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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. The offices of Networking Operations Center along with the Office of Telecommunications, 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 the Division of IT.

With or without written approval, changes to these specifications 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 Operations Center (NOC) for the network equipment, and 3) Classroom Support Services for classrooms and audio-video. Contacts for these teams are given below.

Table 1. Contacts

<table>
<thead>
<tr>
<th>Team</th>
<th>Name</th>
<th>Role</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACNS/Telecommunications</td>
<td>Jason Huitt</td>
<td>Director of Network &amp; Telecom</td>
<td>(970) 491-2511</td>
</tr>
<tr>
<td>Telecommunications Projects</td>
<td>William Tremelling</td>
<td>Team Lead</td>
<td>(970) 491-3839</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(970) 567-6560</td>
</tr>
<tr>
<td>Classroom Support Services</td>
<td>Jamie McCue</td>
<td>Interim Team Lead Classroom support</td>
<td>(970) 491-4147</td>
</tr>
<tr>
<td></td>
<td>Allen Sneesby</td>
<td></td>
<td>(970) 491-6038</td>
</tr>
</tbody>
</table>

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 the interpretation of the standards referenced in the previous paragraph and provides additional detail, in some cases superseding those standards. 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).

As defined by the American National Standards Institute/Telecommunications Industry Association, or ANSI/TIA, Telecommunications physical infrastructure 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 delivering 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
- Systimax Structured Cabling System (SCS) standard
- TDMM BICSI 14th Edition volumes one and two
This document provides the interpretation of 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

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

1.4 General Guidelines

Integral to the telecommunications infrastructure in buildings is the secure communications rooms, consisting of the MDF and, generally, one or more IDF. 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, requiring environmental conditioning, also are housed in these rooms. The MDF and IDF 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 the 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, an addendum before 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 Systimax Solutions Premier or Select Installation Partner and listed on commscope.com. Approval of certification must be submitted to the Division of IT. In addition, the Division of IT requires that contractors provide Technicians and Installers certified by the Building Industry Consulting Service International, Inc. (BICSI) permanently assigned for the duration of the CSU project. Division of IT 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 Division of IT contact person for questions regarding this section.

1.7 Exceptions

Any exceptions to these standards are to have documented approval by the Division of IT or may incur additional charges to address any labor or material necessary to address the changes.
2 Horizontal Infrastructure

2.1 General Provisions
Systimax 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. IDF's are to be located to maintain less than a total 90-meter cable run. All cabling is to run to the same floor communication room.

Per Systimax cabling warranties, no cabling is permitted to be painted. It is a violation and will be subject to being replaced at the 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. All remodeled areas of campus will use Cat6A and will be evaluated on a case-by-case basis. Exceptions to this as granted only by the Vice President of Information Technology.

<table>
<thead>
<tr>
<th>Table 3 Cable Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cat. 5e plenum (installed only at the direction of VP of IT)</td>
</tr>
<tr>
<td>Cable</td>
</tr>
<tr>
<td>Jack</td>
</tr>
</tbody>
</table>

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 underfloor areas. The contractor shall determine whether the space is a plenum space before starting, consultation with CSU Telecommunications and CSU Facilities.

2.4 **Underground Cable**
All cable placed in raceways installed underground shall be rated for wet locations.
- Make sure that equipment is properly grounded and surge protection is utilized.

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 the "Jump Rope" and "Banjo" style of patching.

2.6 **Asbestos**
CSU Environmental Health Services shall inspect buildings to be wired 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


Conduit capacity shall be as follows: For a 1" conduit, a maximum quantity of 4 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.

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

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

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

Table 4 Conduit Fill Capacity

<table>
<thead>
<tr>
<th>Number of Cables</th>
<th>Percentage Fill</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>53%</td>
</tr>
<tr>
<td>2</td>
<td>31%</td>
</tr>
<tr>
<td>&gt;2</td>
<td>40%</td>
</tr>
</tbody>
</table>
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 a lateral clearance of 24 inches on at least one side of the trapeze hung tray. CSU prefers an 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 a wire basket tray is to be used, please contact the Division of IT 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 for each building and provided to the Division of IT.

The Division of IT contact from Table 1 shall be notified prior to any testing so that the representative or designee may be present during the testing. If the circuit testing is conducted in the absence of the University representative or designee, 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 Division of IT contact.

2.11 As-Builds
Upon completion of termination and testing, as-built 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's labeling scheme. Each drop shall be labeled on the front of the jack faceplate, on the patch panel in the IDF's or MDF, and 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's 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
Division of IT 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 the Division of IT (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 the Division of IT crews does not damage the ceiling grid. If the ceiling grid is installed before cabling work, the Division of IT 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

Division of IT room space, MDF, and IDF’s shall be dedicated to the telecommunications function and related support facilities. Equipment not related to the support of the Division of IT functions shall not be installed, passed through, or entered in the telecommunications rooms without review by the Division of IT 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 Division of IT 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 Division of IT.

Division of IT will not 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. Division of IT requires a minimum of three (3) weeks from the completion of the items mentioned above 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.

Division of IT strongly recommends that early in the design phase, all parties desiring to install equipment in the MDF and/or IDF’s be collectively engaged to discuss equipment placement and determine size requirements for the communications rooms. This includes any servers or equipment to be mounted in the rooms. Signatures and permission must be obtained in advance for any non-Division of IT/Facilities operated equipment to be mounted in the communication rooms ("Division of IT Communications Room Installation Agreement"). Forms are available via the Division of IT 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 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 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:


All remodeling and restoration projects will be held to and strictly enforce all new installation codes and standards.
3.2 Main Distribution Frame (MDF) (EF)/(ER)

Division of IT 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 circuit.

Two 20 amp, 120 volts NEMA 5-20 terminated on double duplex outlets,
and two 30 amp, 208 volts NEMA L6-30 outlets 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 the Division of IT.

Provisioning of power and receptacles for non-Division of IT equipment requiring power installed in the MDF or IDF's is the responsibility and at the expense of the entity responsible for the equipment. No extension cords are acceptable, whether they be 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 an MDF 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.

MDF (entrance facilities) EF shall be environmentally conditioned to accommodate loads of 10,000 BTU/hr to network equipment loads. The 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 the 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

<table>
<thead>
<tr>
<th>Building Size (ASF)</th>
<th>MDF Size (Length x width - ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 5,000</td>
<td>Hoffman Box</td>
</tr>
<tr>
<td>5,000 to 10,000</td>
<td>10x8</td>
</tr>
<tr>
<td>10,000 to 50,000</td>
<td>10x12</td>
</tr>
<tr>
<td>50,000 to 100,000</td>
<td>12x12</td>
</tr>
<tr>
<td>100,000 to 150,000</td>
<td>14x14</td>
</tr>
<tr>
<td>150,000 to 200,000</td>
<td>14x16</td>
</tr>
</tbody>
</table>

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

Division of IT shall provide customized communication room designs based on the requirements of each project. Please contact the Division of IT 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 IDF’s 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 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.

And two 30 amp, 208 volts NEMA L6-30 outlets 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 the CSU Division of IT.
Provisioning of power and receptacles for non-Telecommunications/ACNS 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, power cabling, or similar shall be allowed to pass through an IDF not associated with the communications services in that specific IDF. IDF 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. An IDF shall be environmentally conditioned to accommodate network equipment loads up to 7,000 BTU/hr. The 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 the floor and painted with matte white paint. All fire-rated labels must be masked off prior to painting and left clearly visible.

All IDFs are to be located that minimize the runs of the data network to the end-user, typically in the center of the wings of buildings. Data cable runs are to be limited to 90 meters, which may affect the IDF placement 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

<table>
<thead>
<tr>
<th>Serving Area</th>
<th>Number of Jacks</th>
<th>Room Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>10,000 sq. ft.</td>
<td>361-480</td>
<td>10x12</td>
</tr>
<tr>
<td>8000 sq. ft.</td>
<td>241-360</td>
<td>10x10</td>
</tr>
<tr>
<td>5000 sq. ft.</td>
<td>0-240</td>
<td>10x8</td>
</tr>
</tbody>
</table>

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 shall open outward, adhere to all fire codes, and be 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 a risk of water ingress exists.

3.4 Offices

Except for the minimum number 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.

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**

All grounding and bonding will generally adhere to the current 14\textsuperscript{th} edition of the BICSI Telecommunications Distribution Methods Manual, TDMM.

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 the electromagnetic interface. (See appendices H and I.)

<table>
<thead>
<tr>
<th>TBB length linear ft.</th>
<th>TBB Size (AWG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less 13</td>
<td>6</td>
</tr>
<tr>
<td>14 – 20</td>
<td>4</td>
</tr>
<tr>
<td>21 – 26</td>
<td>3</td>
</tr>
<tr>
<td>27 – 33</td>
<td>2</td>
</tr>
<tr>
<td>34 – 41</td>
<td>1</td>
</tr>
<tr>
<td>42 – 52</td>
<td>1/0</td>
</tr>
<tr>
<td>53 – 66</td>
<td>2/0</td>
</tr>
<tr>
<td>&gt; 66</td>
<td>3/0</td>
</tr>
</tbody>
</table>

*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 and 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 horizontal runs 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 the inclusion of a readily accessible and adequately sized pull box, the location of which shall be clearly marked on drawings. In situations where cable trays, conduits, 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 cables shall be run between the MDF and each IDF in a star configuration. At a 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 the Division of IT. Fiber cables shall be run in conduit or in 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

<table>
<thead>
<tr>
<th>Number of active data jacks</th>
<th>Base fiber count</th>
<th>30% allowance</th>
<th>Total fiber count</th>
</tr>
</thead>
<tbody>
<tr>
<td>96</td>
<td>6 pair</td>
<td>1 pair</td>
<td>3 pair</td>
</tr>
<tr>
<td>144</td>
<td>6 pair</td>
<td>1 pair</td>
<td>4 pair</td>
</tr>
<tr>
<td>240</td>
<td>12 pair</td>
<td>2 pair</td>
<td>7 pair</td>
</tr>
<tr>
<td>336</td>
<td>12 pair</td>
<td>3 pair</td>
<td>10 pair</td>
</tr>
</tbody>
</table>
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 multimode 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 wavelengths 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 Division of IT contact from Table 1 on a USB stick.

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. All network cabling will be supported by 18" ladder rack above all racks and cabinets within the "TR" Telecom rooms for future growth. Where changes in height are unavoidable, transitions shall be gradually sloping. The cable ladder rack shall be routed so as not to interfere with the installations 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. All pass-through sleeves must meet necessary wall ratings and 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, Entrance Facility or EF. Thus, generally, the Building Entrance and the MDF are one and the same at the University. In specific venues, the Division of IT 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 the Division of IT 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.

Division of IT may request the removal of unauthorized cable(s) within the Division of IT's entrance conduits. Copper and fiber cables will be brought into the building in separate conduit systems. There shall be no more than 180 degrees of bends between pull points. Using large radius PVC coated GRC and or fiberglass sweeps. Utility vaults 30" x48" x24" will be used when there are 180 degrees or more in the run.

5.2 University Policy Governing Entrance Infrastructure

The Division of IT 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's 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) Daytime, 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-built drawing. However, for outside plant infrastructure projects, the contractor in addition shall illustrate route(s), depth and benchmark measurements from existing landmarks and fixtures. Please refer to the As-Builts section in Chapter 2 for details.
The contractor shall report on the progress of the work to the Division of IT 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 Division of IT contact from Table 1 shall approve any deviation.

Conduit shall only have new 1800 lb. Sequential Mule Tape will be 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 the cable. Polyrope shall not be accepted within the duct.

**Installation** - The inner duct shall be installed a minimum of twenty-four to 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 the start of work (e.g., utility hole). The inner ducts shall have duct plugs installed and secured around the 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. Inner duct entering through the utility hole or concrete foundations shall be core drilled and have link seals installed. The manhole shall have sufficient racking drilled and mounted for cable attachment and service coil support. CSU shall be consulted for the determination of service coil length and racking requirements.

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

Materials - The contractor shall coordinate with the Division of IT 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. The conduit duct shall have a No.12 UF-type tracer wire installed outside the conduit. The Division of IT contact shall approve any deviation. Conduit shall have only new 1800 lb. Sequential Mule Tape to be 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 the 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. The contractor shall internally brace the vault to ensure its integrity throughout installation and soil compaction to the extent necessary. Each newly installed or reinstalled vault shall be excavated 2’ deeper to accommodate a 2’ 1” minimum aggregate of rock to bring the vault to grade and maintain adequate drainage. Each newly installed or reinstalled vault shall have a 3M 1401 – XR 4” Ball Marker installed inside the vault. Vaults shall NOT be drilled or penetrated without prior approval. Vaults shall be sized to accommodate copper or fiber optic cables and service coils neatly. Conduits shall gradually sweep below the bottom of the fiberglass vaults. Ducts shall have duct plugs installed and secured around the cable to prevent debris from entering the conduit.

6.5 Steam Tunnel Cable Installation

Contact CSU Facilities Management at (970-491-0077) before 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. Division of IT 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 are 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 the
  Division of IT 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's 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 specifications, i.e.: 2.4Ghz, 5GHz.
- All new construction and remodels should receive input from the Division of IT regarding how the project will affect current wireless signals.
- All new construction and remodels should receive input from the Division of IT 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.
- Division of IT 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.
- Division of IT 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.
- Division of IT 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, the Division of IT 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 the finished surface.
- Mount wireless box minimum 7’ to maximum 12’ above the finished floor.
- Mount wireless box no less than 1’ from the center of the box to ceiling, adjacent walls, ducts, plenums, or other permanent obstructions.
- Mount box vertical (P/Mud 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.
- Ensure minimum 1’ clearance from the center of the box to any obstructions.
- Suppose ceiling height exceeds 15’ above-finished floor mount wireless on the nearest wall rather than the ceiling. Notify the Division of IT of change since this will require a different type of wireless access point.
- Division of IT needs a minimum 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 the finished floor.
- Suppose ceiling height exceeds 15’ above-finished floor mount wireless on the nearest wall rather than the ceiling. Notify the Division of IT of change since this will require a different type of wireless access point.
- Ensure minimum 1’ clearance from the center of the box to any obstructions.
- Wireless access points shall be located below any building ductwork, 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.
- Ensure minimum 2' clearance from the center of the box to any obstructions.
- Provide a waterproof cover plate.
- Mount box with cover plate flush with the finished surface.
- Lightning/Surge protection is required.
- See Appendix G
- 1" Conduit system needs to be broken before exiting the building setting a junction box or open with conduit bushing to and accessible ceiling space for internal connections. Rated patch assemblies will be utilized for all exterior penetrations with RJ-45 modular plug.
- No external jacks will be allowed. All terminations will terminate on the interior of the building and rated patch cord assemblies cabling patched to the outdoors.

8.6 Hard Lid Ceiling Mounted Wireless:
- Provide a 4-11/16 deep electrical box with a 2-gang plaster ring mounted flush to the finished surface.
- Ensure minimum 1' clearance from the center of the box to any obstructions.
- Suppose ceiling height exceeds 15' above-finished floor mount wireless on the nearest wall rather than the ceiling. Notify the Division of IT of change since this will require a different type of wireless access point.
- See Appendix H

9 Telephony

The Division of IT provides Voice over IP and Voice in the cloud service for all university endpoints. All installations are to support current CSU telephony standards. Consultation with The Division of IT contacts, as listed on page 5, Table 1, is required to ensure compliance with all current CSU standards. The contractor must provide drawings to The Division of IT contact as listed on page 5, table 1, so comments can be provided for the design development 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 are 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 the 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: Division of IT, CSUPD, and a limited set of Facilities staff. Primary access is to be via card key.
- Division of IT requires that all communication rooms be secured with the campus card key standard.
- Physical cylinders must be the Medeco Q-Series.
- Access via key or card key is approved by the Director of Division of IT
- Access to communication rooms cannot be blocked by gates, doors, or fences not utilizing the 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 be able to connect and test these systems, the building's data network is required. The Division of IT 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 the Division of IT in advance of any installation. To ensure permanent networking can be installed, the required communications rooms (MDF and IDF) will need to be completed three weeks prior to any BAS Testing. If neither of these options is 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 Division of IT employees only, with ¾ A/C Plywood installed per specifications. The further definition requires permanent power to be in place, all cooling installed and completed, drywall operations complete, cable tray and conduit work completed, and the room is not used for stored materials.

- Temporary network solution: For an additional charge, the Division of IT can install a temporary data network to test building systems. This additional charge includes temporary switches, cleaning, and re-calibrating test equipment, professionally cleaning the communications rooms prior to installation, cleaning fiber connections after the temporary network has been removed and before the permanent network is installed.

- Please refer to the Division of IT contact from Table 1.
Appendices

Appendix A – Network Switch Protocol Specifications

Spanning-Tree: 802.1W (RSTP)
- The 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. The 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 ports 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
Appendix C – Typical Handhole Installation
Appendix D – Wall Mounted Wireless

- Mount wireless box no less than 1\' from center of box to ceiling, adjacent walls, ducts, plenums or other permanent obstructions.
- Provide a recessed 4"-1/6" deep electrical box with a 2-gang plaster ring.
- Mount box with ring flush to finished surface.
- Mount box vertical (plaster ring mounting holes top to bottom need at least 1\' of clearance from box on all sides.
- Maximum 1/2" above finished floor.
- Minimum 7' to 9' wall view.
Appendix E – Suspended Ceiling Mounted Wireless

- Front View

Provide a 4-1/16" deep electrical box above.

Ceiling tile with a cover plate, insulate minimum 1". Notice of ceiling grid and tile selection.

Clearance from center of box to any obstructions.

CSU Telecom/Access need minimum 30 day notice.

Mount wireless on nearest wall rather than ceiling.

Try ceiling height exceeds 15' above finished floor.

Mount CSU Telecom/Axons of channel since this will notify CSU Telecom/Axons of channel since this will

require a different type of wireless access point.
Appendix F – Open Ceiling Mounted Wireless

Type of Wireless Access Point:
Since this will require a different notify CSU/Telecom/Ans of Change nearest wall rather than ceiling.

If ceiling height exceeds 15", above finished floor mount wireless on

Provide a 4"-11/16" deep electrical box.

Above finished floor, and in no case higher than 12" work piping and other obstructions located below any building duct.

Wireless access points shall be
Appendix H – Hard Lid Ceiling Mounted Wireless

This will require a different type of wireless access point.

If this occurs, please notify OCU Telecom/ANS of change since

mount wireless on ceiling wall rather than ceiling

if ceiling height exceeds 15’ above finished floor

insure minimum 1’ clearance from

ceiling flush to finished surface.

Provide a 4’-11/16” deep electrical

center of box to any obstructions

Powers 44
Appendix I – Main Building Ground

ANSI/TIA J-STD-607-A

5.3.1
Appendix J - Typical grounding and bounding scheme for a multi-story building.
(It is intended as a guide rather than explicit instructions.)

ANSI/TIA J-STD-607-A

Figure 3.1-1