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Information Technology Cabling Standards

1.0 General

BYU’s cabling plant is designed to transport high-speed information signals. The design and installation of this cabling plant must adhere to the specifications provided in this document and the *Building Industry Consulting Service International* (BICSI) telecommunications distribution methods manual unless these practices conflict with national and/or local codes. The specifications in this document take precedence over conflicting BICSI specifications and recommendations. All variances to these specifications must be approved by the Office of Information Technology (OIT) Development PRIOR to installation.

1.1 Key Terms

The following key terms are applicable to BYU OIT systems and facilities:

**Backbone Cabling** - Cabling that provides interconnection between MDFs, BDFs, and IDFs.

**Building Distribution Frame (BDF)** - The main protector and cross connect terminal or building entrance terminal for each building. The BDF is located in the "master systems room". The building feeder cable(s) terminate on the BDF.

**Bonding** - A low impedance path obtained by securely joining all non-current carrying metallic components to assure electrical continuity.

**Bonding Conductor** - A conductor that connects the non-current carrying components of electrical equipment, raceways or enclosures to the building-grounding conductor and having the capacity to safely conduct any electrical current likely to be imposed on it.

**Cabling** - In this document, “Cabling” refers to multiple wires, coax or optical fibers in a single sheath. For example, station cable consists of four twisted pairs of wire.

**CMP Cable** - Communication plenum cable (see NEC article 800).

**CMR Cable** - Non-plenum fire resistant communication riser cable (see NEC article 800).

**Communication Room** - The room that contains Audio/Visual and/or Voice/Data cabling and equipment.

**Electrical Protection Device** - A device used to protect personnel and equipment from electrical surges and other potentially harmful electrical currents or transient voltages resulting from lightning or other power sources.

**Emergency Paging (EP)** - A distributed sound system used to broadcast information and directions in the event of an emergency.
Feeder Cable - Consists of the cabling connecting the MDF to the BDF of each campus building. This cabling is sometimes referred to as "entrance" or "trunk" cables.

Home Run - Designates the station cables (horizontal distribution) in a building that are directly routed and terminated in a communication room.

Intermediate Distribution Frame (IDF) - Cross connect terminals for riser cables and station wire in large buildings that cannot be serviced by a single BDF terminal. IDF's are located in the “intermediate System Rooms”. IDF's are connected to the BDF by vertical or horizontal riser cables.

Information Technology Systems (ITS/IT Systems) - These systems include but are not limited to the following types of systems: data network, telephone, video distribution, speech reinforcement, emergency paging, audio, RF (radio, satellite, wireless networks), etc.

Location Code - The number assigned by BYU OIT Services to each individual jack or station termination. A duplex jack will have two location codes assigned. One unique location code will be provided for each half of a duplex jack.

Main Distribution Frame (MDF) - The main protector and cross connect terminal located at one of four systems equipment rooms.

Protector Panel - The panel that houses plug-in type circuit protectors. The multi-pair protector panel includes the plug in protector fld and a cross connect fld.

Protector - (See Electrical Protection Device)

Riser Cable - The cabling that connects the BDF to an IDF.

Sleeves - Sleeves are short pieces of pipe or conduit that are installed through the floor or wall structure, de-burred with bushings installed.

Station Cable - The cabling used to connect from the IDF to a voice/data jack.

Tip Splice - The splice point between feeder cable and the electrical protection device tip cable.

Tip Cable - The cable which enters the electrical protection device.

1.2 Design

BYU OIT provides the design for BDF and IDF layouts, backbone types and counts, horizontal types and counts and all cable types including fiber and copper. In addition, OIT determines the number and location of network jacks used to carry voice, video and data. OIT will review and approve the design of conduit runs, wire trays and other cable pathways.
1.3 Installation

All cabling, terminals, jacks, and related equipment will be installed in a neat and orderly manner using current industry best practices. Multiple cables will be neatly bundled and tied to attachment points. No cable will be attached to, resting on or otherwise touching the fire sprinkler pipes, ceiling, ceiling grid, conduits or support components of these systems.

1.4 Inspections and Acceptance

BYU OIT personnel will conduct periodic inspections of system cabling during the installation. OIT will then perform a final acceptance inspection at the completion of the installation. The final acceptance inspection will include a site visit to all jack locations and communication rooms, quality assurance testing of cable runs as needed, and a possible site visit and inspection by the cabling vendor representative.

The cable plant will not be accepted by BYU OIT until all inspections and testing is completed and the contractor has provided BYU OIT with a copy of all required test results. After the test results have been reviewed, BYU OIT will provide the contractor with a list of items to be corrected before acceptance.

1.5 Materials

All cables and materials will be UL listed and comply with TIA, NEC and BYU specifications. All materials will be provided by the contractor unless otherwise noted. Material manufacturers and part numbers are included at the end of this document. Where part numbers are provided the defined material must be used. Where part numbers are not provided the preferred manufacturer and part is left to the contractor’s discretion.

1.6 Approved Contractors

OIT will act as the contractor for all IT Systems. As needed, OIT will contract the work to qualified subcontractors as listed below.

**Pre-approved telecommunications subcontractors are:**

1. Americom Technology 5123 South 300 West, Murray 84107 Phone: (801) 261-4300
2. Niels Fugal Sons Co. 1005 South Main, Pleasant Grove 84062 Phone: (801) 785-3152
3. Cache Valley Electric 1990 South 4130 West Salt Lake City, Utah 8410 Phone: (801) 908-2680
4. FiberTel 1735 East Canyon Road Springville, Utah 84663 Phone: (801) 489-0659
5. Others that may be determined in the future
Pre-approved audio/visual subcontractors are:

1. General Communications 4332 S. 500 W. Murray UT 84123 Phone (800) 453-6304
2. Lassco Sound & Systems 1012 Beck St. Salt Lake City, UT 84103 Phone (801) 521-3421
3. Poll Sound 4026 S. Main Murray, UT 84107 Phone (801) 261-2500
4. Others that may be determined in the future.

2.0 Communication Rooms (BDFs and IDF)

2.1 General

Communication rooms will be dedicated to building OIT Systems ONLY. Allowances in the communication room have been given to the University Police DVR system. Placement of the DVR will be dictated by the Infrastructure Engineer. Communication rooms will not contain high voltage transformers, power panels, fire alarm panels, controllers, etc. Any exceptions require a written request to be approved by the OIT architect and CIO. See Figure 1 on page 6 for a typical room layout. See attachments 1 and 2 for an example of rack layouts.

2.2 Design and Sizing

Communications’ room terminal design and layout will be provided by BYU OIT.

BDFs will be at least 10’ x 12’ to allow for wall mounted wiring terminals and equipment racks.

IDFs will be sized according to Table 1.

<table>
<thead>
<tr>
<th>Serving Area</th>
<th>Closet Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>930 square meters (10,000 square feet)</td>
<td>3 meters (10 feet) X 3.4 meters (11 feet)</td>
</tr>
<tr>
<td>745 square meters (8,000 square feet)</td>
<td>3 meters (10 feet) X 2.74 meters (9 feet)</td>
</tr>
<tr>
<td>465 square meters (5,000 square feet) or less</td>
<td>3 meters (10 feet) X 2.4 meters (8 feet)</td>
</tr>
</tbody>
</table>

Table 1 – IDF Room Sizes

2.3 Sanctioned Use

Communication rooms will be dedicated to OIT IT Systems ONLY.

2.4 Non-Sanctioned Use

Communication rooms must not contain high voltage transformers and/or power panels.
2.5 Location

Building design will provide for a communication room on each floor. Exceptions must be approved by BYU OIT. Communication rooms must be located such that horizontal cables will not exceed 90 meters (295 feet) in length. Where feasible, these rooms should be centrally located in a building. When construction consists of multiple floors these communication rooms should be aligned in a vertical stack.

2.6 Plywood

All walls will be covered with rigidly fixed ¾” A-C plywood, 8’ high, capable of supporting attached equipment. The plywood must be fire rated or painted with fire resistant paint on every visible surface, and be fastened to wall frame members.

2.7 Lighting

Systems room lighting will provide a minimum of 500 lx (50 foot-candles) measured at the point of termination. Light switches should be easily accessible when entering a communication room. Light fixtures are to be installed a minimum of 8 feet-6 inches above the finished floor and attached to a structural ceiling. Lights will be placed on emergency power circuits.

2.8 Ceiling

To facilitate the routing of cabling, communication rooms must not have suspended/false ceilings. All communication rooms will have a minimum ceiling height of 10’.

2.9 Floor

Floors will be sealed concrete without further covering.

2.10 Doorway

The doorway providing entry to a communication room should be a minimum of 36” wide and 80” high hinged to open outward and fitted with a lock. Doors should be placed in such manner as to allow for maximum use of the space.

2.11 Environmental

The communication rooms will be designed to allow adequate cooling for all systems equipment. The temperature range should be 64°F to 75°F (18°C to 24°C). The humidity range should be 20% to 55%.
2.12 Electrical Power

The Communication Room will have a minimum of four 120 VAC duplex outlets. Each outlet will be feed from a separate 20 AMP 3-wire circuit breaker. In addition, one specialty outlet will be installed to accommodate a UPS system. Outlet locations will be provided by OIT.

![Figure 1 – Typical BDF Layout](image)

- **AFF** = Above finished floor
- **EDP** = Electrical distribution panel
- **HVAC** = Heating, ventilating, and air conditioning
- **TGB** = Telecommunications grounding busbar

3.0 Cabling Pathways
3.1 General

All cabling, terminals, jacks, and related equipment will be installed in a neat and orderly manner. Multiple cables will be neatly bundled and tied to attachment points including J-hooks, D-Rings, cable tray, communication conduits and support wires installed to accommodate cabling, etc. No cabling will be attached to, rest on or otherwise touch the fire sprinkler pipes, ceiling, ceiling grid or support components of these systems. No cabling will be attached to electrical conduits. No cable length will exceed 4’ without being supported.

3.2 Electrical Contractor

All cabling pathways leading into and out of the communication room(s) will be installed by the Electrical Contractor; i.e. conduit, cable tray, J-hooks, sleeves, etc. All cabling pathways contained within a communication room will be installed by OIT or its selected communications subcontractor.

3.3 Conduits and Sleeves

Conduit runs will not have more than two (2) 90-degree bends. No conduit will have a bend greater than 90-degrees.

All conduits will be rigid metallic or EMT and will be de-burred and bushed.

Bend Radius

<table>
<thead>
<tr>
<th>Conduit Size</th>
<th>Bend Radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 2”</td>
<td>6 times the inside diameter</td>
</tr>
<tr>
<td>&gt; 2”</td>
<td>10 times the inside diameter</td>
</tr>
</tbody>
</table>

3.4 Entrance Conduits

Entrance conduits from tunnels or manholes to the BDF will be 4-inches in diameter. The quantity of conduits will be determined by the OIT Infrastructure Engineer.

To prevent shearing, the sleeves will extend a minimum of 10-feet beyond the foundation wall in order to reach undisturbed soil.

The sleeves will have a downward slope of 1-inch per foot for the length of the sleeve away from building entrance.

All unused conduits must be plugged or capped.
3.5 Backbone Conduits

A minimum of four (4) 4” conduit sleeves will be provided between vertically stacked Communication Rooms.

Where Communication Rooms are not vertically stacked (4) 4” conduits must be installed connecting these rooms. These conduits must tie to the tray in such manner as to minimize conduit length, bends, etc.

The conduits/sleeves will be placed immediately adjacent to the wall, allowing room for bushings or caps.

Conduits/Sleeves will be stubbed at least 1” and no more than 6” above the floor and threaded for collars.

3.6 Horizontal Conduits

The electrical contractor will install all conduits, conduit fittings and boxes. No conduit will be smaller than 1 inch in diameter.

Conduits and/or boxes must not be surface mounted.

Conduits will be extended from the telecommunications outlet to a communications room or a cable tray.

Device boxes will be a deep double-gang box with a double-gang mud-ring.

3.7 Communication Room(s) Pathways

Cabling installed vertically on communication room walls will be passed through "D-rings" placed 18 - 24 inches apart and attached to the rings with Velcro-ties, providing cable support and strain relief.

Cables will be attached to the ladder rack installed in the Communication Rooms using Velcro-ties, providing strain relief and cable support.

4.0 Backbone Cabling

4.1 General

In all cases, except for the building feeder cabling, CMP (plenum) cable will be installed.

4.2 Riser, Tie and Panel Tie Cables

Riser cables will be installed by OIT or selected subcontractor from the BDF to each IDF.
In some cases, tie cables will be installed by OIT or selected subcontractor from an IDF to another IDF.

Panel ties will be installed by OIT or selected subcontractor when using CAT6 cabling from the wall mounted riser location to the rack mount patch panel.

4.3 Feeder Cabling

Outdoor feeder cabling will not exceed a length of 50’ before entrance into a building.

4.4 Cable Labeling

All feeder, riser, tie, and panel tie cabling that terminates on 110 punch blocks will be labeled using Siemens S110 designation strips (part number S110-LBL-T-(X)). All labels will be printed in type face. The label colors will be:

- green for feeder cabling
- blue for riser cabling
- pink for tie cabling
- orange for panel tie cabling

Cable Identification Numbers will be provided by OIT to subcontractors.

4.5 Fiber Cabling

50’ service loops will be provided in each communication room for backbone fiber.

Outdoor rated fiber cabling will not exceed a length of 50’ before entrance into a building.

All fiber labeling will be printed in a type face.

Cable Identification Numbers will be provided by OIT to subcontractors.

5.0 Horizontal Cabling

5.1 General

No station cable will exceed 90 meters (295 feet) in length from IDF to jack.

When cables are routed in dropped ceilings, they will be suspended at least twelve inches above the ceiling tiles and light fixtures.

Jack icons will be the same color as the jack.

1’- 2’ of service loop will be left where the cable enters the wall/conduit closest to the jack end of each station cable.
Wrap around labels will be placed on each jack cable within eight to twelve inches from the jack termination.

OIT or its selected subcontractor will install a jack blank for each unused position on a faceplate.

Jacks and faceplates will match the color of the electrical outlets in the room (in most cases this will be a grey jack on a stainless steel faceplate).

5.2 Copper Cabling

In all cases CMP (plenum) cable will be installed.

Two (2) four pair cables will be installed from each jack location to the communication room (typically IDF). Jack locations will be determined by OIT in conjunction with the customer.

All station cabling terminated on 110 punch blocks will be labeled using Siemens S110 Designation Strips (S110-LBL-T-(X)). All labels will be printed in type face. The label color will be white for station cables. The same standards apply for patch panel labels. Each duplex jack will be labeled with the unique number determined by OIT and provided to the subcontractor.

All terminations and wire dressing will be in compliance with the Siemens Product Warranty.

5.3 Fiber Cabling

20’ service loops will be provided in the communication room for a fiber jack.

Fiber function will be labeled by a standard white colored label.

6.0 Grounding

6.1 General

All Grounding/Earthing will be installed using specifications found in NEC article 250 - GROUNDING and article 800 - COMMUNICATIONS CIRCUITS, local codes, and BYU specifications.

A bonding/grounding conductor will be calculated for the size that conforms to the guidelines set by NEC and BISCI. A minimum of 6 AWG bonding conductor will be used.

The electrical contractor will bond and ground all cable trays.

The electrical contractor will install a grounding bus bar in each BDF/IDF.

OIT or its selected subcontractor will ground the protector panel and racks to the bus bar.

The feeder cabling will be bonded to an approved ground at every point where the conductors enter or exit the cable sheath. This is typically done in the BDF.
The shields of all cables in each splice will be bonded together by placing a bonding ribbon between cable shields.

Protector panel will be grounded to the building ground.

7.0 Fire Stopping

7.1 General

Properly designed fire stop systems will be installed to prevent or retard the spread of fire, smoke, water, and gases throughout the building. This requirement applies to openings designed for telecommunications use that may or may not be penetrated by cables, wires, and raceways. Such systems will comply with all applicable national and local fire protection codes.

Appropriate fire barriers will be placed around the cables within sleeves, and all unused sleeves will be fire sealed.

8.0 Testing

8.1 General

Cables with fewer than 100 pairs, such as station cable, must show test results indicating that it has zero bad pairs or conductors.

When a subcontractor is utilized, the subcontractor will provide to OIT Documentation a complete list of all pairs tested.

8.2 Backbone Cabling

The contractor will test all cable conductors (pairs) for continuity, pair reversals, transposed pairs, split pairs or grounded conductors.

Cables with 100-pairs or greater must have no more than 1% cable pair failures. For example, a 200-pair cable must have no more than 2 bad pairs.

All feeder cable conductors (pairs) will be tested from the MDF to the BDF. All riser cable conductors (pairs) will be tested from the BDF to the IDF.

8.3 Horizontal Cabling

All station cable conductors (pairs) will be tested from the BDF/IDF to the jack. All station cables will be permanent link tested.
8.4 Fiber Cabling

All fiber will be Power Meter tested to determine cable attenuation.

OTDR testing will be conducted to provide fiber lengths for all fiber runs. Only one strand of fiber need be tested in each fiber cable to obtain distance information.

OTDR results for every strand in a fiber cable containing a splice will be given to OIT documentation.

9.0 Documentation

9.1 General

When a subcontractor is used, OIT will provide floor plan maps depicting the jack’s location and the numbering for that jack.

The subcontractor will provide OIT Documentation with updated floor plan maps depicting any jack location changes and all test results including length.

10.0 Warranty

10.1 General

When OIT subcontracts the implementation of an IT systems the subcontractor will fulfill all requirements as stated in this document, including all testing, submission of test results and the required paper work to create a warranty of the voice/data cabling installation with the Siemens Company. The contractor will warranty to BYU, without limitations or qualifications that all equipment, components, materials and workmanship will perform in accordance with local and national codes and the specifications of this document.

The contractor will apply for the highest available warranty from the Siemens Company for the system installed.

The subcontractor will provide a temporary warranty until such time as a formal warranty has been approved by the Siemens Company and presented to BYU OIT. Upon receipt of the warranty certificate, future issues will be referred to the Siemens Company.
Attachments