



UNIVERSITY OF
TORONTO

Product and Installation Specifications

for

Building Data Communication Cabling

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Information and Technology Services
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1. OVERVIEW

This document is the specification for the installation of Structured Cabling Systems at the University of Toronto. The voice part of this specification will cater for the use of voice services. The data part is suitable for the provision of high speed Ethernet communications for individual buildings. It should be noted that the cable plant is also used for various personal safety and security applications under the auspices of the U of T Police unit as well as the Fire Alarm and the Facilities & Service networks. The principle use of this practice is for the construction of new building, major renovations, or additions to cable plant.

The following changes to the previous release (November 2010) of this document have been made.

1. Product eligibility is based on standards and is not restricted to products and OEMs mentioned in the document.
2. Multimode fibre cables of all types (OM1, OM3, and OM4) have been excluded from specifications. Current and future fibre installations to be single mode (SM) only.
3. UTP Cat3 100 pair cables have been excluded (replaced with 25 pair Cat3/Cat5e UTP cables where applicable)
4. Vertical riser Cat5e 25 pair intra-building UTP cables have been excluded.

1.1 General Scope

The practice basically follows the relevant EIA, TIA, CSA standards and architectures for commercial buildings. As such, it is focused on the facilities required within a building not the inter-building facilities that are required to ensure a comprehensive University wide network. For specifications of telecommunications rooms see the University document “**Communications Infrastructure Specifications, Standards and Practices**” and for conduit sizes see the EIA/TIA 569A standard.

The practice aims to ensure a cabling system that will give a predictable, consistent and flexible subsystem with a substantial lifetime for the applications that the University needs. It specifies Cat 6 cable for the horizontal UTP copper systems. The formerly specified Cat5e cable has been replaced by Cat6 cable. This practice specifies which OEMs can be used. Recommended OEMs include, but are **not** limited to, Belden, Commscope, Panduit and Hubbell. It will be noted that for telecommunications rooms, there is single vendor approach for the piece parts such as racks, power distribution units and cable management subsystems. This is done for consistency to make it easier for technicians to service and expand the facilities in those rooms.

- 1.1.1 This document specifies the requirements for the installation of all horizontal UTP cabling and all copper/fibre backbone cabling to support voice and data applications in a new or renovated space. It should be noted that Category 6 cabling is specified in the vertical riser in addition to fibre.
- 1.1.2 The cabling contractor shall supply and install a complete telecommunications cabling system based on a physical star wiring topology that is designed in accordance with practices recommended by the Building Industry Services International (BiCSI)

organization. Furthermore, the cabling contractor shall include all communication outlets, terminating hardware and selected connectivity devices as outlined in this specification.

- 1.1.3 It is the responsibility of the cabling contractor to report any errors and/or omissions in this specification with their bids.

1.2 Inquiries

Bidders who find discrepancies or omissions in this specification, or who have any doubt as to the meaning or intent of any part of this specification, shall direct their questions or other inquiries by email or facsimile to the Manager, Network Implementation, I+TS/ Enterprise Infrastructure Solutions of the University.

2. PRODUCT AND INSTALLATION STANDARDS

- 2.1 The equipment, material and installation shall conform to the latest version of the applicable codes, standards and regulations of authorities having jurisdiction. All references to codes, standards and regulations should first be made with respect to Canadian documents.
- 2.2 All components supplied and/or installed will support current applications and any future application introduced by recognized standards or user forums that use EIA/TIA 568 component and link/channel specifications for cabling.
- 2.3 The specifications detailed in this document are accompanied by EIA/TIA and/or CSA requirements both for product and installation practices. The following are communications standards documents that must be adhered to:

Standard	Title
ANSI/TIA-568-C.0	Generic Telecommunications Cabling for Customer Premises
ANSI/TIA-568-C.1	Commercial Building Telecommunications Cabling Standard
ANSI/TIA-568-C.2	Balanced Twisted-Pair Telecommunication Cabling and Components Standard
ANSI//TIA-568-C.3	Optical Fiber Cabling Components Standard
ANSI/EIA/TIA-569-A	Commercial Building Standard for Telecommunications Pathways and Spaces
ANSI/EIA/TIA-606(A)	Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

ANSI/EIA/TIA-607(A) for	Commercial Building Grounding and Bonding Requirements Telecommunications
ANSI/EIA/TIA-598	Colour Coding of Fiber Optic Cables
ANSI/EIA/TIA-455	Test Procedures For Fiber Optics, Cables and Transistors
ANSI/EIA/TIA-604-3	FOCIS 3 Fiber Optic Connector Intermatability Standard
ANSI/ICEA S-83-596	Fiber Optic Premises Distribution Cable
ANSI/ICEA S-83-640	Fiber Optic Outside Plant Communications Cable
ANSI/NECA/BICSI-568	Standard for Installing Commercial Building Telecommunications Cabling
CSA T530	Commercial Building Standard for Telecommunications Pathways and Spaces
CSA T528	Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
CSA T527	Commercial Building Grounding and Bonding Requirements for Telecommunications
CSA C22.1	Canadian Electric Code Part 1 Ontario Hydro Electrical Safety Code
CSA C22.2 No. 232-M	Fiber Optic Cables
CSA-C22.2 No. 182.4-M90	Plugs, Receptacles, and Connectors for Communication Systems.
CSA-C22.2 No. 214-94	Communications Cables
ISO/IEC 11801	Information Technology - Generic Cabling for Customer Premises.

3. PRODUCT SPECIFICATIONS

3.1 General conditions

- 3.1.1 This document specifies that the horizontal structured cabling system shall be a **single manufacturer end-to-end solution**. Recommended manufacturers include, but are not limited to, Panduit TX 6000™ System, Belden IBDN 2400 System, Commscope Gigaspeed XL, and Hubbell NEXTSPEED Cat.6 AMP Connect solution. See appendices for examples of vendor product list and part numbers. It is recommended to consult vendors on current product offerings.

- 3.1.2 The Cat 6 end-to-end system solution shall meet or exceed 250MHz in the channel. Third party test results shall be required such as ETL test results. In house manufacturer test results are **not** acceptable.
- 3.1.3 Products installed must meet or exceed all local, provincial and federal building, fire, health, safety and electrical codes.
- 3.1.4 The cabling contractor is responsible for complete storage, handling, delivery, and installation of all materials used in the performance of the work.
- 3.1.5 The cabling contractor is responsible for keeping the workplace clean, safe and free from debris at all times. All debris must be removed from the site on a daily basis. The costs for cleaning are the responsibility of the cabling contractor.

3.2 Cabling support structure

- 3.2.1 The cabling contractor is to supply and install Cable Ties, cable support system and any other miscellaneous hardware required for supporting all horizontal cabling where conduit or cable tray has not been provided. All horizontal cabling must be supported at 48” to 60” intervals.
- 3.2.2 Where required by local codes all cabling shall be installed in metallic EMT conduit.

3.3 Communications cabling

Category 6 Horizontal Data Cable

- 3.3.1 The horizontal data cabling shall be solid copper, blue unshielded twisted pair (UTP), 4-pair, 23 AWG, CMP rated (FT6) or CMR rated (FT4), Category 6 cable as applicable. Acceptable examples of cables are Panduit TX 6000™ System, Belden IBDN 2400 System, Commscope Gigaspeed XL, or Hubbel NEXTSPEED Cat6 AMP Connect solution.
- 3.3.2 The cable shall be tested and characterized to 350 MHz and have a positive PSACR above 250 MHz. It shall also be UL listed.
- 3.3.3 The jacket shall be printed with a 1000’ to 0’ marking system and/or 333 meters to 0 meters system.

3.4 Work area outlet solutions

Category 6 Modular Jacks

- 3.4.1 Horizontal UTP Category 6 data cabling to be terminated at the workstation shall be terminated with modular 8 position, 8 wire RJ45 connector. Recommended OEMs include, but are not limited to Panduit, Belden, Commscope or Hubbell. Modules are to

be wired as per T568A. Modular data jacks shall be blue in colour except when used for wireless applications in which case they shall be orange in colour

- 3.4.2 The approved horizontal UTP Category 6 voice cabling to be terminated at the workstation shall be terminated with modular 8 position, 8 wire RJ45 connector. Recommended OEMs include, but are not limited to Panduit, Belden, Commscope or Hubbell. Modules are to be wired as per T568A. Modular voice jacks shall be white in colour.
- 3.4.3 Modular jacks must meet FCC Part 68 Subpart F; contacts are to be plated with 50 micro inches of gold.
- 3.4.4 Modular jack contacts shall have a minimum of 2500 plug insertions without degradation of electrical or mechanical performance as per the IEC60603-7 specification.
- 3.4.5 Jack termination shall utilize a paired termination sequence. Maintain untwist to a maximum of ½ inch during termination.
 - i. Leave one (1) foot or thirty (30) centimeters of cable slack in the ceiling above each work area outlet location. If the cable is installed in conduit leave one (1) foot or thirty (30) centimeters of cable slack in the closest pull box and or cable tray.

Work Area Patch Cords

- 3.4.6 Patch cords shall be stranded Category 6 and meet or exceed FCC Part 68 and IEC 60603-7 specifications. The plug shall have contacts plated with 50 micro inches of gold for improved durability and have a minimum of 2500 plug insertions without degradation of electrical or mechanical performance.
- 3.4.7 The patch cord shall be blue in colour and shall be ten (10) feet or three (3) meters in length except when used for wireless applications in which case they shall be orange in colour and shall be no more than seven (7) feet or two (2) meters in length.
- 3.4.8 Patch cords shall be manufacturer assembled and verified. Some of recommended manufacturers are Panduit, Belden, Commscope, and Hubbell.

Flush Mounted Faceplates

- 3.4.9 The horizontal UTP cabling shall be terminated at the workstation on a flush mounted wall plate. Each faceplate shall be 4 or 6 ports on a single gang to allow for future growth. All unused ports will have blank modules installed.
- 3.4.11 Faceplates shall be UL listed and CSA Certified.

Furniture Faceplates

- 3.4.12 Horizontal UTP cabling terminated at the workstation in systems furniture shall use a four-port faceplate. All unused ports shall be filled in with blank inserts.

Concrete Floor Box

- 3.4.13 Horizontal UTP cabling shall be terminated at the workstation in a Wellmark 400 Series Concrete Floor Box or equivalent and shall use NEMA standard Decora Module frames. All unused ports shall be filled in with blank inserts.

Consolidation Point Enclosures

- 3.4.14 For zone cabling installations, consolidation point boxes/enclosures shall be used. Panduit used as an example, in-floor applications should be Panduit Panzone CIFZ series, and in-ceiling applications Panduit Panzone CICZ series. Active in-ceiling applications may be Panduit Panzone CICZC2X2A. For smaller Zone Cabling installations, consolidation point boxes/enclosure may be Panduit WMCPEPPBL, Panduit CUFMB24BL, CUFB48BL, or equivalent by different manufacturer.
- 3.4.15 All consolidation point boxes/enclosures must be UL2043 approved for use in air-handling spaces for in-ceiling applications.

3.5 Telecommunications room termination solutions

Horizontal Data Cable Terminations

- 3.5.1 All data Cat 6 horizontal UTP cabling shall be terminated on RJ45 modular jacks and connected to modular rack mount patch panels. The modular patch panels shall be mounted in a standard 19" rack.
- 3.5.2 Modular patch panels shall be 24 or 48 port modular panels and shall be **black** in colour. RJ45 modular jacks shall be used to connect to modular patch panels.
- 3.5.3 Leave ten (10) feet and or three (3) meters of slack in the telecommunications room to allow for future rack relocation if required. Do not store the slack in bundled loops. Cable slack should be stored in an extended loop or in figure eight.

Category 6 UTP Backbone Riser Cable (Optional)

- 3.5.4 Between each telecommunications room and the BEF twelve (12) Category 6 UTP cables are to be installed and terminated on a modular rack. Approved Category 6 cables from recommended OEMs include, but are not limited to, Belden, Commscope, Panduit and Hubbel. Category 6 modular jacks are to be **blue** in colour except when used for wireless applications in which case they shall be **orange**.

Telecom Room Patch Cords

- 3.5.5 Patch cords shall be stranded Category 6 and meet or exceed FCC Part 68 and IEC 60603-7 specifications. The plug shall have contacts plated with 50 micro inches of gold

for improved durability and have a minimum of 2500 plug insertions without degradation of electrical or mechanical performance.

- 3.5.6 Data patch cords shall be **blue** in colour and shall be seven (7) feet and or two (2) meters in length unless otherwise specified.
- 3.5.7 Approved patch cords shall be manufacturer assembled, tested and verified. Some of recommended manufacturers are Panduit, Belden, Commscope or Hubbell.

Fiber Optic Backbone Cabling - Singlemode

- 3.5.9 The approved intra-building singlemode fibre optic backbone cables shall be 9/125um OS2 and constructed with Corning optical fibre. Indoor cables shall be tight buffered with CMP (FT6) or CMR (FT4) where applicable. If needed, outdoor cables shall be loose tube CMR (FT4) outdoor rated fibre optic cable. Recommended manufacturers are Panduit, Belden, Commscope, Corning, and Hubbell.
- 3.5.10 The approved intra-building singlemode fibre optic backbone cables from the Building Entrance Facility (BEF) to the Telecommunications Room (TR) shall be a minimum twelve (12) strand cable unless otherwise specified by the University of Toronto.
- 3.5.11 Cable to be formed into groups of 12 fibres. Groups and individual fibres shall be identified in accordance with ANSI/EIA/TIA-598-A
- 3.5.12 Fiber optic cable groups shall be assembled to form a single compact core and covered by a protective sheath. The sheath shall consist of an overall jacket and one or more layers of dielectric material applied over the core.

Fiber Optic Connectors

- 3.5.13 The fibre optic connectors must be field installable connectors. The connectors shall be LC style UPC for both inter-building backbone cables and intra-building backbone cables. All connectors are to meet ANSI/EIA/TIA and IEC standards for repeatability.
- 3.5.14 The connector shall be capable of terminating on either 900 micron tight-buffered cable, 3.0 mm jacketed fibres or 250 micron loose tube fibres. The connector shall also have a zirconia ceramic ferrule for both multimode and singlemode connectors and must have a locking feature to the coupler.
- 3.5.15 The connector shall provide a strain relief mechanism for installation on a single fibre. The fibre within the body of the connector shall be isolated mechanically from cable tension bending and twisting as per ANSI/TIA-568-C.3.

Fiber Optic Patch Panels

- 3.5.16 The fibre optic patch panel shall be rack mountable in a 19" rack and **black** in colour. The panels shall comply with ANSI/TIA-568-C.3 (connecting hardware section).

Recommended manufacturers include, but are not limited to Panduit, Belden, Commscope, Corning and Hubbell.

- 3.5.17 The fibre optic patch panel shall have a slide out shelf or swing out drawer for access to the fibre terminations, adapter panels for patching.
- 3.5.18 The fibre optic patch panel shall provide for bend radius control and use a strain relief to accommodate the fibre optic cables.
- 3.5.19 The fibre optic patch panel shall be capable of terminating tight buffered and loose tube multimode or singlemode fibre optic cables.

Fiber Optic Patch Cords

- 3.5.20 Dual fibre optic patch cords are to be singlemode 9/125um. Connector types on ends of patch cords to be determined by the University of Toronto.
- 3.5.21 Patch cords to be factory assembled and verified. Fiber patch cords shall comply with ANSI/TIA-568-C.3
- 3.5.22 The colour of the singlemode patch cords will be **yellow**. The length of the patch cords will be ten (10) feet or three (3) meters unless otherwise specified. Recommended manufacturers include, but are not limited to, Panduit, Belden, Commscope, Corning and Hubbell.

3.6 Rack and cable management system

Telecommunication Racks

- 3.6.1 Telecommunication racks shall be 19", floor mounted, **black** in colour, accommodate a minimum of 45 rack unit space, and have anchor holes in the base. Each rack shall be equipped with one (1) duplex outlet on a dedicated 15 A, 120 V, isolated ground circuit. Panduit CMR series rack part number 19X84S is an example of a recommended manufacturer.
- 3.6.2 All telecommunications racks are to be fitted with one (1) **black** 10 outlet horizontal, rack mount, power strip.
- 3.6.3 All racks are to be equipped with a Telecommunications rack ground bar, example Panduit TRGB19.
- 3.6.4 The colour of the rack and accessories shall be **black**.

Vertical Cable Management

- 3.6.5 A six inch (6") vertical cable manager is to be provided on each side of the 19" inch rack, except where racks are ganged together. Panduit patch runner PRVF6 (vertical manager), PRD6 (door) or equivalents shall be used.
- 3.6.6 Where racks are ganged together utilize an eight inch (8") PRVF8 (vertical manager), PRD8 (door) or equivalents between the racks. Depending on the number of horizontal drops where racks are ganged together the twelve inch (12") PRVF12 (vertical manager), PRD12 (door) or equivalent shall be used.
- 3.6.7 The vertical cable manager shall have a metal door that hinges open from the right or left.
- 3.6.8 The vertical cable manager shall have bend radius control built into the manager so as patch cables transition into the manager they are not resting on a sharp edge.

Horizontal Cable Management

- 3.6.9 One (1) horizontal cable manager per copper patch panel is to be provided. Managers are to be 1U for 24 port patch panel or 2U for 48 port patch panel.
- 3.6.10 The horizontal cable manager door shall hinge up or down, must have bend radius control built into the slots for patching and transitioning into the vertical managers and must have retaining clips.
- 3.6.11 The colour of the horizontal cable manager shall be **black**. Panduit PatchLink series, WMPFSE, WMPHF2E is an example of an acceptable product.

3.7 Raceway solutions

- 3.7.1 All single channel or multi-channel Raceway solutions and accessories installed shall be Panduit, Wiremold, or equivalent.
- 3.7.2 All Raceway shall be installed to the recommended practices of the manufacturer and all-applicable electrical codes. All accessories shall have bend radius control built in for communications cabling as per the ANSI/EIA/TIA 569 –A standard.

3.8 Grounding and bonding

- 3.8.1 The grounding and bonding of the telecommunications system shall meet all local, provincial and national codes and bylaws.
- 3.8.2 All grounding and bonding shall be installed as per ANSI/EIA/TIA 607(A)
- 3.8.3 A separate ground should be established for the telecommunications system. Where this is not possible the telecommunications system ground shall be tied into the building/electrical ground.

- 3.8.4 A communications ground that is continuous and permanent through all telecommunication rooms must be established.
- 3.8.5 All racks and cabinets must be grounded to the telecommunications grounding system using 6 AWG green insulated stranded copper ground wire. All racks are to be equipped with Panduit TRGB19 telecommunications rack ground bars or equivalent.

3.9 Miscellaneous

Test Equipment

- 3.9.1 The cabling contractor is to use the Fluke DTX series scanner or equivalent with the latest version of firmware to test the UTP cabling system. All optical fibre shall be tested with a light source meter. (Details in the testing section of this document.)

Spiral Wrap

- 3.9.2 Cables running from system furniture feed points to the system furniture shall be neatly wrapped with Panduit T50R-C series spiral wrap and or PW series Pan Wrap or equivalent. Cabling contractor to size the spiral wrap accordingly.

Fire stopping

- 3.9.3 The cabling contractor must supply and install all required fire stopping materials to reestablish the integrity of any and all fire-rated architectural structures and assemblies they have worked on. Mechanical systems consisting of standard conduit, sleeves, cored holes and all horizontal and backbone pathways that penetrate fire-rated barriers shall be fire stopped. The cabling contractor must install an approved fire-stop material recommended by CSA, ULC or UL in accordance with all applicable codes. Intumescent putties and or cementitious materials with a minimum three (3) hour rating shall be used.

4. INSTALLATION

The approved contractors that have been chosen to participate in this bid shall be a certified installer. The contractor shall have a minimum of five (5) years industry experience and have been trained in the proper installation practices as per ANSI/TIA-568-C. All contractors shall have manufacturer trained technicians with a minimum of two (2) years installation experience.

4.1 General conditions

- 4.1.1 The approved cables and components must be installed and terminated in accordance with the ANSI/TIA-568-C standard. Particular attention must be given to maintaining the integrity of the pair twists, bend radius and ensuring proper distance is kept from fluorescent light fixtures, electrical cables or any other source of EMI.

- 4.1.2 Leave ten (10) feet and or three (3) meters of slack in the telecommunications room to allow for future rack relocation if required. Do not store the slack in bundled loops. Store cable slack in an extended loop or a figure eight. Leave one (1) foot of cable slack in the ceiling above each work area outlet location.
- 4.1.3 The maximum horizontal cable length is not to exceed 90 meters or 295 feet. If the 90 meters or 295 feet constraint cannot be met, the cabling contractor is to notify the University of Toronto.
- 4.1.4 All plywood backboard(s) are to be supplied and installed by the contractor unless otherwise noted. All plywood backboards shall be fire retardant.
- 4.1.5 All cables and pathways such as conduits, cable tray or other systems used for communication cable distribution to be run parallel or perpendicular to building lines.
- 4.1.6 To minimize any possibilities of disruption, maintain the minimum clearances from electrical and heat sources when routing cables.
- 4.1.7 Any deviation from the cable routing, outlet and equipment locations shown on drawings must be approved by the consultant and documented on as-built drawings.
- 4.1.8 Avoid scraping, denting, or otherwise damaging cables, before, during or after installation. The cabling contractor, without any additional compensation, shall replace damaged cables.
- 4.1.9 Bush, ream and remove any sharp projections on all conduits prior to installation of communications cables.

4.2 Horizontal cable distribution

- 4.2.1 The cabling contractor is to supply Panduit Tak-Ty cable ties or equivalent and any other miscellaneous hardware required to support horizontal cabling where conduit or cable tray has not been provided.
- 4.2.2 Pull all cables in a continuous run. No cable splices will be permitted.
- 4.2.3 Leave one (1) foot or thirty (30) centimeters of cable slack in the ceiling above each work area outlet location. If the cable is installed in conduit leave one (1) foot or thirty (30) centimeters of cable slack in the closest pull box and or cable tray.
- 4.2.4 When bundling cables, comply with manufacturer's recommended bundling practices for installation. Ensure that excess pressure is not placed on the cable at any point that may result in the compression or deformation of the cable jacket and internal pair/conductor geometry.
- 4.2.5 Provide blank filler plates for all unused modular jack positions on faceplates.

4.3 Horizontal cabling

- 4.3.1 Supply and install horizontal cabling as detailed on communications cabling layout drawings.
- 4.3.2 A typical station cable drop consists of a combination of one (1) horizontal voice and one (1) horizontal data cable unless otherwise noted on the drawings and or otherwise specified.
- 4.3.3 All horizontal data and voice cabling will originate from the telecommunication room out to the designated workstation location in a star topology.

4.4 Rack and cable management system

- 4.4.1 All 19” racks and brackets are to be located as shown on communications cabling layout drawings.
- 4.4.2 All racks are to be anchored securely to the floor.
- 4.4.3 All racks, patch panels, cabinets, metal raceways and data equipment are to be grounded to building ground bus bars using Panduit Network Grounding Systems product or equivalent.

4.5 Fire stopping

- 4.5.1 Fire stopping requirements must include prevention of fire from passing through a barrier. These seals are required to maintain safety and security within the clients’ premises.
- 4.5.2 The cabling contractor must re-establish the integrity of any and all fire-rated architectural structures and assemblies they have worked on.

4.6 Labeling

- 4.6.1 All labels shall be Panduit Identification or equivalent Products for voice and data structure cabling systems.
- 4.6.2 Cable labels shall be of self-laminating vinyl construction with a white printing area and a clear tail that self laminates the printed area when wrapped around a cable. The clear area should be of sufficient length to wrap around the cable at least one and one-half times and be installed within 2” of the termination point of the cable, patch cord or pigtail.
- 4.6.3 All adhesive cable labels shall meet the legibility, defacement, and adhesion requirements specified in UL 969 (Ref. D-16). In addition the labels shall meet the general exposure requirements in UL 969 for indoor use.

- 4.6.4 All cable labels shall be compliant with the TIA/EIA-606(A) Section 6.2.2 Cable Labeling, Section 6.2.4 Termination Hardware Labeling, and Section 6.2.6 Termination Position Labeling.
- 4.6.5 All patch panel and BIX/110 block labels are to be mechanically printed and are to follow the guidelines in CSA-T528-93 for Colour Coding of Termination Fields.
- 4.6.6 Label all cabling in accordance with CSA-528 specifications. One label should be attached to the front of the workstation faceplate, one to the front of the patch panel, and one at each end of the cable.
- 4.6.7 All labels must be mechanically printed. **Hand written labels are not permitted.**
- 4.6.8 All intra-building and inter-building backbone cables for voice and data shall be labeled. Labeling shall include destination (building) to and from at each end.
- 4.6.9 The horizontal cables shall be labeled in the format **D-floor#-room#-cable#**. The per room cable numbers shall be sequential beginning at 1.

Example: D03-038-2 represents a second data cable to room 038 of the third floor.

Example: D11-099-5 represents a fifth data cable to room 099 of the 11th floor.

Note: At the University in many buildings the floor is implicit in the room number and, therefore, the label may be shortened by omitting the explicit floor number.

4.7 Testing

- 4.7.1 The cabling contractor is to use the Fluke DTX series or equivalent with the latest version of firmware to test the UTP cabling system. A light source and power meter will be used to for all fibre optic cables. The cabling contractor must ensure that all cabling is tested in accordance to the proposed specifications of the category installed.
- 4.7.2 Upon completion of testing by the cabling contractor, a University representative may choose to witness up to 10% of the cables being tested.
- 4.7.3 All deficiencies must be corrected before the Project Manager will provide a certificate to release the holdback on the project.
- 4.7.4 Category 6 field test parameters shall be. Testing of all 4 pairs is to include but not be limited to the following:
 - 1) Wire Map
 - 2) Insertion Loss
 - 3) Equal Level Far End Cross Talk (ELFEXT)
 - 4) Power sum equal level far end cross talk (PSELFEXT)
 - 5) Delay Skew

- 6) Power sum attenuation to crosstalk ratio (PSACR)
- 7) Near end cross talk (NEXT)
- 8) Propagation Delay
- 9) Cable length
- 10) Power sum near end cross talk (PSNEXT)
- 11) Return Loss

- 4.7.5 A tester with the most recent version of its software and firmware must perform all tests in accordance to ANSI/EIA/TIA TSB-67. The nominal velocity of propagation (NVP) must be set specific to each cable manufacturer before testing. Portable testers to be calibrated on a minimum annual basis. Fluke DTX or equivalent shall be used.
- 4.7.6 Test patch cords for the tester must be designed and approved for testing by the manufacturer. Field assembled patch cords are not acceptable.
- 4.7.7 Test each strand of fibre with a Power Meter / Light Source combination operating at wavelengths of 850 nm and 1300 nm for multimode fibres and 1310 nm and 1550 nm for single mode fibres. Perform these tests in both directions. These tests shall be completed after cable installation, splicing and connectors are installed. Provide test results in soft copy to the University representative for the project.
- 4.7.8 All cable faults must be corrected. Splicing of any cables will not be permitted, for any reason, unless prior authorization if received in writing by the University of Toronto.

5. DOCUMENTATION

5.1 “As built” drawings

The cabling contractor is required to provide as-built drawings of the cable installation. This shall include the pathway of the cables from the telecommunications rooms to the workstation. The as-built drawings shall also include all additional cabling installed during the project. The cabling contractor shall provide the as-built drawings to the University of Toronto within 7 business days of the completion of the project.

5.2 Cable test results

The cabling contractor shall provide all test results in hard and soft copy to the University of Toronto. The electronically supplied test results shall be in the proper tester format. Test results shall include all voice and data horizontal cables and all voice and data backbone cables. The hard copy report shall indicate for each cable, when it was tested successfully and the signature of the technician that performed the test. The entire report must be signed by an authorized person for the cabling contractor at the end of the project.

6. WARRANTY

The cabling contractor must provide the owner with a 20 year product warranty and a minimum one (1) year labour warranty.

Appendix 1. Example: Belden Bill of Materials

<http://www.e-catalog.beldensolutions.com/link/57078/en/conf/0-0>

Ordering (CPC)	Product Code (PEC)	DESCRIPTION Number
AX101456	NXPPF1U24EB	NXPPF1U24EB FLEX PATCH PANEL 1U 24P BLACK EA 1
AX101458	NXPPF2U48EB	NXPPF2U48EB FLEX PATCH PANEL 2U 48P BLACK EA 1
AX101437	NXF AFL4P-03	NXF AFL4P-03 NORDX/CDT faceplate 4-port, flush, white assy EA 25
AX101441	NXF AFL6P-03	NXF AFL6P-03 NORDX/CDT faceplate6-port, flush, white assy EA 25
AX101821	NXLFSMFP-03	LabelFlex System labels for MediaFlex plates, White, 10sheets/pack EA 1
AX100310	NXMAA4-03	NXMAA4-03 MDVO 106 ADAPTER, 4-port, WHITE EA 50
AX100928	NXMAB4-04	NXMAB4-04 MDVO MODULAR FURNITURE ADAPTER 4-port EA 1
A0643207	QNE4M6(103)	QNE4M6(103) MDVO MULTIMEDIA OUTLET BOX, 6-port, white EA 1
AX100041	NX7L26AA1	FiberExpress Rack Mount patch panel, 1U, Black Universal Connector Panel EA 1
AX100068	NX7L26FA1	FiberExpress Rack Mount patch panel, 2U, Black Universal Connector Panel EA 1
AX100077	NX7L26MA1	FiberExpress Rack Mount patch panel, 3U, Black Universal Connector Panel EA 1
AX100115	NX6F26NA	FiberExpress Rack Mount patch panel, 4U, Gray Universal Connector Panel EA 1
AX100495	NX7L26SA	FiberExpress Wall Mount patch panel, Small, Black EA 1
AX100541	NX7L26TB	FiberExpress Wall Mount patch panel, Medium, Gray EA 1
AX100543	NX7L26UB	FiberExpress Wall Mount patch panel, Large, Gray EA 1

Singlemode fibre patch cables

FPSLDLD002M	FX PATCH CORD, OS2, LC DUPLEX - LC DUPLEX, 2 M
FPSLDLD003M	FX PATCH CORD, OS2, LC DUPLEX - LC DUPLEX, 3 M
FPSLDLD005M	FX PATCH CORD, OS2, LC DUPLEX - LC DUPLEX, 5 M

Category 6 Backbone Components**Riser Cables Terminated in Cabinet – RJ45**

Part Number	Description
24566315	IBDN GigaFlex 2412 (CMR) Cable, White
AX101456 or 1571	1U, 24-port Flex Patch Panel, Black or Gray
AX101066 or 63	GigaFlex PS6+ Module, Black or Gray
AX3500xx	GigaFlex PS6X Modular Cord, various colors and lengths

Riser Cables Terminated in a Cabinet – BIX Cross-Connect

24566315	IBDN GigaFlex 2412 (CMR) Cable, White
AX101986	GigaBIX Rack Mount Panel
AX101447	GigaBIX Connector, 6-port
AX101486	GigaBIX Wire Guard
AX101483	GigaBIX Designation Strip
24570521	GigaBIX Cross-Connect Wire, 4-pair
NXGX-CDDGY-YGY-HHH.H	GigaBIX PS6+ Modular Cord, RJ45 – Open, Gray (HHH.H = length in feet, i.e. 007.5 is 7.5ft)

Riser Cables Terminated on BIX Cross-Connect on wall

24566315	IBDN GigaFlex 2412 (CMR) Cable, White
AX101472	GigaBIX Mount
AX101447	GigaBIX Connector, 6-port
AX101486	GigaBIX Wire Guard
AX101483	GigaBIX Designation Strip
24570521	GigaBIX Cross-Connect Wire, 4-pair
AX101478	GigaBIX Management Ring
NXGX-CDDGY-YGY-HHH.H	GigaBIX PS6+ Modular Cord, RJ45 – Open, Gray (HHH.H = length in feet, i.e. 007.5 is 7.5ft)

Appendix 2. Example: Panduit Bill of Materials

http://www.panduit.com/ccurl/71/255/SA-NCCB51_FULL_WEB_1-3-13.pdf

Modular Patch Panels

CPPL24WBL Y – Panduit 24 Port Patch Panel Black
 CPPL48WBL Y – Panduit 48 Port Patch Panel Black

Flush Mount Face Plate

CFPL4IW Y – Panduit 4 Port Faceplate with Label International White
 CFPL6IW Y – Panduit 6 Port Faceplate with Label International White
 CPGIW – Panduit Rectangular Faceplate for Decora Frame International White

Decora Faceplate

CFG4IW – Panduit 4 Port Decora Frame International White
 CF1064IW Y – Panduit 106 Duplex Frame International White

Furniture Face Plate

CFFPL4BL – Panduit 4 Port Furniture Face Plate Black

Surface Mount Box

CBXC4IW-A – Panduit 4 Port Surface Box International White
 CBXD6IW-AY – Panduit 6 Port Surface Box International White

Fiber Optic Patch Panels Rack Mount

FRME1 – Panduit 1U Fiber Optic Rack Mount Patch Panel Black
 FRME2 – Panduit 2U Fiber Optic Rack Mount Patch Panel Black
 FRME3 – Panduit 3U Fiber Optic Rack Mount Patch Panel Black
 FRME4 – Panduit 4U Fiber Optic Rack Mount Patch Panel Black

Fiber Optic Patch Panels Wall Mount

FWME2 – Panduit 12/24 Port Patch Panel Wall Mount Black
 FWME4 – Panduit 24/48 Port Patch Panel Wall Mount Black
 FWME8 – Panduit 48/96 Port Patch Panel Wall Mount Black

Fiber Cable Singlemode

FSDR912Y - 12 strand Singlemode 9/125 Fiber Optic Cable Riser Rated
 FSDR924Y - 24 strand Singlemode 9/125 Fiber Optic Cable Riser Rated
 FSDP912Y – 12 strand Singlemode 9/125Fiber Optic Cable Plenum Rated
 FSDP924Y - 24 strand 9/125 Singlemode Fiber Optic Cable Plenum Rated

F9E10-10M3Y LC to LC singlemode duplex patch cord, 9/125µm

CAT 6 Copper Backbone Components

Cable

PUP6004BU-UY – Panduit CAT6 Plenum 4 Pair UTP Cable Blue
 PUP6004WH-UY - Panduit CAT6 Plenum 4 Pair UTP Cable White
 PUR6004BU-UY - Panduit CAT6 Riser 4 Pair UTP Cable Blue
 PUR6004WH-UY - Panduit CAT6 Riser 4 Pair UTP Cable White

Modular Jacks

CJ688TGYL – Panduit RJ45 Modular Jack Yellow

Modular Patch Panels

CPPL24WBLY – Panduit 24 Port Patch Panel Black

Telecommunications Rack

CMR19X84S – Panduit CMR Steel Rack (Black)

Vertical Cable Management

PRVF6 – Panduit Patch Runner 6”
 PRD6 – Panduit Patch Runner Door 6”
 PRVF8 – Panduit Patch Runner 8”
 PRD8 – Panduit Patch Runner Door 8”
 PRVF12 – Panduit Patch Runner 12”
 PRD12 – Panduit Patch Runner Door 12”

Horizontal Cable Management

WMPFSE – Panduit 1U Horizontal Cable Manager Black
 WMPHF2E – Panduit 2U Horizontal Cable Manager Black

Grounding and Bonding

TRGB19 – Panduit Telecommunications Rack Ground Bar

Miscellaneous

T50F-C* - Panduit Spiral Wrap
 PW50F-T20 – Panduit Pan-Wrap
 PW75F-C20 – Panduit Pan-Wrap
 J-MOD – Panduit Cable J Hook Support System
 JMJH2-X20 – Panduit J Hook
 JMCMB25-1-X – single level ceiling mount bracket
 JMCMB25-3-X – three level ceiling mount bracket
 JMCB-X – chaining bracket
 TTS-20R0 – Panduit Tak-Tape 20ft roll
 TTS-35RX0 – Panduit Tak-Tape 35ft roll
 HLS15RO – Panduit ¾” Tak-ty 15ft roll
 HLS-75RO – Panduit ¾” Tak-ty 75ft roll

Labels

S100X150YAJ – 2500 ea. Panduit Wrap Around Labels
C195X040Y1J – Panduit Face Plate Label
C261X035Y1J – Panduit Patch Panel Label

Appendix 3. Example: Hubbell Bill of Materials

<http://ecatalog.hubbell-premise.com/productinformation/viewcatalog.aspx?Dest=hubbell-premise.com/literature/ecatalog/g.pdf>

Category 6 Copper Components - Hubbell NextSpeed Link6:

C6RPEB	Hubbell Category 6 UTP Cable, Plenum (FT6), Blue
C6RPEW	Hubbell Category 6 UTP Cable, Plenum (FT6), White
C6RREB	Hubbell Category 6 UTP Cable, Riser (FT4), Blue
C6RREW	Hubbell Category 6 UTP Cable, Riser (FT4), White
HXJ6B	Hubbell Category 6 RJ45 Modular Jack, Blue
HXJ6W	Hubbell Category 6 RJ45 Modular Jack, White
P6E24U	Hubbell Category 6 - 24 Port, Loaded 1U Patch Panel, Black
P6E48U	Hubbell Category 6 - 48 Port, Loaded 2U Patch Panel, Black
P624AU	Hubbell Category 6 - 24 Port, Angled Loaded 1U Patch Panel, Black
P648AU	Hubbell Category 6 - 48 Port, Angled Loaded 2U Patch Panel, Black
HC6B07	Hubbell Category 6 Patch Cord, 7', Blue
HC6B10	Hubbell Category 6 Patch Cord, 10', Blue
HC6W07	Hubbell Category 6 Patch Cord, 7', White
HC6W10	Hubbell Category 6 Patch Cord, 10', White

Unloaded Modular Keystone Patch Panels:

UDX24E	Hubbell Modular - 24 Port, Unloaded 1U Patch Panel, Black
UDX48E	Hubbell Modular - 48 Port, Unloaded 2U Patch Panel, Black
UDXA24	Hubbell Modular - 24 Port, Angled Unloaded 1U Patch Panel, Black
UDXA48	Hubbell Modular - 48 Port, Angled Unloaded 2U Patch Panel, Black

Single Mode Fiber Optical Cable - Hubbell OptiChannel:

HFCD1006RS	Hubbell Indoor OS2 Single Mode - 6 Strand Fiber Optic Cable, Riser, Yellow
HFCD1012RS	Hubbell Indoor OS2 Single Mode - 12 Strand Fiber Optic Cable, Riser, Yellow
HFCD1024RS	Hubbell Indoor OS2 Single Mode - 24 Strand Fiber Optic Cable, Riser, Yellow
HFCD1006PS	Hubbell Indoor OS2 Single Mode - 6 Strand Fiber Optic Cable, Plenum, Yellow
HFCD1012PS	Hubbell Indoor OS2 Single Mode - 12 Strand Fiber Optic Cable, Plenum, Yellow
HFCD1024PS	Hubbell Indoor OS2 Single Mode - 24 Strand Fiber Optic Cable, Plenum, Yellow
HFCD14006RS	Hubbell Indoor/Outdoor OS2 Single Mode - 6 Strand Fiber Optic Cable, Riser, Black
HFCD14012RS	Hubbell Indoor/Outdoor OS2 Single Mode - 12 Strand Fiber Optic Cable, Riser, Black
HFCD14024RS	Hubbell Indoor/Outdoor OS2 Single Mode - 24 Strand Fiber Optic Cable, Riser, Black
HFCD14006PS	Hubbell Indoor/Outdoor OS2 Single Mode - 6 Strand Fiber Optic Cable, Plenum, Black
HFCD14012PS	Hubbell Indoor/Outdoor OS2 Single Mode - 12 Strand Fiber Optic Cable, Plenum, Black
HFCD14024PS	Hubbell Indoor/Outdoor OS2 Single Mode - 24 Strand Fiber Optic Cable, Plenum, Black

Single Mode Fiber Connectors - Hubbell ProClick:

FCSC900KSM	Hubbell SC ProClick Connector, OS2 Single Mode, Blue
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Single Mode Fiber FSP Adapter Panels - Hubbell OptiChannel:

FSPSCDS3Y	Hubbell 6-Port SC (3 Duplex) Adapter Panel, Single Mode, Yellow
FSPSCDS4Y	Hubbell 8-Port SC (4 Duplex) Adapter Panel, Single Mode, Yellow
FSPSCDS6Y	Hubbell 12-Port SC (6 Duplex) Adapter Panel, Single Mode, Yellow

Single Mode Fiber Patch Cords - Hubbell OptiChannel:

DFPCSCSCS3SM Hubbell SC to SC Duplex Fiber Patch Cord, OS2 Single Mode, Yellow

Fiber Patch Panels - Rack Mount - Hubbell OptiChannel:

FCR1U3SP Hubbell Fiber Patch Panel, 1U, Unloaded (3 FSP panel capacity), Black
 FCR2U6SP Hubbell Fiber Patch Panel, 2U, Unloaded (6 FSP panel capacity), Black
 FCR2U9SP Hubbell Fiber Patch Panel, 2U, Unloaded (9 FSP panel capacity), Black
 FCR3U12SP Hubbell Fiber Patch Panel, 3U, Unloaded (12 FSP panel capacity), Black
 FCR4U15SP Hubbell Fiber Patch Panel, 4U, Unloaded (15 FSP panel capacity), Black

Fiber Wall Mount Enclosures - Hubbell OptiChannel:

FTU1SP Hubbell Wall Mount Fiber Enclosure, Unloaded (1 FSP panel capacity), Black
 FTU2SP Hubbell Wall Mount Fiber Enclosure, Unloaded (2 FSP panel capacity), Black
 FTU4SP Hubbell Wall Mount Fiber Enclosure, Unloaded (4 FSP panel capacity), Black

Faceplates / Surface Mount Boxes - Hubbell NextFrame:

IFP14W Hubbell IFP Flush Wall Faceplate, 4 Port Keystone, Single Gang, White
 IFP16W Hubbell IFP Flush Wall Faceplate, 6 Port Keystone, Single Gang, White

 AFP14W Hubbell AFP Angled Wall Faceplate, 4 Port Keystone, Single Gang, White

 ISF4W Hubbell Decora Outlet Frames, 4 Port Keystone, White
 ISF6W Hubbell Decora Outlet Frames, 6 Port Keystone, White
 NP26W Hubbell Decora Wallplate, Single Gang, White

 FP2BK Hubbell Furniture Faceplate, 2 Port Keystone, Black
 FP4BK Hubbell Furniture Faceplate, 4 Port Stacked Keystone, Black
 FP4BBK Hubbell Furniture Faceplate, 4 Port Straight Keystone, Black

 ISB4W Hubbell ISB Surface Mount Box, 4 Port Keystone, Unloaded, White
 ISB6W Hubbell ISB Surface Mount Box, 6 Port Keystone, Unloaded, White

Telecom Racks / Managers / Cabinets / Enclosures - Hubbell NextFrame:

IS7 Hubbell iFrame Racking System, 2 or 4 Post, 45U, Built-In Vertical Management, Black
 HC119CE1N Hubbell NextFrame Horizontal Manager, 1U, Front Rings, Black
 HC219CE3N Hubbell NextFrame Horizontal Manager, 2U, Front & Rear Rings, Front Cover, Black
 HC219CC3N Hubbell NextFrame Horizontal Manager, 2U, Front & Rear Rings, Front & Rear Cover, Black
 HSQ36 Hubbell QuadCab Wall Mount Cabinet, 19U, 36"H x 22"W x 20"D, Black
 RE4B Hubbell ReBox Equipment Cabinet, 5U, 32"H x 24"W x 10"D, Black
 RE4XB Hubbell ReBox Equipment Cabinet, 5U, 42"H x 24"W x 10"D, Black

Ladder Rack / Wire Basket Tray - Hubbell NextFrame:

HLS1012B Hubbell NextFrame Ladder Rack, 12"W x 10'L, Black
 HBTxyBK series Hubbell Wire Basket Tray, Round Wire, Black (available in various sizes)
 HBTxySBK series Hubbell Wire Basket Tray, Flat Wire, Black (available in various sizes)

Grounding & Bonding - Hubbell ShieldBond:

HBBB14210A Hubbell TGB Grounding Busbar, 16 Hole Configuration, 2" x 10"
 HBBB14224B Hubbell TGB Grounding Busbar, 36 Hole Configuration, 2" x 24"
 HBBBHR19 Hubbell Grounding Bar, Cabinet Mount, 8 Hole Configuration, 0.75" x 19"

HBBBVR36 Hubbell Grounding Bar, Cabinet Mount, 16 Hole Configuration, 0.75" x 36"
HGRKTDxD Hubbell Grounding Cable Kit, with #6 AWG (green coated) Wire and 2 Double Lugs, Labelled (various sizes available)

Appendix 4. Example: Commscope Bill of Materials

<http://www.commscope.com/Product-Catalog/#market-enterprise>

Patch Panels – Modular

CommScope 1U Modular Panel, 24-port empty	M2000-24
CommScope 2U Modular Panel, 48-port empty	M2000-48

Flush Mount Face Plate

CommScope 4 Port Faceplate with Label White	M14L-262
CommScope 6 Port Faceplate with Label White	M16L-262

Decora Faceplate

CommScope 3 Port Decora Frame White	M108FR3-262
CommScope 4 Port 106 Duplex Frame White	M106FR2-262

Furniture Face Plate

CommScope 4 Port Furniture Face Plate Black	M14C-003
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Surface Mount Box

CommScope 4 Port Surface Box White	M104SMB-A-262
CommScope 6 Port Surface Box White	M104SMB-262

Patch Cords

CAT6 Patch Cord Blue – 7 foot	UC1BBB2-0ZF007
CAT6 Patch Cord Blue – 10 foot	UC1BBB2-0ZF010

Singlemode Fiber Optic Cable

TeraSPEED 12-strand smode cable, plenum	5201 012A WPYL
TeraSPEED 24-strand smode cable, plenum	5201 024A WPYL
TeraSPEED 12-strand smode cable, riser	5200 012A WRYL
TeraSPEED 24-strand smode cable, riser	5200 024A WRYL

Fiber Optic Patch Panels Rack Mount

CommScope 1U Fiber Optic Rack Mount Patch Panel Black	600G2-1U-MOD-SD
CommScope 2U Fiber Optic Rack Mount Patch Panel Black	600G2-2U-MOD-SD
CommScope 4U Fiber Optic Rack Mount Patch Panel Black	1000G2-4U-MOD-SD

Fiber Optic Patch Cords

CommScope LC LC Singlemode Duplex Patch Cord, 10ft	FFWLCLC42-JXF010
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Category 6 UTP Cable

GigaSPEED XL CAT6 Plenum 4-Pair UTP Cable Blue 2071 004EBL
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GigaSPEED XL CAT6 Plenum 4-Pair UTP Cable White	2071 004EWH
GigaSPEED XL CAT6 Riser 4-Pair UTP Cable Blue	1071 004EBL
GigaSPEED XL CAT6 Riser 4-Pair UTP Cable White	1071 004EWH

Category 6 Patch Panels – Fixed Port

GigaSPEED XL CAT6 24 Port Patch Panel Black	1100GS3-24
GigaSPEED XL CAT6 48 Port Patch Panel Black	1100GS3-48

Patch Panels – Modular

CommScope 1U Modular Panel, 24-port empty	M2000-24
CommScope 2U Modular Panel, 48-port empty	M2000-48

Category 6 Modular Jacks

GigaSPEED XL CAT6 RJ45 Modular Jack Black	MGS400-318
GigaSPEED XL CAT6 RJ45 Modular Jack Yellow	MGS400-262

Category 6 Patch Cords

GigaSPEED XL CAT6 Patch Cord Blue - 7 foot	CPC3312-02F007
GigaSPEED XL CAT6 Patch Cord Blue - 10 foot	CPC3312-02F010

Telecommunications Rack

CommScope Standard Open Rack, 19”w x 84”h	RK3-45A
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Vertical Cable Management – Single-sided

CommScope Vertical Cable Mgmt w/ Door, 6”w	VCM-SS-84-6
CommScope Vertical Cable Mgmt w/ Door, 10”w	VCM-SS-84-10
CommScope Vertical Cable Mgmt w/ Door, 12”w	VCM-SS-84-12
CommScope Cable Management Spool	CABLE-MGT-SP

Horizontal Cable Management

CommScope 1U Horizontal Cable Manager, Black	HTK-19-SS-1U
CommScope 2U Horizontal Cable Manager, Black	HTK-19-SS-2U
CommScope 3U Horizontal Cable Manager, Black	HTK-19-SS-3U