Product and Installation Specifications

for

Building Data Communication Cabling

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Information and Technology Services
Enterprise Infrastructure Solutions
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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 The formerly specified Cat5e cable has been replaced by Cat6 cable.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 additional 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:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSI/TIA-568-C.0</td>
<td>Generic Telecommunications Cabling for Customer Premises</td>
</tr>
<tr>
<td>ANSI/TIA-568-C.1</td>
<td>Commercial Building Telecommunications Cabling Standard</td>
</tr>
<tr>
<td>ANSI/TIA-568-C.2</td>
<td>Balanced Twisted-Pair Telecommunication Cabling and Components Standard</td>
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<tr>
<td>ANSI/TIA-568-C.3</td>
<td>Optical Fiber Cabling Components Standard</td>
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<tr>
<td>ANSI/EIA/TIA-569-A</td>
<td>Commercial Building Standard for Telecommunications Pathways and Spaces</td>
</tr>
<tr>
<td>ANSI/EIA/TIA-606(A)</td>
<td>Administration Standard for the Telecommunications Infrastructure of Commercial Buildings</td>
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### 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 Hubbell 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 1/2 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 assembles 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


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<td>NXFAFL6P-03</td>
<td>NORDX/CDT faceplate6-port, flush, white assy</td>
<td>EA 25</td>
</tr>
<tr>
<td>AX101821</td>
<td>NXLFSMFP-03</td>
<td>LabelFlex System labels for MediaFlex plates, White, 10sheets/pack</td>
<td>EA 1</td>
</tr>
<tr>
<td>AX100310</td>
<td>NXMAA4-03</td>
<td>MDVO 106 ADAPTER, 4-port, WHITE</td>
<td>EA 50</td>
</tr>
<tr>
<td>AX100928</td>
<td>NXMAB4-04</td>
<td>MDVO MODULAR FURNITURE ADAPTER 4-port</td>
<td>EA 1</td>
</tr>
<tr>
<td>A0643207</td>
<td>QNE4M(103)</td>
<td>MDVO MULTIMEDIA OUTLET BOX, 6-port, white</td>
<td>EA 1</td>
</tr>
<tr>
<td>AX100041</td>
<td>NX7L26AA1</td>
<td>FiberExpress Rack Mount patch panel, 1U, Black Universal Connector Panel</td>
<td>EA 1</td>
</tr>
<tr>
<td>AX100068</td>
<td>NX7L26FA1</td>
<td>FiberExpress Rack Mount patch panel, 2U, Black Universal Connector Panel</td>
<td>EA 1</td>
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<tr>
<td>AX100077</td>
<td>NX7L26MA1</td>
<td>FiberExpress Rack Mount patch panel, 3U, Black Universal Connector Panel</td>
<td>EA 1</td>
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<tr>
<td>AX100115</td>
<td>NX6F26NA</td>
<td>FiberExpress Rack Mount patch panel, 4U, Gray Universal Connector Panel</td>
<td>EA 1</td>
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<tr>
<td>AX100495</td>
<td>NX7L26SA</td>
<td>FiberExpress Wall Mount patch panel, Small, Black</td>
<td>EA 1</td>
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<tr>
<td>AX100541</td>
<td>NX7L26TB</td>
<td>FiberExpress Wall Mount patch panel, Medium, Gray</td>
<td>EA 1</td>
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<tr>
<td>AX100543</td>
<td>NX7L26UB</td>
<td>FiberExpress Wall Mount patch panel, Large, Gray</td>
<td>EA 1</td>
</tr>
</tbody>
</table>

### 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

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


Modular Patch Panels

CPPL24WBLY – Panduit 24 Port Patch Panel Black
CPPL48WBLY – Panduit 48 Port Patch Panel Black

Flush Mount Face Plate

CFPL4IWY – Panduit 4 Port Faceplate with Label International White
CFPL6IWY – 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
CF1064IWY – 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 9/125 Fiber 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
- PWS50F-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 3/4” Tak-ty 15ft roll
- HLS-75RO – Panduit 3/4” 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


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

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:

DFPCSCS3SM 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"
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBBBVR36</td>
<td>Hubbell Grounding Bar, Cabinet Mount, 16 Hole Configuration, 0.75&quot; x 36&quot;</td>
</tr>
<tr>
<td>HGRKTDxD</td>
<td>Hubbell Grounding Cable Kit, with #6 AWG (green coated) Wire and 2 Double Lugs, Labelled (various sizes available)</td>
</tr>
</tbody>
</table>
Appendix 4. Example: Commscope Bill of Materials

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

<table>
<thead>
<tr>
<th>Patch Panels – Modular</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CommScope 1U Modular Panel, 24-port empty</td>
<td>M2000-24</td>
</tr>
<tr>
<td>CommScope 2U Modular Panel, 48-port empty</td>
<td>M2000-48</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flush Mount Face Plate</th>
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</thead>
<tbody>
<tr>
<td>CommScope 4 Port Faceplate with Label White</td>
<td>M14L-262</td>
</tr>
<tr>
<td>CommScope 6 Port Faceplate with Label White</td>
<td>M16L-262</td>
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<table>
<thead>
<tr>
<th>Decora Faceplate</th>
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<tbody>
<tr>
<td>CommScope 3 Port Decora Frame White</td>
<td>M108FR3-262</td>
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<tr>
<td>CommScope 4 Port 106 Duplex Frame White</td>
<td>M106FR2-262</td>
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<table>
<thead>
<tr>
<th>Furniture Face Plate</th>
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<tbody>
<tr>
<td>CommScope 4 Port Furniture Face Plate Black</td>
<td>M14C-003</td>
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<table>
<thead>
<tr>
<th>Surface Mount Box</th>
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<tbody>
<tr>
<td>CommScope 4 Port Surface Box White</td>
<td>M104SMB-A-262</td>
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<tr>
<td>CommScope 6 Port Surface Box White</td>
<td>M104SMB-262</td>
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<table>
<thead>
<tr>
<th>Patch Cords</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>CAT6 Patch Cord Blue – 7 foot</td>
<td>UC1BBB2-0ZF007</td>
</tr>
<tr>
<td>CAT6 Patch Cord Blue – 10 foot</td>
<td>UC1BBB2-0ZF010</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Singlemode Fiber Optic Cable</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TeraSPEED 12-strand smode cable, plenum</td>
<td>5201 012A WPYL</td>
</tr>
<tr>
<td>TeraSPEED 24-strand smode cable, plenum</td>
<td>5201 024A WPYL</td>
</tr>
<tr>
<td>TeraSPEED 12-strand smode cable, riser</td>
<td>5200 012A WRYL</td>
</tr>
<tr>
<td>TeraSPEED 24-strand smode cable, riser</td>
<td>5200 024A WRYL</td>
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<table>
<thead>
<tr>
<th>Fiber Optic Patch Panels Rack Mount</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>CommScope 1U Fiber Optic Rack Mount Patch Panel Black</td>
<td>600G2-1U-MOD-SD</td>
</tr>
<tr>
<td>CommScope 2U Fiber Optic Rack Mount Patch Panel Black</td>
<td>600G2-2U-MOD-SD</td>
</tr>
<tr>
<td>CommScope 4U Fiber Optic Rack Mount Patch Panel Black</td>
<td>1000G2-4U-MOD-SD</td>
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<table>
<thead>
<tr>
<th>Fiber Optic Patch Cords</th>
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<tbody>
<tr>
<td>CommScope LC LC Singlemode Duplex Patch Cord, 10ft</td>
<td>FFWLCLC42-JXF010</td>
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<table>
<thead>
<tr>
<th>Category 6 UTP Cable</th>
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<tbody>
<tr>
<td>GigaSPEED XL CAT6 Plenum 4-Pair UTP Cable Blue</td>
<td>2071 004EBL</td>
</tr>
<tr>
<td>Product Description</td>
<td>Model Number</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>GigaSPEED XL CAT6 Plenum 4-Pair UTP Cable White</td>
<td>2071 004EWH</td>
</tr>
<tr>
<td>GigaSPEED XL CAT6 Riser 4-Pair UTP Cable Blue</td>
<td>1071 004EBL</td>
</tr>
<tr>
<td>GigaSPEED XL CAT6 Riser 4-Pair UTP Cable White</td>
<td>1071 004EWH</td>
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**Category 6 Patch Panels – Fixed Port**

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Model Number</th>
</tr>
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<tbody>
<tr>
<td>GigaSPEED XL CAT6 24 Port Patch Panel Black</td>
<td>1100GS3-24</td>
</tr>
<tr>
<td>GigaSPEED XL CAT6 48 Port Patch Panel Black</td>
<td>1100GS3-48</td>
</tr>
</tbody>
</table>

**Patch Panels – Modular**

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Model Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>CommScope 1U Modular Panel, 24-port empty</td>
<td>M2000-24</td>
</tr>
<tr>
<td>CommScope 2U Modular Panel, 48-port empty</td>
<td>M2000-48</td>
</tr>
</tbody>
</table>

**Category 6 Modular Jacks**

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Model Number</th>
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<tbody>
<tr>
<td>GigaSPEED XL CAT6 RJ45 Modular Jack Black</td>
<td>MGS400-318</td>
</tr>
<tr>
<td>GigaSPEED XL CAT6 RJ45 Modular Jack Yellow</td>
<td>MGS400-262</td>
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</table>

**Category 6 Patch Cords**

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Model Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>GigaSPEED XL CAT6 Patch Cord Blue - 7 foot</td>
<td>CPC3312-02F007</td>
</tr>
<tr>
<td>GigaSPEED XL CAT6 Patch Cord Blue - 10 foot</td>
<td>CPC3312-02F010</td>
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</table>

**Telecommunications Rack**

<table>
<thead>
<tr>
<th>Product Description</th>
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</tr>
</thead>
<tbody>
<tr>
<td>CommScope Standard Open Rack, 19”w x 84”h</td>
<td>RK3-45A</td>
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**Vertical Cable Management – Single-sided**

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Model Number</th>
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</thead>
<tbody>
<tr>
<td>CommScope Vertical Cable Mgmt w/ Door, 6”w</td>
<td>VCM-SS-84-6</td>
</tr>
<tr>
<td>CommScope Vertical Cable Mgmt w/ Door, 10”w</td>
<td>VCM-SS-84-10</td>
</tr>
<tr>
<td>CommScope Vertical Cable Mgmt w/ Door, 12”w</td>
<td>VCM-SS-84-12</td>
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<tr>
<td>CommScope Cable Management Spool</td>
<td>CABLE-MGT-SP</td>
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**Horizontal Cable Management**

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Model Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>CommScope 1U Horizontal Cable Manager, Black</td>
<td>HTK-19-SS-1U</td>
</tr>
<tr>
<td>CommScope 2U Horizontal Cable Manager, Black</td>
<td>HTK-19-SS-2U</td>
</tr>
<tr>
<td>CommScope 3U Horizontal Cable Manager, Black</td>
<td>HTK-19-SS-3U</td>
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