

SECTION 16742

TELECOMMUNICATIONS SYSTEMS

The following guidelines are provided for installation of telecommunications infrastructure for Dartmouth College supported by Computing, Network Services.

These guidelines may be modified by Network Services to meet specific needs. Any modification requires written approval and must be documented.

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1. Definitions:

Building Main Distribution Frame (BDF)-

Primary telecommunications room for a building. This is the common point of appearance for the Inter and Intra building copper and fiber backbone cabling.

Intra-building Distribution Frame (IDF)-

Sub-telecommunications rooms within a building connecting to the BDF or another IDF. More than one IDF may exist on a floor in order to keep the distance between any telecommunications outlet and a telecommunications room from exceeding 290ft.

Backbone Cabling

Common to both Inter and Intra buildings, extending from BDF's between buildings and BDF/IDF's within buildings. These include Copper UTP cable and Fiber, single mode and multimode 62.5/125micrometer.

Horizontal/Home Run Cabling

Cables, which terminate on one end in a BDF/IDF patch panel and the other end at a station location. These copper cables consist of eight (8) insulated, solid conductors formed into four individual twisted pairs and are rated for no less than Cat6.

Work Station Location-

Telecommunications outlet/connector ready to receive work area equipment such as telephones, fax machines, data terminals and computers. More than one location may exist in an office to ensure work area equipment cable does not exceed 16ft.

2. Codes and Standards

All work shall meet all applicable codes and standards, including but not limited to:

- National Fire Protection Assoc. (NFPA) 70.
- Building Industry Consulting Service International (BICSI) Standards.
- National Electrical Manufacturers Assoc. (NEMA) Standards.
- Electronics Industry Assoc./Telecom. Industry Assoc. (EIA/TIA).
- Commercial Building Telecom. Wiring Standards (EIA/TIA-568-C).
- Technical Systems Bulletin-Additional Cable Specifications for UTP Cables (TSB-36).
- Telecommunications Systems Bulletin-Additional Transmission Specifications for UTP Connecting Hardware (TSB-40).

Commercial Building Standard for Telecommunications Pathways and Spaces (EIA/TIA-569).
Dartmouth College Design & Construction guidelines.
Dartmouth College Computing Network Services Telecommunications Systems.

The most stringent code of these governing bodies shall apply.

3. DESIGN CRITERIA

3.1 Distribution Frames (BDF/IDF)

- The Building Main Distribution Frame (BDF), and/or the Intermediate Distribution Frame (IDF), may be shared with both Access Control and Fire Alarm.
- There shall be a minimum of one Telecommunications room per floor. The rooms shall be vertically aligned where possible. If not possible, the provision to house non-plenum backbone cable shall be required.
- BDF/IDF's shall not share with electrical distribution; transformers pose the threat of damage or EMF interference. Janitorial services, pose water/electrical threats. Storage area's present fire hazards as well as hindering access to equipment.
- The designer is required to refer to and comply with the EIA/TIA-569 section, "Telecommunications Room", for room design parameters including architectural elements, mechanical, & electrical requirements. DC-Network Services shall review the space during the design development phase. Consultants may make arrangements to review the EIA/TIA-569 document with DC-Network Service's office.
- Existing BDF/IDF's that need expansion in order to comply with the new standard must meet the TIA/EIA specifications for a communications room. When dealing with an existing BDF/IDF, the design choice will be made and specified by Dartmouth Network Services on a case by case basis.
- The horizontal cable length to the farthest workstation shall be limited to 82meters, (269feet).
- Cable tray or Unistrut is required to support all horizontal sections of cable.
- When renovating, existing work station locations will be upgraded to comply with the standard being implemented.
- Each room must have a minimum of two (2), 2-gang duplex- power receptacle. Each duplex receptacle to be on a dedicated, 120-volt, 20 amp, circuit. Location of this circuit breaker must be noted at the outlet.
- 19-inch, 7 ft. rack space shall be available for fiber enclosure(s), copper 48port patch panel(s), cable management, Uninterruptable Power Supply(s) and 25% future growth.

- Floor space for a rack(s) shall include 3' front and rear access.
- Climate control shall be available in the room.
- The BDF/IDF must have its own secure room, with a solid door, 3' wide.
- Card Access and backup key shall be provided seven days per week to each room.
- Where possible, the BDF/IDF shall be on emergency generator power. Refer to DC Standards, GENERATOR SETS.

3.2. Cabling

3.2.1. Inter and Intra-Building

- All Optical fiber and copper cables shall be handled, installed and supported as per manufacturer's guidelines. During the laying of the cable, installer shall take care not to over stress the cable. After the cable is installed, installer shall make sure that all parts of the cable are supported properly and shall be stress free at both ends and throughout their length.
- The Telecommunications grounding system shall comply with the requirements listed in ANSI-J-STD-607-A-2002. Backbone systems must comply with all applicable National, Regional, or Local building and electrical codes.
- Cabling shall be placed through shafts, conduit, raceways or floor penetrations and supported according to the manufactures recommendations.
- All horizontal sections of cable will be supported by Cable tray or Unistrut.
- Cables shall be labeled at both ends.
- All cabling must be routed in such a manner as to ensure all bundled cabling is neat.
- All exposed cable bundles to be bound at a maximum of every 24inches, Velcro bindings shall be hand tightened only to a point where the sheath is not deformed.
- The cables shall be rated for the specific indoor or outdoor use as required, e.g. Aerial, Buried, Conduit and/or Plenum.
- When conduit is used, the maximum number of bends between cable pulling points shall be no more than two(2) ninety-degree bends.
- Fiber:
 - 62.5/125micrometer
 - Maximum Attenuation: 3.5/1.0
 - NFPA 70, Type OFN complying with UL 1666.
 - Comply with TIA/EIA-568B
 - At no time shall the cable's static or dynamic bending radius be exceeded.
 - A service loop of 12ft shall be secured in the raceway for future use.

- The manufacturer's instruction for securing the fiber in the fiber enclosure shall be followed.
- Fiber enclosure shall be mounted close to the top of a rack.
- Install in inner duct. Inner ducts are to be permanently labeled as containing fiber optic cable.
- Voice Copper:
 - Cable capable of meeting the power sum requirements of ANSI/TIA/EIA-568-B.2
 - Terminated in patch panels on racks.

3.2.2 Intra-Building

- The building backbone cabling shall be configured as a physical star, with separated dedicated cables to each BDF/IDF.
- Fiber minimum of 12 single mode(sm) and 24 multi mode(mm) 62.5/125micrometer fibers per each IDF to the BDF shall be installed for Data.
- Voice Copper minimum of 25pair UTP multipair per IDF to the BDF.
- Data Copper
 - CAT6a or better shall be utilized in academic buildings.
 - Cat6e shall be utilized in non-academic buildings such as administration and residential life buildings.
 - The specified standard shall be maintained through out a project.
 - When the need for plenum rated cable is established for a portion of a project that standard will be maintained throughout the project.
 - Color blue.

3.2.3 Inter-Building

- Fiber Optic Cable shall be 24fiber single mode fiber and 24fiber multimode 62.5/125-micrometer.
- Voice Copper
 - Minimum of 50pair UTP multipair capable of meeting the power sum requirements of ANSI/TIA/EIA-568-B.2 shall be installed between buildings (BDF's) for Voice.
 - Building Entrance Protection will be provided for all pairs at both ends.

3.2.4 Horizontal/Home Run Cable

- Outlet Specifications
 - Minimum of two (2), or maximum of four (4), series data cables will be one continuous run to each work station location.
 - All 4 pairs will be terminated pin/pair assignment T568B.
 - A minimum of one (1) foot of each cable shall be left coiled in the ceiling above the workbox for future re-terminations and will include the station location label.

- Patch Panel Specifications
 - One CAT6e, 4pair media series cable will be terminated to one CAT6e patch panel RJ45 jack position.
 - One CAT6a, 4pair media series cable will be terminated to one CAT6a patch panel RJ45 jack position.
 - All 4 pairs will be terminated pin/pair assignment T568B.
 - Patch panels will have min 48ports.
 - A minimum six(6)ft. service loop shall be coiled, and secured in the Cable tray or Unistrut in the BDF and IDF room(s) and will include the station location label.

3.2.5 Pathway Specifications

- All cabling shall be installed in a dedicated pathway/raceway system. The system is generally composed of EMT and cable tray but may also include Wire Basket where necessary. Non-metallic wiremold is not allowed. Refer to EIA/TIA-569 Pathway & Spaces.
- All raceway systems shall be installed so that they form a contiguous pathway system and are securely fastened to building surfaces. The contractor may propose an alternate route to minimize interference with existing systems, however all alternate routes must be approved by Dartmouth College Network Services.
- All wiring shall be neatly installed into pathway. No wiring shall be attached to any other electrical conduits, plumbing, heating or air conditioning structures. Wiring shall be routed so that it does not interfere with access to panels, switches, valves or other maintenance systems.
- All surface run cabling will be installed in raceway, wiremold, EMT conduit, or other approved system. All transitions (bends, tees, et cetera) will be done with factory made fittings or properly executed field bends. The maximum number of bends between cable pulling points shall be two(2) ninety-degree bends. Runs over 100 ft shall have a pullout box.
- Any cable concealed above ceiling grids will be supported off of ceiling grid using D-Rings or bridle rings and, wherever practical, bundled together. All

- bindings used (Velcro or hook and pile) shall be hand tightened only to a point where the sheath is not deformed.
- All penetrations in station raceway will have rubber or equivalent grommets to prevent cable cuts on rough edges. Refer to DC Standards section 16110, 'RACEWAYS'.
 - All pathway/raceway will be of sufficient size to accommodate all wiring. Fill density not to exceed 40%.
 - All raceway will be attached to the building structure using screws and anchors. A minimum, attachment will be every two feet. See division 16190 'SUPPORTING DEVICES' for requirements of supports.
 - When the cable tray is passing through a hard-lid ceiling, access ceiling panels shall be installed at 8-foot intervals. The panels shall be within 2 feet of the cable tray. Access panels shall not be mounted directly underneath the cable tray.
 - All coring in viewable areas must be patched with appropriate material and painted if necessary. This work will be inspected.
 - Existing cable trays may be used where additional capacity does not exceed 40% fill density.
 - After all cables are installed and successfully tested, station runs penetrating fire and/or smoke barriers will be sealed with a UL listed removable smoke and flame stop, having a fire rating suitable for the penetration concrete is not acceptable.
 - Conduit space in the riser path between the BDF and each IDF shall not exceed 50% capacity. Pull string must be left in conduit.
 - The riser path must be smooth with no right angles or sharp bends.
 - All cable sheaths will be protected from sharp metal edges. Where the cable passes over a sharp edge, a bushing or grommet will be installed to protect the cable.

3.3 Work Station Area(s)

3.3.1 Standard Telecommunications Outlet

- Communication station outlets will be located in the permanent building structure.
- Minimum of two, maximum of four(4), receiver modules(jacks), will be installed at each location. Color to be specified by job, module default color is grey.
- Faceplates will have a minimum of two(2), maximum of four(4) positions. Faceplates shall accept modules for each cable available at the location. Faceplate default color is grey.

- The odd patch panel position(s) to be mounted on the left and the even patch panel position(s) to be mounted on the right when the faceplate is mounted in the finished position. Lower value number(s) on top and higher value number(s) below.
- In all dry wall office areas, modular jacks and inserts will be flush mounted in double gang 4x4", 4" deep boxes with plaster rings. All double gang boxes will be fed with a minimum of a 1" conduit.
- In residence halls, laboratories and computer oriented workplaces; the mounting height for the boxes is 32" above the finished floor (i.e. just above desktop level). Otherwise the DC-FPO or DC-FOM Project Manager will specify the heights of all boxes as part of the detailed design process before work begins.
- In demountable partition and/or areas requiring surface mount boxes, Contractor will supply and install double gang boxes with a minimum depth of 2-¼" near existing services. Boxes will be affixed to surfaces using screws and/or special purpose clips; the use of double-sided tapes is not acceptable.
- All outlets positioned in sheetrock shall conceal all cable exit holes.
- Labeling on the faceplate will be typed in bold black over white.
- All faceplates shall be identified with permanent labels. Label will indicate floor, telecommunications room and patch panel position. Labels shall use ANSI/TIA/EIA-606-A standards. An example label would be 3A1 where:
 - '3' indicates that the cable is going to the third floor.
 - 'A' indicates that the cable is terminated at the first or only IDF.
 - '1' indicates that the patch panel position.

3.3.2 Wireless

- Will have double gang box mounted a minimum of twelve(12) inches below the ceiling surface or into an approved ceiling tile.
- Will contain two (2), CAT6 or greater home run data cables.
- Does not need a faceplate.
- In every other way outlet specifications apply, see 3.3.1 and 3.2.4.

3.3.3 Wall Phone

- Will have single gang box mounted fifty-two(52) inches above floor (ada).
- Will contain two (2), CAT6 or greater home run data cables.
- In every other way outlet specifications apply, see 3.3.1 and 3.2.4.

3.3.3 Floor Box

- Specified mounts shall be used.
- Will contain two (2), CAT6 or greater home run data cables.

- Other mounts may be used after modules(jacks) have been replaced with modules used by Dartmouth College Network Services, must be verified before install.
- In every other way outlet specifications apply, see 3.3.1 and 3.2.4.

3.3.4 Modular Furniture

- As modular furniture is not part of the permanent building structure, no station run cabling shall be located or terminated within it.
- Patch cables shall be run from communication station outlets located in the building structure by the Modular furniture contractor.
- Accessibility to communications work station outlet critical when installing Modular furniture.
- The modular furniture contractor will determine the lengths of voice and data patch cords required at each location, not to exceed 25'. They will document this information on drawings and in a spreadsheet.
- Dartmouth College Network Services shall provide patch cables in lengths of 7', 14' and 25'.
- All patch cables will be protected from metal edges with grommets or other permanent means (tape is not acceptable). Applicable Cat 6 or CAT6a bend radiuses for flexible cable will be observed.
- Power will be avoided as much as is reasonably possible.
- The contractor will be responsible for the cable installation within the Modular furniture and are not done until the data cable is plugged into an appropriate wall jack and tested.

4. Quality Assurance

4.1 Qualification of Contractor

- The contractor will accept complete responsibility for the design, installation, certification, and support of the cabling system. The contractor must show proof that contractor has the certifying manufactures support on all these issues.
- In the event that subcontractors are used for any portion of the work or technical support, the customer will look to the contractor for all corrective action.
- All Work shall be performed and supervised by Telecommunications Technicians and Project Managers who are qualified to install voice, data and image cabling systems and to perform related tests as required by Dartmouth Network Services in accordance with the manufacture's methods.

- Telecommunications Technicians employed shall be fully trained and qualified on the installation and testing of the equipment to be installed. Evidence that the contractor is a current certified installer must be provided in writing prior to work commencing on the structured cabling for the building.
- The contractor (including subcontractor(s) if any) shall have a proven track record in cabling projects. This must be shown by the inclusion of details of at least three projects involving Category6 cabling and optical fiber, which have been completed by the contractor in the last two years. Names addresses and phone numbers of references for the three projects shall be included.
- Contractor shall use only an approved tel/data subcontractor for all work associated with this section. If the bidder wishes to seek approval of a contractor not on the approved list, it must be done prior to Bid Date and shall not be assumed they are approved or will be approved until the college provides written confirmation of their approval of the tel/data contractor being submitted for approval. If the bidder utilizes the pricing of a yet unapproved tel/data contractor it is entirely at the risk of the Bidder. The current list of approved contractors can be requested from Dartmouth Network Services.
- The contractor shall be responsible for the following items:
 - All cross connect rings or spools
 - All connecting blocks and/or patch panels
 - All mounting brackets and/or relay racks.
 - All Blue station cable (voice, data and CATv as required).
 - All communication workstation outlets (default color grey, and other colors if requested) and terminating hardware as required.
 - All conduit/inner duct (as required).
 - All hangers and mounting hardware.
 - All wraps, bushings and miscellaneous parts.
 - All installation tools and equipment necessary to complete project.
 - All coring, as required.
 - All modular jack hardware as required.
 - All construction (labor & materials) as stated.
 - Co-ordinate inspections with the on campus departments who will be maintaining the system at completion.
- The contractor is responsible for assembly of all components including, but not limited to:
 - Communication workstation boxes.
 - Faceplates.
 - Connectors.
 - Racks.
 - Patch Panels.
 - Fiber enclosures.

- Contractor will be required to attend a pre-wiring meeting with Dartmouth College Network Services and all other interested parties. Cabling will be subject to inspections throughout the cabling process to insure the correct understanding and implementation of the cable standards. It is the responsibility of the contractor to contact Network Services to arrange inspections per the following times:
 1. Before beginning.
 2. After first station location wires are pulled.
 3. Before terminations at both ends of cable have started.
 4. Final inspection after testing is complete. Test results will be required at this time.

4.2 Testing

- Permanent links testing for UTP copper shall be conducted for 100% of pairs and shall identify pair reversal, opens, shorts, resistance and length. Testing shall be per ANSI/TIA/EIA-568-B.1 section 11.
- Basic or Tier 1 fiber network certification is required in all fiber optic cabling links; tests attenuation / insertion loss, length and polarity. This test ensures that the fiber link exhibits less loss than the maximum allowable loss.
- Fiber test measurements shall be taken from both ends, to ensure proper connector termination.
- All tests must be documented. Date, time, test set identifier, the technician and the witness are to be logged. The test log file is one of the deliverables required for system acceptance and job completion certification.
- Results of testing will be provided to the Owner's on-site representative on paper and electronically.
- A paper copy of test results must be signed and dated by the Contractor's foreman or project manager to certify that testing was conducted according to the specified procedures and the results are as stated.
- Test and Acceptance document will list the building, BDF/IDF, outlet number, and location of the outlet.
- Test document will list summary & detailed results.
- All Cable will be tested using equipment capable of testing the level of cable installed.
- The contractor will provide a detailed and complete list of the test equipment used identifying manufacturer model number, serial number, calibration date, and calibration period of all units used for testing.

4.3 Project Closeout

- Records will, at a minimum, correlate station location number and horizontal/riser distribution cable number. A clean, legible copy of these records must be submitted upon project completion. An electronic record using Microsoft Office format will also be submitted upon project completion.
- Three (3) complete sets of as-built drawings following project completion will at a minimum, show the location and type of all telecommunications rooms, distributing cable runs, and communication station outlets.
- Each IDF and BDF will contain a copy of "as-built" drawings provided by the contractor. These copies will be placed in plastic sleeves prior to posting.
- The contractor will update all changes to drawings until the project is accepted.
- The original will be provided to Dartmouth College Network Services.
- All rooms and terminal facilities must be free of cable clippings, empty reels, cartons or other refuse resulting from the installation.
- The contractor shall provide documentation describing the essential system elements and the requirements for maintaining the integrity of the cabling system over time. Documentation shall include, as a minimum, guidelines for system expansion and modification (moves, additions, changes of service) as well as labeling and record keeping.

4.4 GUARANTEE

- At the completion of all work, the Contractor shall deliver a Letter of Guarantee to Dartmouth College Network Services. This guarantee certifies that the Contractor shall promptly replace or repair any equipment or materials found to be damaged by workmanship or failure due to workmanship that becomes apparent within one (1) year from the date of job completion. This letter shall be included in the documentation.

5.1 Products

Manufacturer	Category / Sub Category	Part Type / Part #
Commscope/Systimax	Category 6 Augmented (6A)48 port Patch Panel	1100GS5-48
Commscope/Systimax	Category 6A jacks	MGS500
Commscope/Systimax	Category 6 Augmented (6A)/Class EA non-plenum rated cable	1091b GigaSPEED X10D cable
Commscope/Systimax	Category 6 Augmented (6A)/Class EA plenum rated cable	2091b GigaSPEED X10D cable

Commscope/Systimax	2 port Ivory Faceplate	M12L-246
Commscope/Systimax	4 port Ivory Faceplate	M14L-246
Commscope/Systimax	Catergory 6 outdoor rated cable	6NF4+
Panduit	Voice 24 port patch panel	VP24382TV25Y
Chatsworth	2 post 7ft Rack	CPI# 55053-703
Chatsworth	Evolution Vertical Manger- double sided	CPI# 35521-703
Corning	Connector Housing (main BDF)	CCH-03U
Manufacturer	Category/sub Category	Part #
Corning	24SM, 12MM 62.5 micron FREEDM fiber	036XWF-TBD-D20
Corning	Connector Housing (IDF's)	CCH=02U
Siemons	Couplers CAT6	CT-C6-C6
Siemons	Faceplate CAT6	CT2-FP
Siemons	Faceplate CAT6	CT4-FP
Siemons	Blanks	CT-BLNK
	TDR room	
Siemons	Patch Panel CAT6	MX-PNL-48
Siemons	Patch Panel Modules CAT6 max jack	MX6-F (02)
Panduit	Voice 24 port patch panel	VP24382TV25Y
Commscope	CAT6 Plenum Cable blue	2071
Commscope	CAT6 PVC Cable blue	1071
Commscope	7ft 3" base 2 Post Rack	RK3-45A
Corning	Connector Housing (main BDF)	CCH-03U
Corning	Connector Housing (IDF's)	CCH=02U
Corning	24SM, 12MM 62.5 micron FREEDM fiber	036XWF-TBD-D20