

Network Telecommunications & Security
Youngstown State University
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Network Telecommunications Design Standards
Last Updated – June 2013

Youngstown State University

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Purpose of the Document

This document provides design specifications for voice and data communications infrastructure at Youngstown State University (YSU). The department of Network Telecommunications & Security is responsible for the communications infrastructure and should be involved in the design process.

Department Contacts

Voice/Data requirements: Michael Caldwell, 330-941-4747, mcaldwell@ysu.edu

Notifications: Jason Rakers, 330-941-3035, jtrakers@ysu.edu

These individuals should be consulted during the initial schematic design phase and engaged during the design and construction phases.

Revision Control

June 2013 –

- Updated fiber optic information on Building Backbone
- Updated Premise Wiring information for cabling colors and Hubbell preferred status
- Updated Specialty Rooms with minimum cabling counts for Podiums and Networked Classrooms.

September 2012 –

- Added section for wireless Access Point installations

August 2011 –

- Removed section titled Contractor Certifications
- Removed reference to Hubbell Mission Critical System Warranty
- Updated Horizontal Infrastructure section
- Updated MDF section
- Updated IDF section
- Adjusted section formatting
- Removed Bob Quigley as Data requirements contact

April 2011 –

- updated to included name change from Network & Telephone Services to Network Telecommunications & Security and contact information
- added Intelligent Electronics Requirements section
- added language to network classroom specifying minimum network jacks
- added language to podium to prohibit active network equipment installation
- added Q2 network dual fiber optic connections back to data centers in the Tod and Meshel Halls.

February 2008 –

- Document created

Applicable Standards

Telecommunications physical infrastructure as defined by the Telecommunications Industry Association/Electronics Industry Association (TIA/EIA), consists of six elements:

- 1) Building entrance
- 2) Building main telecommunications room or Main Distribution Frame (MDF)
- 3) Backbone cabling
- 4) Telecommunications closets or Intermediate Distribution Frames (IDF)
- 5) Horizontal cabling
- 6) Work area

These elements will be augmented by a seventh element, networking equipment, required to provide a minimum level of data/voice service for the building.

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

- TIA/EIA 568A Commercial Building Telecommunications Cabling Standard
- TIA/EIA 569 Commercial Building Standard for Telecommunications Pathways and Spaces
- TIA/EIA 607-A-2002 Commercial Building Grounding and Bonding Requirements for Telecommunications
- most current edition NEC
- BICSI DD 120-Grounding Fundamentals for TELCO Facilities Chapter 4 Telecommunications Systems Grounding (as reference)
- IEEE 802.3-1993

This document provides interpretation of the standards referenced in the previous paragraph and provides additional detail, in some cases superseding those standards. Should the contractor require additional interpretation of the design guidelines, the contractor should contact the designated department contact.

Standards Hierarchy

Type	System
Grounding, Bonding, and Fire stopping	TIA/EIA, NEC, BICSI
Fiber Optics	Corning
Category 5e or higher	Hubbell SCS, TIA/EIA
Data/Voice	TIA/EIA

General Guidelines

Integral to the telecommunications infrastructure in buildings are the 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 requiring a very clean environment. Expensive and delicate networking devices, requiring environmental conditioning, also are housed in these rooms. In this regard, the MDF and IDFs shall be completed including environmental conditioning and completed early in the project timetable. In particular, all penetrations shall be completed and sealed (e.g., capped) before Telecommunications work can continue in these environments.

Equipment and Materials Specifications

Specifications for equipment and materials, used in the construction process, are specified in the Materials List.

Contact the designated department contact for the Materials List.

*Some materials have no substitutions. Where substitutions are allowed, written pre-approval is required from the department contact prior to the final design bid.

Intelligent Electronics Requirements

Youngstown State University leverages talent sets and knowledge pools, as a result the University only permits certain intelligent electronic equipment to be installed as part of the telecommunications infrastructure.

Voice Telecommunications - NEC manufactured phone systems and end-stations

Data Telecommunications - Cisco Systems LAN switches, routers, and wireless access points

Horizontal Infrastructure

Premise Wiring – Plenum rated category 5e cable or greater, connectors, and fixtures shall be used for horizontal data cabling. Data cable runs shall be strictly limited to 100 meters in total length, according to standards. In particular, IDFs are to be located so as to maintain less than a total 100-meter cable run. Hubbell is preferred. Primary cabling color scheme is green for data, white for voice, and red for other.

Conduit – When conduit is used, 90° fittings shall not be used between outlet boxes and cable tray. Conduit bends shall conform to accepted radii for the type of conduit used. There shall be no more than 180 degrees between pull points. Conduits shall terminate slightly above cable tray and generally perpendicular to the tray without a down-turning

end. Contractor shall ensure that conduit ends are easily accessible for cable installation. Conduit ends shall be fitted with an appropriate bushing to minimize chafing. All conduits shall be bonded to the cable tray, bolted lugs and green insulated grounding wire, minimum 14 AWG. Telecommunications conduit(s) entering the MDF and/or IDF shall have ground bushings installed.

Testing and Reporting of Test Results – Each Data/Voice drop installed shall be tested using a calibrated Fluke Series 4000 Tester or higher version in accordance with the latest EIA/TIA 568 standards, and the results recorded on a separate CD/DVD or electronically delivered for each building and provided to the department contacts.

The designated department contact 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.

Network (Cable) Drops – Each network (data/voice) location should have a face plate installed with six (6) available network jacks on each opposite wall with 4 of the 6 jacks wired for use. In a four-sided room this equates to two walls with housing potential for 12 network jacks available for either data or voice network services.

As-builds - Upon completion of termination and testing, as-built drawings of all cable drops shall be provided within seven work days for each major phase of work; such as 1) floors, 2) wings, or 3) entire buildings. The as-built drawings shall be provided in electronic format as indicated by the YSU network contact. These files are to be on a separate CD-ROM for each building.

Drop Labeling – Each drop installed shall be labeled per the YSU labeling scheme. Each drop shall be labeled on the front of the jack faceplate, on the patch panel in the IDF or MDF, and on both ends of the cable.

Invasive Work and Work Schedules - Invasive work (i.e., core and/or 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.

Communication Rooms

Telecommunications room space, MDF and IDF, shall be dedicated to the telecommunications function and related support facilities. The MDF and per floor IDF locations in multiple story buildings should be stacked on top of each other. Equipment not related to the support of the telecommunications function shall not be installed, passed through, or entered in the telecommunications rooms without review by Network

Telecommunications & Security and consideration in the sizing of the space, environmental requirements, etc.

Main Distribution Room – MDF

Network Telecommunications & Security shall provide customized communication room designs based on the requirements of each project. Please contact the department Contact. The following are general guidelines in the absence of a custom communications room design.

Buildings shall have a 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 should be provided in the MDF in strict accordance with the TIA/EIA 607 standard and extended to all IDF's as described therein. All penetrations of the MDF envelope must be fire-stopped.

There shall be a minimum of one communications room per floor. Additional rooms, one for each area up to 10,000 square feet or where the horizontal distance to the work area exceeds 250 feet, shall be required.

TIA/EIA 569 shall be strictly observed for the MDF, especially as to location (away from electromagnetic interference), perimeters (no false ceilings), limited access (i.e., security), HVAC, lighting and electrical. In particular, MDF shall be provided with two dedicated, separate 120 v, non-switched, 20 Amp ac electrical circuits terminating on dual outlets on the wall adjacent to the telecommunications racks – these locations shall be determined in consultation with Network Telecommunications & Security.

No piping, 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 the MDF. Switched lighting of 50-foot candles shall not be sourced from the same circuit as the telecommunications equipment.

MDF shall be environmentally conditioned to accommodate network equipment loads up to 6,000 w plus all other applicable cooling loads. Temperature in MDF shall not exceed 80°F. Communications equipment in the average MDF emits 3413 BTH/hr.

The MDF shall have 3/4" A/C plywood wall mounted, void free, 8' high, painted with two coats of fire resistant matte finish white paint, and capable of supporting attached voice and video distribution equipment as shown. The flame-spread rating shall be no greater than 25 when tested according to ASTM W84.

The voice and video distribution shall be mounted on the walls of the MDF in accordance with the EIA/TIA 569 standard. The MDF also serves as the fiber distribution point for the

building and also houses the building-level data switch. In medium and large buildings no other equipment, excluding edge communication switches, shall be housed in the MDF without approval.

In small buildings, where the MDF is the only communications room, the MDF may also house edge switches that are used to distribute the data network to the end user.

In medium to large buildings, the MDF is typically located on the ground floor, where telecommunications enters the building, in an area central to the locations of the IDFs.

In buildings susceptible to flooding, the MDF and all IDFs should be located on the first floor and not the basement. Note that if data is served out of the MDF, data cable runs are to be limited to 90 meters in length, and this may affect placement of the MDF or require an IDF to be added.

The MDF shall be large enough to accommodate at least two 7'x19" relay racks; one for the building fiber and copper distribution and the other for the building network equipment and associated UPS. The MDF shall also accommodate the telephone and video distribution systems which may be wall or rack mounted.

All penetrations of the MDF envelope shall be fire-stopped. These penetrations may consist of vertical penetrations for 4" diameter conduit or horizontal "pass-through" 4" diameter conduit penetrations to ladder racks. ****rings or "J-type" hangers for riser cables between communication closets, copper or fiber, shall not be used.***

MDF SIZES

Building Size (ASF)	MDF (Length x width - ft)
0 to 10,000	10' x 8'
10,000 to 50,000	10' x 12'
50,000 to 100,000	12' x 12'
100,000 to 150,000	14' x 14'
150,000 to 200,000	14' x 16'

The building use and/or configuration may require reconsideration of the telecommunications room sizing. Ideally, this is addressed during the schematic phase of the project with the department contacts.

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.

Intermediate Distribution Room (IDF)

Each floor shall have a dedicated IDF. The IDF houses the edge data/voice network switches that are used to distribute the data/voice network to the end user. Edge network

switches are housed in vertical racks. Analog telephone connections shall be made on punch-down terminals affixed to 3/4" plywood backboards in the IDF.

All exposed backboard surfaces shall be painted with two coats of fire-resistant matte white paint. The flame-spread rating shall be no greater than 25 when tested according to ASTM W84. Video connections shall enter the IDF on dedicated single-mode fiber optic bundles and terminate on rack mounted fiber patch panels. Video connections, from these fiber-optic receivers to the end user, shall be accomplished using splitters and coaxial cables run in a star configuration to every classroom/laboratory.

Grounding and bonding shall be provided in the IDF in strict accordance with TIA/EIA 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.

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

IDF shall be secure and environmentally conditioned. IDF's shall be supplied with two dedicated, 20 Amp, electrical circuits terminating on dual outlets on the wall adjacent to the equipment racks

IDF shall be supplied with 50-foot candle of witched lighting which shall not be sourced from the same circuit as the telecommunications equipment.

IDF shall be sized to accommodate an equipment load of 3000 w. Temperature in IDF shall not exceed 80°F. Communications equipment in the average IDF emits approximately 1716 BTU/hr.

IDF 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: 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 IDF shall be vertically stacked within the building.

IDF 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.

IDF Sizes

Serving Area/No. of Jacks	Room Size (length x width – ft)
10,000 sq ft/361-480	10x12

8,000/241-360	10x10
5,000/0-240	10x8

Doors shall open outward, adhere to all fire codes, and secured with self-locking locksets. 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 drain pipes not directly required in support of the equipment within the communications rooms. A floor drain shall be provided within the room if risk of water ingress exists.

Campus Room Types

Several generic types of rooms have been defined for categorization purposes. 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 Network Telecommunications & Security and the building occupant.

Individual Office – a single individual occupies an individual office. The minimum configuration for communications shall be two outlets, located on opposite walls, each with two voice and four data jacks.

Shared Office – more than one individual (e.g., graduate students or staff) may occupy a shared office. At least two outlets shall be installed in every shared office on opposite walls. Outlets should be placed around the perimeter of the office at distances of approximately every 12 feet. Each outlet shall consist of two voice and four 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.

General Classroom – a general classroom shall have a minimum of three outlets, located at the front, rear, and center ceiling of the room, with two voice jacks and four data jacks.

Computer Laboratory or Networked Classroom – a computer laboratory or a networked classroom may have many computers in it and shall be provided liberally with data and power outlets mounted preferably along the walls. Drop-down conduits shall be avoided wherever possible in computer classrooms as they obstruct vision. **The minimum recommended quantity is one wired network jack and one dual power outlet per eight seats.**

The specific design shall be developed in consultation with the building occupant.

Note that electrical power outlets shall be provided in conjunction with data outlets and may require additional power to be run to electrical junction boxes and from there to the

computer room. The amount of electrical power supplied to such rooms must be sufficient to accommodate a high density of computers.

A podium in every classroom should be anticipated and appropriate conduit or in-floor ducting should be installed for current or future use. No active network switching equipment will be installed in a podium, only inactive infrastructure (such as a patch panel) based on current podium usage a minimum of 8 wired network jacks should be provided..

Riser/Building Backbone Infrastructure

The building backbone cabling consists of fiber cable for data and video and copper cable for voice. These cables shall be run between the primary datacenters on campus (Meshel and Tod) and the remote building in a star topology. A minimum of 6 strands single mode fiber is required per building back to reach datacenter (12 strands total = 6 to Meshel and 6 to Tod). Special use cases may require a composite consisting of 6 strands single mode fiber and 24 strands of 62.5 micron multimode fiber. A minimum 25-pair copper for voice is required per building back to Tod datacenter for emergency telephone services.

Standard fiber optic connectors are: FC/LC for Single Mode Fiber and ST/FC for Multimode Fiber.

The infrastructure for the building backbone cabling shall consist of conduit between the MDF and each IDF. Separate conduits shall be used for copper cables (voice) and fiber cables (data and video).

EIA/TIA 569 shall be strictly 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 shall exist in conduits without inclusion of a readily accessible 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.

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. Multimode fiber is primary only used within the Building MDF to all the IDFs within the building in a star topology.

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

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 sufficient access to the ladder rack for cable installation and maintenance. Mount cable ladder racks between 7 and 8 feet AFF (above the finished floor) so as 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 4" diameter conduits passing through the firewall. The bottom of these pass-through conduits shall be aligned with the top of the cable ladder to ensure proper cable support and unrestricted passage. These pass-through conduits shall be no more than 40% full.

Building Entrance Infrastructure

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. For redundancy purposes, dual single mode fiber optic feeds into each university building are utilized for transport back to the data centers in Meshel and Tod Hall.

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

Network Telecommunications & Security may request removal of unauthorized cable(s) within telecommunication entrance conduits. Copper and fiber cables shall be brought into the building in separate, metal conduits. No more than a total of 180 degrees of bends, using long radius metal sweeps, shall exist in conduit runs between pulling points.

The contractor agrees to remedy all defects identified by YSU during the final inspection of the contractor's work. The scheduling of the remedies shall be approved by YSU. 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 YSU.

The contractor shall be responsible for providing an as-build drawing. However, for outside plant infrastructure projects, the contractor in addition shall illustrate route(s), depth and benchmark measurements from existing landmarks and fixtures.

Conduit shall only have virgin (new) 2400 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***

Buried conduit duct shall have a No. 12 UF type tracer wire installed outside the conduit. The department contact shall approve any deviation.

Grounding and Bonding

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.

Grounding and bonding shall be provided in the MDF in strict accordance with TIA/EIA J-STD-607-A-2002 standard, the most current edition NEC Article 250, 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.

Wireless Access Point Installation

Access Points (APs) will be provided by the University for installation by the electrical contractor. Each AP unit installed will have dual copper (Category 5e or greater) runs back to the IDF. The contractor will provide a floor plan documenting the locations of each installed AP, including the MAC address of the AP unit at each location and the cable run's ID number. Both cable runs will be tested for errors prior to installing the AP unit, the print out of cable test results will be provided to Network Telecom.