install cable trays with space to permit access for installing the cables. Clear space shall be provided above the top rail equal to the loading depth but not less than 12 inches. Provide lateral clearance of 24 inches on at least 1 side of the trapeze hung tray. CSU prefers aluminum ladder type cable tray with 9" spacing on rungs. All cable trays must be trapeze hung. The use of wire baskets is discouraged. If wire baskets are to be used, please contact the Networking & Telecommunications Contact, Table 1, to discuss installation requirements.

In the event of an unforeseen obstacle requiring the cable tray to be transitioned from tray to conduit, the conduit shall be equal to or greater than the square inches of tray being replaced.

Every effort should be made to minimize changes in elevation or direction in the cable tray. If it becomes necessary to do so, those changes shall be accomplished by using factory manufactured and approved "UL" listed connections for bonding purposes.

All components within the cable tray system shall meet grounding and bonding requirements.

Cables shall be pulled with no more than a 25-pound pull force applied at any time during installation.

Cable trays are to be installed early enough in the process to minimize disruption to the trays during subsequent construction.

2.9 Testing and Reporting of Test Results

All cable installed shall be tested using a calibrated Fluke Series DSX-5000 Tester or higher version in accordance with the latest EIA/TIA 568 standards, and the results recorded on a separate USB stick as a FLW file for each building and provided to Networking & Telecommunications.

The Networking & Telecommunications contact from Table 1 shall be notified prior to any testing so that the representative or designate may be present during the testing. If the circuit testing is conducted in the absence of the University representative or designate, then the University may request a retest with the University representative present at the tester's expense.

2.10 Systimax Certification

CSU requires that upon completion and testing of each building/project, Systimax certification be obtained. The Telecommunications contact person is responsible for coordinating the Systimax certification and facilitating any remedies. Please refer to Table 1 – Contacts for the name of the Networking & Telecommunications contact.

2.11 As-Builds

Upon completion of termination and testing, as-build drawings of all drops shall be provided within four weeks for each major phase of work, such as 1) floors, 2) wings, or 3) entire buildings. The as-build drawings shall be provided in AutoCAD version 2013 or higher format. These files are to be on a separate USB stick for each building.

2.12 Drop (Circuit) Labeling

Each drop installed shall be labeled per CSU labeling scheme. Each drop shall be labeled on the front of the jack faceplate, on the patch panel in the IDFs or MDF, and on both ends of the cable.

2.13 Labels

Four labels per fiber cable, two for the cable and two for the fiber patch panel, shall be prepared for all fiber cables. The University may elect to install the labels.

2.14 Invasive Work

Invasive work (e.g., core drilling, hammer drilling or work that is noisy, dusty, etc.) shall be conducted during off-business hours. Other work shall be coordinated with the University designated representative (e.g., to pull cables during off-hours), and these arrangements shall be determined by mutual agreement.

2.15 Scheduling for the Pulling of Cable

Networking & Telecommunications crews will pull low voltage cable inside the building, terminate it at the specified wall jacks, test and certify the cable. To do this work, the contractor will need to coordinate with Networking & Telecommunications (see Table 1 "Contacts") to ensure cable work is scheduled and complete prior to the installation of the ceiling grid. This will allow easy access to the cable trays and ensure that Networking & Telecommunications crews do not damage the ceiling grid. If the ceiling grid is installed prior to cabling work, Networking & Telecommunications will not be responsible for any damage to the grid and will begin using contingency funds to pay for the extra labor expense.

3 Communication Rooms (TR)

3.1 General Provisions

Networking & Telecommunications room space, MDF and IDFs shall be dedicated to the telecommunications function and related support facilities. Equipment not related to the support of the Networking & Telecommunications functions shall not be installed, passed through, or entered in the telecommunications rooms without review by Networking & Telecommunications and consideration in the sizing of the space, environmental requirements, etc. such equipment should be installed in the EF.

In rare cases where the project manager and Networking & Telecommunications agree to host equipment from a non-CSU entity and that entity desires unsupervised access to the communication room, the project must provide for: 1) Cardkey access on the communication room door; 2) locking cabinets for CSU equipment; 3) Any other security arrangement deemed necessary by Networking & Telecommunications.

Networking & Telecommunications CANNOT install equipment in communications rooms prior to the completion of the following items: (a) permanent dedicated power, (b) proper grounding and lighting, and (c) secure permanent door and two keys provided to the Telecommunications Contact. Networking & Telecommunications REQUIRES a minimum of three (3) weeks from the completion of the aforementioned items until the service data for the following services: (a) elevator telephones, (b) fire alarm(s), (c) door security, (d) environmental controls, and (e) voice, data and/or video services.

Networking & Telecommunications strongly recommend that early in the design phase all parties desiring to install equipment in the MDF and/or IDFs be collectively engaged to discuss placement of equipment and determine size requirements for the communications rooms including any servers or equipment to be mounted in the rooms. Signatures and permission must be obtained in advance for any non Networking & Telecommunications/Facilities operated equipment to be mounted in the communication rooms ("Networking & Telecommunications Room Installation Agreement"). Forms are available via Networking & Telecommunications contact listed in Table 1.

ANSI/TIA 569 shall be strictly observed for all Telecommunications rooms, EF, ER, TR, TE, also known as MDF, IDF. Such requirements as not sharing with electrical rooms, sources of electromagnetic interference (EMI), radio frequency interference (RFI), perimeters (no false ceilings), limited access (i.e., security), HVAC, lighting and electrical. All exterior mounted electrical panels must be approved by contacts in table 1.

All Telecommunications rooms will comply with codes and standards from BICSI and ANSI/TIA 569 revision.

BICSI Heat dissipation 751 to 5016 BTU (220 to 1470 watt-hours) per cabinet/rack

ASHRAE Class A1, A2, A3, and A4 environmental requirements for telecommunications spaces are provided along with the additional guidance that temperature and humidity should be controlled to support continuous operation in the following ranges:

Temperature: 18 – 27°C (64 – 81°F). Maximum relative humidity (RH): 60%.
Minimum dew point: -9°C (16°F). Maximum dew point: 15°C (59°F)

Temperature and humidity specifications provided for distributor rooms, distributor enclosures, entrance rooms or spaces, access provider spaces, service provider spaces, and common distributor rooms are as follows:

Temperature: 5 – 35°C (41 – 95°). Minimum relative humidity (RH): 8%
Maximum relative humidity (RH): 80%. Maximum dew point: 28°C (82°F)

All remodel and restoration projects will be held to, and strictly enforcing new codes and standards for installations.

3.2 Main Distribution Frame (MDF) Entrance Facility (EF) Equipment Room (ER)

Networking & Telecommunications shall provide customized communication room designs based on the requirements of each project. Please contact the Telecommunications Contact Table 1 page 3.

The following are general guidelines in the absence of a custom communications room design.

Buildings shall have an MDF where voice, video and data enter the building. The MDF also serves as the distribution point for voice, video and data and shall be secure to protect the integrity of these systems, particularly E911 services.

Grounding and bonding shall be provided in the MDF that includes bonding to equipment racks, cable trays and telecommunications conduits in strict accordance with the ANSI/TIA 607 standard, the most current edition NEC, and as a reference *BICSI DD 120-Grounding Fundamentals for TELCO Facilities, Chapter 4 Telecommunications System Grounding* and extended to all IDF as described therein. All penetrations of the MDF envelope shall be fire-stopped.

In buildings of size 5,000 square feet or greater, a secure room dedicated to telecommunications shall be provided for the MDF. In smaller buildings, a secure wall-mounted Hoffman box may be an option in lieu of a separate, dedicated room.

ANSI/TIA 569 shall be strictly observed for the MDF, such as not sharing with electrical rooms, sources of electromagnetic interference (EMI), radio frequency interference (RFI), perimeters (no false ceilings), limited access (i.e., security), HVAC, lighting and electrical.

MDF Power Requirements:

MDF shall be provided with four dedicated and one general use circuits.



5-20R

Two 20 amp, 120 volts NEMA 5-20 terminated on double duplex outlets,



L6-30R

and two 30 amp, 208 volts NEMA L6-30 outlet on the wall adjacent to the telecommunications racks. The general use outlet shall be near the door for ease of access – these locations shall be determined in consultation with Networking & Telecommunications.

Provisioning of power and receptacles for non-Networking & Telecommunications equipment requiring power installed in the MDF or IDFs is the responsibility and at the expense of the entity responsible for the equipment. No extension cords are acceptable whether they are loose on the floor or tied to the infrastructure.

No piping (sewer, water, or other fluid), ductwork, mechanical equipment, or power cabling or similar shall be allowed to pass through a MDF that is not associated with the communications services in that specific MDF. Switched lighting of 50-foot candles shall not be sourced from the same circuit as the telecommunications equipment.

MDFs (entrance facilities) shall be environmentally conditioned to accommodate network equipment loads up to 10,000 BTU/hr. Temperature in MDFs (entrance facilities) **shall not exceed 80°F**.

The MDF shall have 3/4" A/C fire treated plywood backboards to be installed on all walls, 8' high starting at least 3.5" from floor and painted with matte white paint. All fire-rated labels must be masked off prior to painting and left clearly visible.

The MDF serves as the fiber distribution point for the building and houses the network equipment.

In a multi-story building, there should be a Telecom room on each floor, centrally located. CSU requires that the MDF be located on the ground floor. All data cable runs are to be limited to 90 meters in length.

The MDF shall be large enough to accommodate at least two 7'x19" relay racks and 3 - 12" vertical organizers; one rack for the building fiber and copper distribution and the other for the building data switches and associated UPS. The MDF shall also accommodate the voice and video distribution systems which may be wall or rack mounted.

All raceways into the MDF envelope shall be a fire barrier pathway.

Table 5. MDF Sizes

Building Size (ASF)	MDF Size (Length x width - ft)
Less than 5,000	Hoffman Box
5,000 to 10,000	10x8
10,000 to 50,000	10x12
50,000 to 100,000	12x12
100,000 to 150,000	14x14
150,000 to 200,000	14x16

Doors shall open outward and adhere to all fire codes. It may be necessary to install double-opening doors for this purpose. Self-closing locksets shall be used to ensure doors are secure upon their closure. All MDF (ER) "Equipment Room", doors will be Secured with electronic door access and the newest Medeco M3 lockset

3.3 Intermediate Distribution Frame (IDF) Telecommunications room (TR) Telecommunications Enclosure (TE) Cubit/Hoffman box (HB)

Networking & Telecommunications shall provide customized communication room designs based on the requirements of each project. Please contact the Networking & Telecommunications Contact Table 1.

The following are general guidelines in the absence of a custom communications room design.

Grounding and bonding shall be provided in the IDF that includes bonding to equipment racks, cable trays and telecommunications conduits in strict accordance with ANSI/TIA J-STD-607-A-2002 standard, the most current edition NEC, and as a reference *BICSI DD 120-Grounding Fundamentals for TELCO Facilities, Chapter 4 Telecommunications System Grounding* and extended to all IDFs as described therein. All penetrations of the IDF envelope shall be fire-stopped.

ANSI/TIA 569 shall be strictly observed for the IDF, such as not sharing with electrical rooms, sources of electromagnetic interference (EMI), radio frequency interference (RFI), perimeters (no false ceilings), limited access (i.e., security), HVAC, lighting and electrical.

IDF/ Telecommunications room TR Power Requirements:

IDF shall be provided with four dedicated and one general use circuit.



Two 20 amp, 120 volts NEMA 5-20 terminated on double duplex outlets.



IDF/ Telecommunications Enclosure TE Cubit/Hoffman box shall be provided



with four dedicated and one general use circuit.

All TE enclosures will meet or exceed all normal telecom requirements except for unique scenarios for equipment needs. Please contact a CSU representative Contact Table 1 on all Telecom enclosure (TE) builds for all projects.

and two 30 amp, 208 volts NEMA L6-30 outlet on the wall adjacent to the telecommunications racks. The general use outlet shall be near the door for ease of access – these locations shall be determined in consultation with CSU Networking & Telecommunications.

Provisioning of power and receptacles for non-Networking & Telecommunications equipment requiring power installed in the MDF or IDFs is the responsibility and at the expense of the entity responsible for the equipment. No extension cords are acceptable either "loose" on the floor or tied to the infrastructure.

No piping, ductwork, mechanical equipment, or power cabling or similar shall be allowed to pass through an IDF that is not associated with the communications services in that specific IDF. IDFs shall be supplied with 50 foot-candles of switched lighting, which shall not be sourced from the same circuit as the telecommunications equipment.

Each floor shall have a dedicated IDF. IDFs shall be environmentally conditioned to accommodate network equipment loads up to 7,000 BTU/hr. Temperature in IDFs **shall not exceed 80°F**.

The IDF shall have 3/4" A/C fire treated plywood backboards to be installed on all walls in the IDF, 8' high starting 3.5" from floor and painted with matte white paint. All fire-rated labels must be masked off prior to painting and left clearly visible.

IDFs shall be located at points that minimize the runs of the data network to the end user, typically in the center of wings of buildings. Data cable runs are to be limited to 90 meters, and this may affect placement of the IDF or require additional IDFs (telecommunications rooms) to be added.

IDFs shall be sized such that there is ample room to install racks to house the equipment. The IDF shall be sized to accommodate a minimum of two vertical 7'x19" relay racks and 3 - 12" vertical organizers: one for the fiber, an IDF switch, and UPS; and another for edge network equipment. Ideally, there shall be 48" of space on each side of the rack lineup. Preferably, the MDF and IDFs shall be vertically stacked within the building.

IDFs shall be sized to accommodate all connections that may potentially be used from that room. In a typical scenario, an IDF would serve an area of approximately 10,000-15,000 Assignable Square Feet (ASF), depending on density of connections deployed from the IDF.

Table 6. IDF Specifications

Serving Area	Number of Jacks	Room Size
10,000 sq. ft.	361-480	10x12
8000 sq. ft.	241-360	10x10
5000 sq. ft.	0-240	10x8

ANSI/TIA 569-B 7.11.5.1.1

Additional rooms, one for each area up to 10,000 square feet or the horizontal distance to the work area exceeds 250 feet, shall be required.

Doors should open outward, adhere to all fire codes, and secured with self-locking locksets. All doors will be Secured with door access and the newest Medeco M3 lockset. It may be necessary to install double-opening doors for this purpose.

The communications rooms shall not be located below water level unless preventive measures against water infiltration are employed. The communications rooms shall be free of water or drainpipes not directly required in support of the equipment within the communications rooms. A floor drain shall be provided within the room if the risk of water ingress exists.

3.4 Offices, Conference Room, Lab Room, Utility Room

Except for minimum numbers of jacks, the following are suggested configurations. In all cases, the final numbers of jacks should be determined in consultation with CSU Telecommunications and the building occupants.

In every office, there shall be a minimum of two data locations, located on opposite walls, each location will have at least two data jacks.

-Typical rooms like conference, utility, hotel, labs, shall have at least one typical convenience outlet to the design.

Where conduit is used, 1" conduit with a 4 11/16" square box 2 1/8" deep shall be placed to each communications outlet.

3.5 Grounding and Bonding

In general, all grounding and bonding adhere to all current BICSI Telecommunications Distribution Methods Manual.

Also compliant to all NFPA 70, NEC, and primary ICT bonding and grounding design standards (i.e., ANSI/TIA 607, ISO/IEC 30129)

The telecommunications bonding backbone (TBB) shall be a copper conductor. The minimum TBB conductor size shall be a No. 6 AWG. The TBB should be sized at 2 kcmil per linear foot of conductor length up to a maximum size of 3/0 AWG. The TBB may be insulated. If the TBB is insulated, the insulation shall meet the fire ratings of its pathway. The sizing of the TBB is not intended to account for the reduction or control of electromagnetic interface. (See appendices H and I.)

Table 7. TBB Sizing

TBB length linear ft.	TBB Size (AWG)
Less 13	6
14 – 20	4
21 – 26	3
27 – 33	2
34 – 41	1
42 – 52	1/0
53 – 66	2/0
> 66	3/0

ANSI/TIA J-STD-607-A 5.4.4.1

All equipment shall be bonded to each rack's supplied bus bar in addition to not utilizing the power cord as the specified ground.

Lightning/Surge protection is required for all OSP cabling entering CSU facilities.

4 Riser/Building Backbone Infrastructure

The building backbone consists of fiber optic cable to support data, voice and video applications as well as copper cabling to facilitate any required analog services.

The infrastructure for the building backbone cabling shall consist of conduit between the MDF and each IDF where the run is vertical, or ladder racks (not hooks or rings) where the run is horizontal. Where conduits are run, separate conduits shall be used for copper cables and fiber cables. However, where runs are horizontal and ladder racks are used, both types of cables shall be run in a ladder rack.

EIA/TIA 569 shall be observed for the building backbone pathways. Conduits shall be sized to be no more than 40% full by volume. Long-radius metal sweeps shall be used instead of 90° fittings. No more than 180 degrees of bends between pull points shall exist in conduits without inclusion of a readily accessible and adequately sized pull box, the location of which shall be clearly marked on drawings. In situations where cable tray, conduit, or sleeves extend outside the MDF/IDF into occupied portions of the building, they shall be fire-stopped.

Both single-mode and 50-micron OM4 multimode fiber cable shall be run between the MDF and each IDF in a star configuration. At minimum, there shall be no less than 12 single-mode and 12 multimode fibers installed. A higher fiber optic pair count shall be permissible in consultation with Networking & Telecommunications. Fiber cables shall be run in conduit or innerduct if cable tray distribution method is selected. The fiber count depends on the number of data jacks in each IDF. One pair of multimode fibers is required for every 48 active data jacks with a 30% allowance for growth. Each number shall be rounded up to the next integer. Table 8 below illustrates fiber counts for a variety of situations:

Table 8. OM4/Single mode Fiber Counts

Number of active data jacks	Base fiber count	30% allowance	Total fiber count
96	6 pair	1 pair	3 pair
144	6 pair	1 pair	4 pair
240	12 pair	2 pair	7 pair
336	12 pair	3 pair	10 pair

Note that fiber bundles are available only in certain numbers of pairs. As an example, consider the example where bundles with 12 fibers (6 pairs) are used. For the second example above, 144 active jacks, one 12-count (6-pair) cable would be required. For the last example above, 336 active jacks, two 12-count cables would be required. On a typical installation of a composite 12 single mode and 12 OM4 multi-mode fiber installation between the MDF and IDF, all fiber connectivity will be Fusion spliced with factory polished LC connectors, and a minimum of two single mode fibers shall have factory Angle Polished Connectors (APC) to accommodate video transfer.

Single-mode fiber shall be pre-tested with an Optical Time Domain Reflectometer (OTDR) at 1310 nm & 1550 nm, upon cable delivery.

Multimode fiber shall be tested post installation at 850 nm and 1300 nm.

A bidirectional end-to-end test shall be conducted at dual wavelength for each fiber installed.

Prior to acceptance by the University, the OTDR and end-to-end test shall be randomly sampled and retested by the University.

Test results shall be electronically documented and submitted to the Networking & Telecommunications contact from Table 1.

Cable ladder racks shall be hung in a manner that ensures a minimum of 12" vertical clearance and 18" horizontal clearance on at least one side to allow for access to the ladder rack for cable installation and maintenance. Mount cable ladder racks 7' 6" AFF (above the finished floor) to be accessible by cable handlers using standard 6-foot ladders. Transitions where changes in height are unavoidable shall be gradually sloping. The cable ladder rack shall be routed so as not to interfere with installation of other systems or access to those systems for maintenance. Coordination with other systems shall be maintained so that where these systems traverse above or below the ladder rack, access shall not be blocked or interfered with. Cable ladder racks shall not pass-through firewalls. Instead, the ladder rack shall stop on either side of the firewall and be interconnected via multiple fire barrier pathways passing through the firewall. The bottom of these pass-through devices shall be aligned with the top of the cable ladder to ensure proper cable support and unrestricted passage. These pass-through Sleeving shall meet all necessary Fire codes.

5 Building Entrance Infrastructure

5.1 General Provisions

At the University, telecommunications typically enter the building into the Main Distribution Frame or MDF. Thus, generally at the University, the Building Entrance and the MDF are one and the same. In certain venues, Networking & Telecommunications may require the addition of an Entrance Facility to accommodate an interface between non-CSU service providers.

Buildings are required to have physically diverse paths to the campus fiber infrastructure from the MDF.

EIA/TIA 569 shall be observed for the building entrance. Underground conduits entering a building shall be dedicated for the exclusive use of Networking & Telecommunications and no more than 25% full by volume.

ANSI/TIA 758-B section 4.3 shall be observed in providing diverse entrance points and routes.

Networking & Telecommunications may request removal of unauthorized cable(s) within entrance conduits. Copper and fiber cables shall be brought into the building in separate conduit systems. There shall be no more than a total of 180 degrees of bends between pull points, using only large radius PVC coated GRC or fiberglass sweeps, shall be used in conduit runs between pulling points.

5.2 University Policy Governing Entrance Infrastructure

Networking & Telecommunications must be contacted, refer to Table 1 – Contacts, during the early planning stages for new constructions or remodels that will require new or modification of entrance infrastructure.

6 Outside Plant Infrastructure

6.1 Introduction and Project Conditions

The following specifications govern services contracted by Colorado State University (CSU). Contractors shall fully adhere to these specifications unless the University designated representative authorizes a waiver or modification in writing.

The contractor shall be responsible for conducting all potholing and/or locates of all utilities along the prescribed route. The contractor is responsible for contacting UNCC at 811. In addition, it is the contractor's responsibility to ensure that all utilities are located including CSU's utilities. Facilities Management telephone number is (970-491-0077).

Locate and protect existing utilities and other underground work in a manner that will ensure that no damage or service interruption will result from excavating and backfilling.

When applicable, the contractor shall be responsible for acquiring all relevant permits for streets, alleys, easements, utility corridors, etc. from the City of Fort Collins.

When utilities are damaged, the contractor shall immediately contact CSU Telecommunications (970-491-5881) Day time, or (970-491-2345) after hours emergency, and CSU Facilities Management (970-491-0077).

The contractor agrees to remedy all defects identified by CSU during the final inspection of the contractor's work. The scheduling of the remedies shall be approved by CSU. The contractor shall be responsible for obtaining a final work acceptance signature, from the University designated representative, on a mutually agreed upon "punch list" to indicate acceptance of the contractor's work by CSU.

The contractor is responsible for adhering to all applicable industry and personal safety standards, including, but not limited to OSHA standards.

The contractor shall be responsible for providing an as-build drawing. Please refer to As-Builds section in Chapter 2 for details. However, for outside plant infrastructure projects, the contractor in addition shall illustrate route(s), depth and benchmark measurements from existing landmarks and fixtures.

The contractor shall report on the progress of the work to the Networking & Telecommunications contact from Table 1 on a mutually agreed-upon schedule.

6.2 Landscaping, Irrigation Systems, Site Protection and Excavation

Contact CSU Facilities Management at (970-491-0077) for all requirements.

6.3 Directional Boring Specifications

Materials - Installed two-inch (2") inner duct, quantity to be determined. The inner duct shall have a No. 12 UF type tracer wire installed outside the duct along the entire path of the duct. The Networking & Telecommunications contact from Table 1 shall approve any deviation.

Conduit shall only have new 1800 lb. Sequential Mule Tape, supplied, and installed by the contractor, in each duct without knots and splices. The mule tape shall be exposed at least six feet (6') for aiding in tying on to cable. Polyrope shall not be accepted within the duct.

Installation - The inner duct shall be installed a minimum of forty-eight inches (24"-48") in depth. The inner duct shall have a gradual radius sweep into the J-box or a location marked by CSU prior to start of work (e.g., manhole). The inner ducts shall have duct plugs installed and secured around cable to prevent any debris from entering the conduit. All vacant inner ducts shall have a duct plug installed and secured.

Building Entrance Only: Inner ducts exposed on the exterior of a building shall have installed GRC fittings to National Electrical Code (NEC) specifications attached for building entry conduit and approved by CSU. Plenum and non-plenum areas may require additional consideration.

Splices, where applicable, shall be dug to the depth of the bore and be in a straight line with the two (2) adjoining bores.

Utility holes - shall be pumped and cleaned before and after work is completed. The manhole shall have sufficient racking drilled and mounted for cable attachment and service coil support. CSU shall be consulted for determination of service coil length and racking requirements. Inner duct entering through the manhole or concrete foundations shall be core drilled and have link seals installed.

Traffic Control - The contractor shall be responsible for providing traffic control commensurate with the requirements of the work it is conducting, and adheres to all municipal, State, and Federal guidelines and standards.

6.4 Trenching

Materials - The contractor shall coordinate with the Networking & Telecommunications contact from Table 1 and they shall specify and approve the vault(s) for each project.

The contractor shall install a four-inch (4") Yellow Caution Tape labeled "Caution" twelve inches (12") above from the nearest conduit located in the trench.

Conduit duct shall have a No.12 UF type tracer wire installed outside the conduit.

The Networking & Telecommunications contact shall approve any deviation.

Conduit shall have only new 1800 lb. Sequential Mule Tape, supplied and installed by the contractor, in each duct without knots and splices. The mule tape shall be exposed at least six feet (6') for aiding in tying on to cable. Polyrope shall not be accepted within the duct.

Installation of Conduit and Vault - All conduits shall be installed a minimum of 24"-48" in depth. When PVC conduit is placed in a trench, PVC coated GRC or fiberglass large radius sweeps shall be used.

The contractor shall ensure that the integrity of the vault is retained throughout its installation. To the extent necessary, the contractor shall internally brace the vault to ensure its integrity throughout installation and soil compaction.

Each newly installed or reinstalled vault shall be excavated 2' deeper to accommodate for 2' 1" minimum aggregate of rock to bring the vault to grade and maintain adequate drainage.

Vault sizes are available width x length x height; 30x48x24" 22tier lid rating and two-piece lid with middle bar support. Labeled Telecom or Telecommunication Vaults shall NOT be drilled or penetrated without prior approval.

Vaults shall be sized to neatly accommodate copper and/or fiber optic cables and service coils.

Conduits shall gradually sweep in below the bottom of the fiberglass vaults.

Ducts shall have duct plugs installed and secured around cable to prevent any debris from entering the conduit.

6.5 Steam Tunnel Cable Installation

Contact CSU Facilities Management at (970-491-0077) prior to commencing any work in the University steam tunnels.

7 Network Equipment

7.1 General Provisions

Buildings shall be supplied with a building data switch and sufficient edge switches to provide network access to current users. Networking & Telecommunications shall be responsible for specifying the specific brand and model for network equipment. Using this standard equipment will ensure that the network equipment is compatible with campus backbone network equipment. This is the only way to ensure that performance, advanced features such as Quality of Service (QoS), multicast, security, and manageability, will exist and interoperate with campus networking Infrastructure. All switches and related network equipment must adhere to CSU's Network Operations Policy <http://policylibrary.colostate.edu/policy.aspx?id=718>

7.2 General Switch Standards:

- If more than two 1U switches are required to provide sufficient connectivity, a chassis-based switch shall be used in place of 3 or more 1U switches.
- All switches are to provide 10G uplinks capability.
- All switches are to provide 1G connections on all edge ports.
- All switches are always to provide PoE+ on all ports.
- In general, an 80% activation rate is to be assumed, that is a 20% allowance shall be made for ports that are not initially activated.
- Switches shall meet all operational standards as listed in Appendix A.
- Switches housed in outdoor locations shall be enclosed in a Hoffman box with environmental controls of heating and cooling.
- Temperatures are not to exceed 80 degrees F nor go below 32 degrees F.
- All switches to be mounted in MDF/IDFs or secured Hoffman type boxes. Switches are not to be installed on desktops, in rooms, labs or other non-communication rooms. Switches installed outside of formal communication rooms are supported on a time and materials basis.
- Network devices not spec'd, configured, installed, and monitored by Networking & Telecommunications and connected to the campus network must be approved in writing and are supported on a time and materials basis.

7.3 MDF Switches Additional Standards:

- The primary MDF switch connects to the campus core with two 10G connections on redundant routes out of the building.
- All MDF are required to have a routing switch that only has uplinks to the campus core and other distribution switches.
- User data connections cannot be terminated on the routing switch. All user
- The primary MDF switch is to have redundant power supplies.
- MDF switches with multiple power supplies are to be able to provide power on all ports at PoE+ levels even if one power supply fails.

8 Wireless Access Points and Devices

8.1 General Provisions

- "Wireless access points" are defined as any device adhering to the IEEE 802.11 Wi-Fi specifications for network access.
- "Wireless devices" are all other devices operating in the same spectrums as the IEEE 802.11 Wi-Fi__33 specifications, i.g.: 2.4Ghz, 5GHz.
- All new construction and remodels should receive input from Networking & Telecommunications regarding how the project will affect current wireless signals.
- All new construction and remodels should receive input from Networking & Telecommunications regarding any necessary adds/moves/deletes from existing wireless Infrastructure.
- Two cat6a cables shall be provided to every access point location.
- PoE+ will be provided over each of the cat6a cables to wireless access points.
- Networking & Telecommunications will specify the type, count, and location of all access points.
- No additional access points or devices acting as an access point can be connected to the campus network per campus IT Security Policy.
- Networking & Telecommunications must approve the use of any wireless device that will connect to the data network. This is to ensure a proper balance of devices within the available spectrums.
- Networking & Telecommunications will specify locations on DD prints for locations of access points. The contractor's responsibility is to ensure that these access points are placed within a 1' diameter of the specified location. If the access points are not placed as specified, it is the contractor's responsibility to move and pay to put the access point in the specified position.
- Wireless access points cannot be installed prior to building completion as drywall dust blocks the heat exhaust fans, causing them to overheat.
- To properly quote the cost for a wireless access point, Networking & Telecommunication need to know:
 - The Room Size
 - The Ceiling Height
 - Description of room usage, e.g., Classroom, conference room, lab space, maximum occupant count

8.2 Wall Mounted Wireless:

- Provide a recessed 4-11/16 deep electrical box with a 2-gang plaster ring.
- Mount box with ring flush to finished surface.
- Mount wireless box minimum 7' to maximum 12' above finished floor.
- Mount wireless box no less than 1' from center of box to ceiling, adjacent walls, ducts, plenums or other permanent obstructions.
- Mount box vertical (plaster ring mounting holes top to bottom)
- See Appendix D

8.3 Suspended Ceiling Mounted Wireless:

- Provide a 4-11/16 deep electrical box above ceiling tile with a cover plate.
- Insure minimum 1' clearance from center of box to any obstructions.
- If ceiling height exceeds 15' above finished floor mount wireless on nearest wall rather than ceiling. Notify Networking & Telecommunications of change since this will require a different type of wireless access point.
- Networking & Telecommunications needs a minimum of 30-day notice of ceiling grid and tile selection.
- See Appendix E

8.4 Open Ceiling Wireless:

- Provide 4-11/16 deep electrical box no higher than 14' above finished floor.
- If ceiling height exceeds 15' above finished floor mount wireless on nearest wall rather than ceiling. Notify Networking & Telecommunications of change since this will require a different type of wireless access point.
- Insure minimum 1' clearance from center of box to any obstructions.
- Wireless access points shall be located below any building duct work, piping and other obstructions and in no case higher than 12' above finished floor height.
- See Appendix F

8.5 Outdoor Mounted Wireless:

- Provide a 4-11/16 deep electrical box with a ground.
- Insure minimum 2' clearance from center of box to any obstructions.
- Provide a weatherproof cover plate.
- Mount box with cover plate flush with finished surface
- Lightning/Surge protection is required.
- See Appendix G
- If the wall height exceeds 15' above finished floor, mount wireless on nearest wall rather than ceiling. Notify Networking & Telecommunications of change since this will require a different type of wireless access point.

8.6 Hard Lid Ceiling Mounted Wireless:

Provide a 4-11/16 deep electrical box with a 2-gang plaster ring mounted flush to finished surface.

Insure minimum 1' clearance from center of box to any obstructions.

If ceiling height exceeds 15' above finished floor mount wireless on nearest wall rather than ceiling. Notify Networking & Telecommunications of change since this will require a different type of wireless access point.

See Appendix H

9 VOIP

Phone service for university locations is provided by Networking & Telecommunications. All installations are to support current VOIP standards. Consultation with Networking & Telecommunications contact as listed in table 1 is required to ensure compliance with all current standards. Contractor is required to provide drawing to the Networking & Telecommunications contact as listed in table 1 so comments can be provided for the DD phase.

10 TV/Video

Network electronic and video equipment specifications shall be respectively provided on a case-by-case basis to ensure that the latest technology and lowest price is applied to the project. Please refer to the contact in Table 1.

11 Emergency and Inter/Intra Building Life and Safety Infrastructure

Colorado State University has contracted with Rave Wireless for Rave Alert. Rave Alert is an emergency text notification service that delivers emergency notification to subscriber's cellular devices. Emergency text notifications will be composed by CSU emergency/police and/or public relations personnel in case of an emergency on campus and/or an outside event that affects the campus community. Rave Alert is an optional subscription service for registered students and faculty and staff.

12 Miscellaneous

12.1 Security and Access to Communication Rooms

- Introduction: Physical keys are restricted to a small set of staff: Networking & Telecommunications, CSUPD and a limited set of Facilities staff. Primary access is to be via cardkey.
- Networking & Telecommunications requires that all communication rooms be secured with the campus cardkey standard.
- Physical cylinders must be the Medeco Q-Series.
- Access via key or cardkey is approved by the Director of Networking & Telecommunications
- Access to communication rooms cannot be blocked by gates, doors or fences not utilizing campus master key system.

12.2 Communication Room Numbering

- Communication Rooms to be numbered starting with a "T".

12.3 Building automation provisioning and permanent network solution:

- New Construction requires testing of Building Automation Systems (BAS), Fire Alarm Systems, Elevators, etc. To test these a building data network is required. Networking & Telecommunications would prefer a permanent network installed but can install a temporary solution for an additional charge. This additional charge will need to be worked out with Networking & Telecommunications in advance of any installation. To ensure permanent networking can be installed, the required communications rooms (MDF and IDFs) will need to be completed three weeks prior to any BAS Testing. If neither of these options are reasonable, the contractor can have a temporary point to point connection installed at their expense.:
- For a permanent network to be installed, the MDF and any required IDFs will need to be completed. Completion is defined as clean, dust free (including dust from any outside construction taking place), locked and accessible to Networking & Telecommunications employees only, with $\frac{3}{4}$ A/C Plywood installed per specifications. Further definition requires permanent power to be in place, all cooling installed and completed, drywall operations complete, cable tray and conduit work completed and that the room is not being used for storage.
- Temporary network solution: For an additional charge, Networking & Telecommunications can install a temporary data network to be used for testing of building systems. This additional charge includes temporary switches, cleaning and re-calibrating test equipment, professionally cleaning the communications rooms prior to installation, cleaning all fiber connections after the temporary network has been removed and before the permanent network is installed.
- Please refer to the Networking & Telecommunications contact from Table 1.

Appendices

Appendix A – Network Switch Protocol Specifications

Spanning-Tree: 802.1W (RSTP)

- Switch is not set as a root switch nor is the default priority reduced.
- No loop or BPDU protect settings on feed port to campus switch. Campus switch port should be configured as a regular data port.

LLDP

- LLDP supported and enabled.

SNMP

- SNMP v3 support
- SNMP community changed from the default.
- Read/write disabled unless necessary.

VLANs

- 802.1q support
- No central VLANs are to be configured on exempt switches.
- Trunking
- LACP

Username/password and switch access

- username/password Changed from the default.
- RADIUS authentication support
- SSH support
- https support

Multicast/IGMP

- Enabled for all VLANs and port connecting to campus switch.

Naming/labeling

- Switch description defined in switch configuration including Building name, room number.

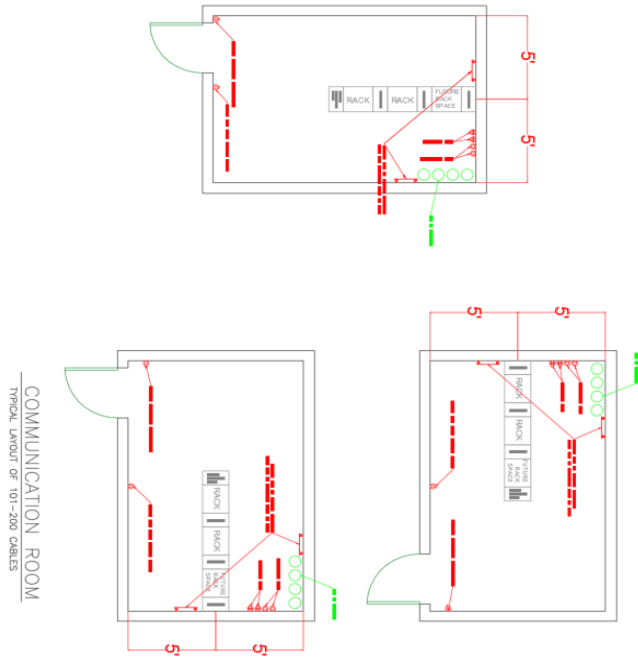
Routing

- Disabled

IPV6

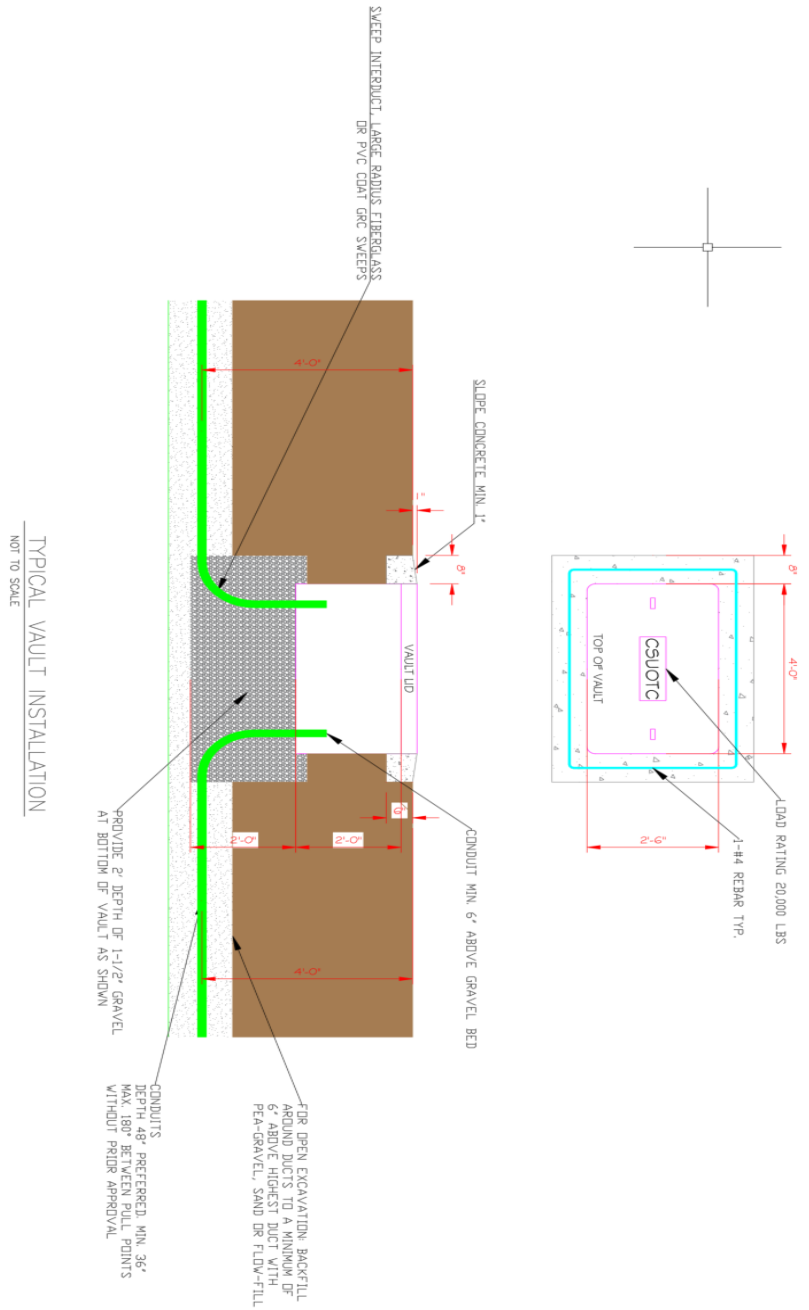
- Supported

Appendix B – Communication Room Layout

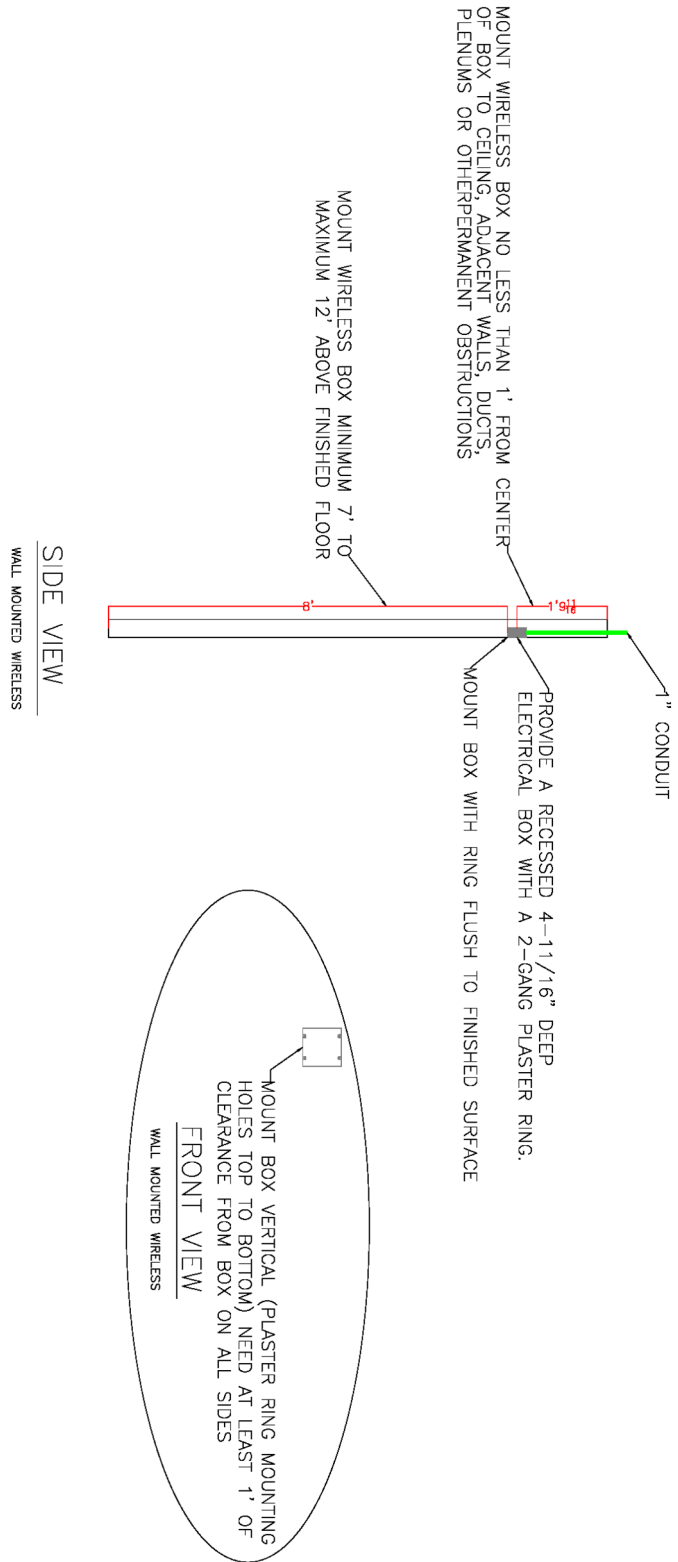


- GENERAL NOTE:
- 1) IDF ROOM SIZE PER (ANSI/TIA-568-D):
 - UP TO 100 DATA CABLES - 10'X15'
 - 101-200 DATA CABLES - 10'X15'
 - 201-800 DATA CABLES - 20'X20'
 - 2) PENETRATION INTO ANY COMMUNICATION ROOM WILL BE NO LESS THAN THE SQUARE INCHES OF THE CABLETRAY.
 - 3) ALL COMMUNICATION ROOMS WILL HAVE A LADDER RACK INSTALLED UNDER THE CABLETRAY.
 - 4) THE BOTTOM OF THE LADDER RACK WILL BE INSTALLED AT 7'6" A.F.F.
 - 5) TOP OF ALL GROUND BAR NO HIGHER THAN 7" A.F.F.
 - 6) SEE CSU TELECOM STANDARDS FOR ROOM FINISH AND POWER REQUIREMENTS.

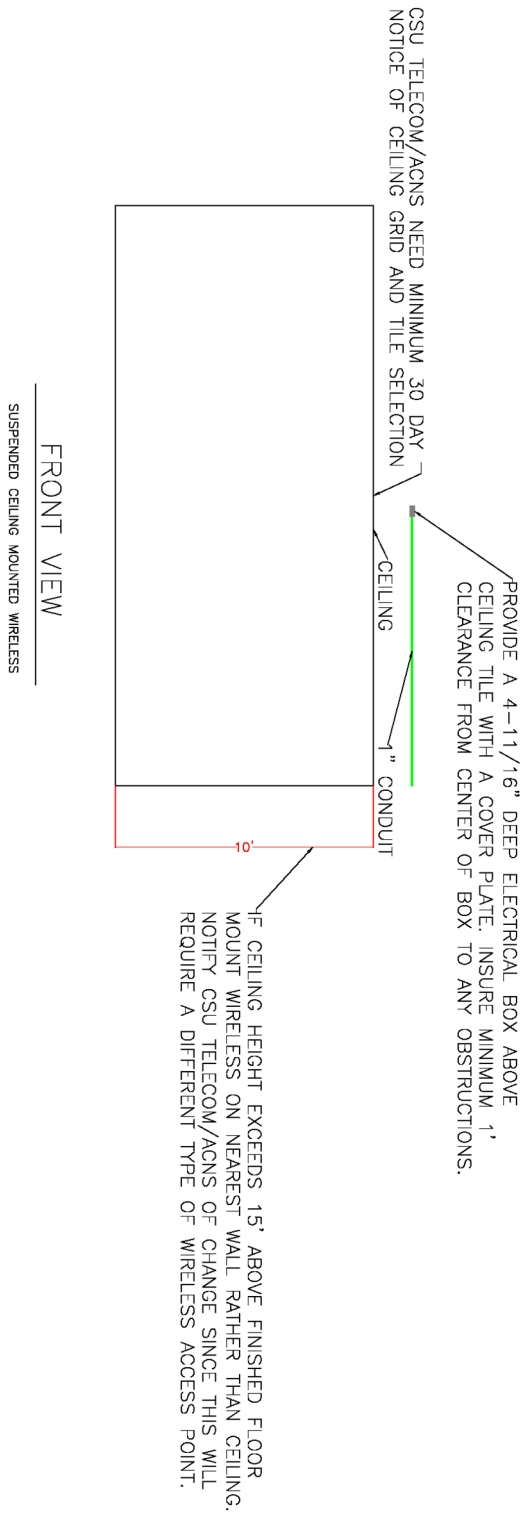
Appendix C – Typical Handhole Installation



Appendix D – Wall Mounted Wireless



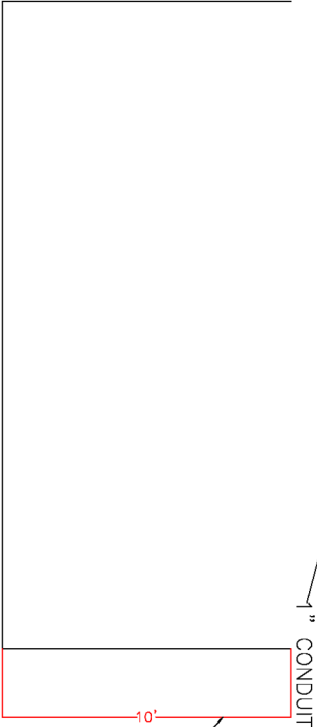
Appendix E – Suspended Ceiling Mounted Wireless



Appendix F – Open Ceiling Mounted Wireless

WIRELESS ACCESS POINTS SHALL BE LOCATED BELOW ANY BUILDING DUCT WORK, PIPING AND OTHER OBSTRUCTIONS AND IN NO CASE HIGHER THAN 12' ABOVE FINISHED FLOOR.

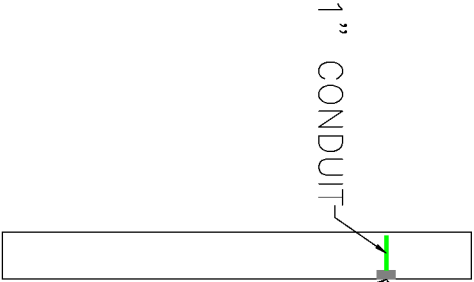
PROVIDE A 4-11/16" DEEP ELECTRICAL BOX NO HIGHER THAN 14' ABOVE FINISHED FLOOR. INSURE MINIMUM 1' CLEARANCE FROM CENTER OF BOX TO ANY OBSTRUCTIONS.



IF CEILING HEIGHT EXCEEDS 15' ABOVE FINISHED FLOOR MOUNT WIRELESS ON NEAREST WALL RATHER THAN CEILING. NOTIFY CSU TELECOM/ACNS OF CHANGE SINCE THIS WILL REQUIRE A DIFFERENT TYPE OF WIRELESS ACCESS POINT.

FRONT VIEW
OPEN CEILING WIRELESS

Appendix G – Outdoor Mounted Wireless



PROVIDE A 4-11/16" DEEP ELECTRICAL BOX WITH A GROUND. MOUNT BOX WITH COVER PLATE FLUSH WITH FINISHED SURFACE. PROVIDE A WEATHERPROOF COVER PLATE.

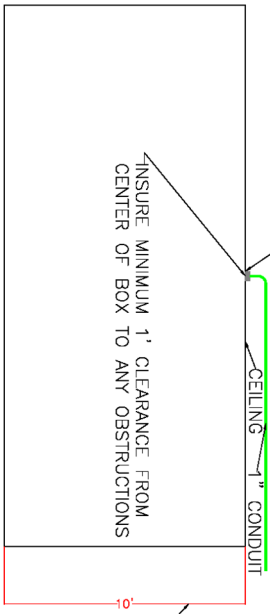
INSURE MINIMUM 2' CLEARANCE FROM CENTER OF BOX TO ANY OBSTRUCTIONS

SIDE VIEW

OUTDOOR MOUNTED WIRELESS

Appendix H – Hard Lid Ceiling Mounted Wireless

PROVIDE A 4-1/16" DEEP ELECTRICAL BOX WITH A 2-GANG PLASTER RING MOUNTED FLUSH TO FINISHED SURFACE.

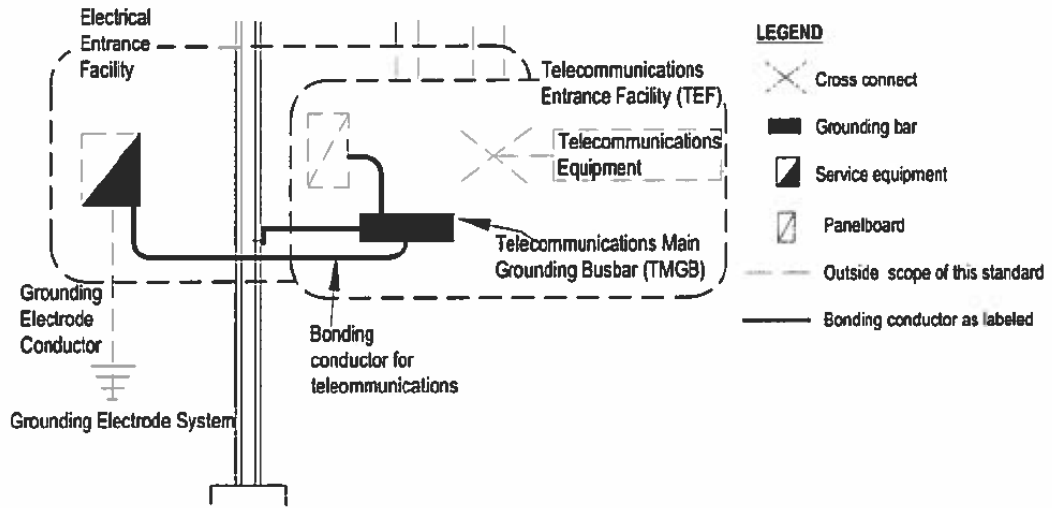


IF CEILING HEIGHT EXCEEDS 15' ABOVE FINISHED FLOOR MOUNT WIRELESS ON NEAREST WALL RATHER THAN CEILING (IF THIS OCCURS PLEASE NOTIFY CSU TELECOM/AGNS OF CHANGE SINCE THIS WILL REQUIRE A DIFFERENT TYPE OF WIRELESS ACCESS POINT)

FRONT VIEW

HARD LID CEILING MOUNTED WIRELESS

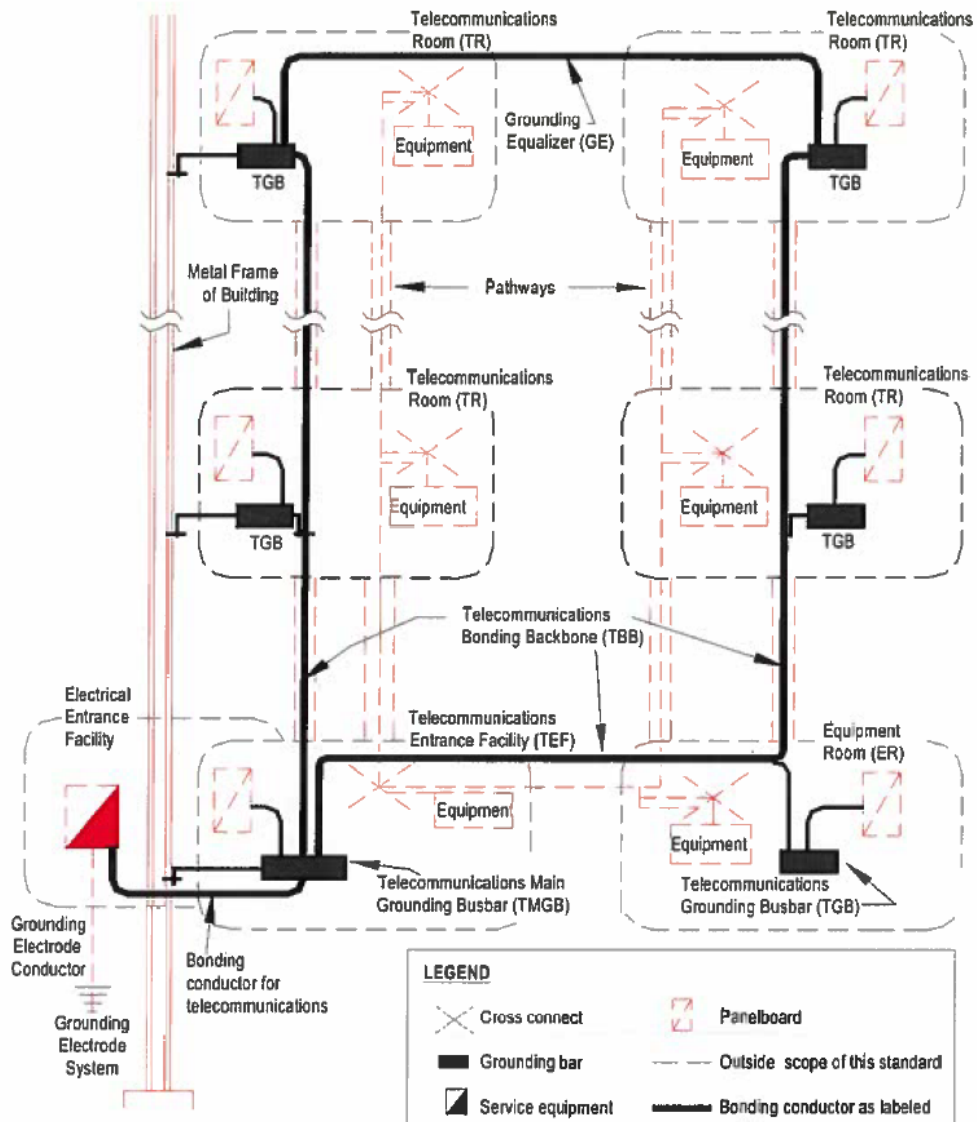
Appendix I – Main Building Ground



ANSI/TIA J-STD-607-A

5.3.1

Appendix J - Typical grounding and bonding scheme for a multistory building.
 (It is intended as a guide rather than explicit instructions.)



ANSI/TIA J-STD-607-A

Figure 3.1-1

Revision History - 22.6 Jan. 4, 2023