TECHNOLOGY GUIDELINES

BUILDING INFRASTRUCTURE

BEST PRACTICES FOR

STATE-OWNED BUILDINGS

April 06, 2015

TABLE OF CONTENTS

		Page Number
Overview		2
Basic Requirements		3
1.1	Regulatory Preferences	3
1.2	Certified Products and Installation	5
1.3	Work Included	5
1.4	Submittals	6
1.5	Quality Assurance	6
1.6	Delivery, Storage and Handling	7
1.7	Miscellaneous	7
Telecommunications Infrastructure		9
2.1	Building Entrance	9
2.2	Conduit Bends	10
2.3	Pull Boxes	10
2.4	Main Equipment Room	10
2.5	Riser Conduits	11
2.6	Equipment Room/Telecommunications Room (ER/TR) Security	12
2.7	Horizontal Subsystem	12
2.8	Workstation Conduit	12
2.9	Workstation Electrical Boxes	12
2.10	Workstation Outlets	12
2.11	Work Area Outlets	13
2.12	Horizontal Cable Runs	15
2.13	Horizontal Cable Lengths	15
2.14	Horizontal Cable Installation	16
2.15	Backbone Riser Cable	16
2.16	Fire stopping	16
2.17	Grounding and Bonding	17
2.18	Connecting Blocks and Patch Panels	17
2.19	Modular Patch Panels	18
2.20	Modular Furniture Locations	18
2.21	Copper (UTP) Patch Cords	19
2.22	Racks/Cabinets	19
2.23	Free-Standing Racks	19
2.24	Wall Mounted Racks	20
2.25	Campus Environment	20
2.26	Video Locations	21
	Acronyms	22
	Glossary	23

OVERVIEW

General Specifications

This document describes the products and execution requirements relating to furnishing and installing telecommunications cabling at new or remodeled State-owned buildings. Backbone and horizontal cabling is comprised of copper and fiber optic cabling, support systems and termination hardware.

This document addresses "telecommunications infrastructure cabling." This term encompasses all types of media used for voice, data and video communications. The media includes, but is not limited to, twisted-pair copper wire, coaxial cable, fiber optic cable and electrical grounding (earthing) cable. The term, Telecommunications, is defined to mean the transmission, reception and the switching of signals, such as electrical or optical, by wire, fiber, or electromagnetic means.

This document includes basic construction and cabling recommendations designed for use by the Department of Administration, Division of Real Estate and Construction Services and the building owner. This does not cover the cable specifications, testing procedures, tools required, and testing documentation that will be used and required by the vendor installing the system. An acronym list and glossary is included.

If you would like to recommend changes to this Document please email:
Mark.Stein@state.mn.us

Basic Requirements

The Horizontal (workstation) Cabling System is based on the recommended installation of (2) 4-pair Unshielded Twisted Pair (UTP) Category 6 or Augmented Category 6 (Category 6A) copper cables. The cable will be installed from the standard telecommunications outlet in the work area to the Equipment Room (ER) and routed to the appropriate rack serving that area and terminated as specified in this document.

Station cables will be installed in conduit in walls and attached to a cable tray system above the ceiling where appropriate. Free-air routing must be avoided unless an approved support method is identified on the drawings or in modular furniture. All installations must meet all Codes and Requirements as described in this document.

Backbone cable will be run in cable tray and/or conduit as identified on the drawings.

All cables and related terminations, support and grounding hardware will be furnished, installed, wired, tested, labeled, and documented by the telecommunications contractor as detailed in the following sections.

Product specifications, general design considerations, and installation guidelines are provided in this written document. Quantities of telecommunications outlets, typical installation details, cable routing and outlet types will be provided as an attachment when they become available. If any bid documents conflict, this written specification will take precedence. The successful vendor will meet or exceed all requirements for the cable system described in this document.

1.1 Regulatory References:

All work and materials will conform in every detail to the rules and requirements of the National Fire Protection Association, National Electrical Code, local Electrical Codes, any other applicable local or national codes, and present manufacturing standards.

All materials will be listed by UL and will bear the UL label. If UL has no published standards for a particular item, other national independent testing standards will apply and such items will bear those labels. Where UL has an applicable system listing and label, the entire system will be so labeled.

The cabling system as described in this document is derived from recommendations made in recognized telecommunications industry standards. The following documents are incorporated by reference:

1.1.1 **ANSI/TIA/EIA - 568-C**, Commercial Building Telecommunications Cabling Standard

1.1.2 ANSI/TIA/EIA – 569-A, Commercial Building Standard for Telecommunications Pathways and Spaces.

1.1.3 ANSI/TIA/EIA – 570-A, Residential Telecommunications Cabling Standard.

1.1.4 ANSI/TIA/EIA – 606-A-A, Administration Standard for Telecommunications Infrastructure of Commercial Buildings.

1.1.5 ANSI/TIA/EIA – 607-B, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

1.1.6 ANSI/TIA/EIA – 729, Screened, 100 ohm Twisted Pair Cabling

1.1.7 ANSI/ TIA/EIA – 758, Customer-Owned Outside Plant Telecommunications Cabling Standard.

1.1.8 BICSI - TDMM, Building Industries Consulting Services International, Telecommunications Distribution Methods Manual (TDMM)

1.1.9 National Fire Protection Agency (**NFPA – 70**), National Electrical Code (**NEC**)

1.1.10 IEEE 802.xx, Wireless Local Area Network (WLAN) Standards and Technologies

If this document and any of the documents listed above are in conflict, then the more stringent requirement will apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most current local codes when developing the proposal for installation.

1.2 Certified Products and Installation.

Manufacturer Approved-Certified: The selected telecommunications wiring contractor must provide documentation that they are manufacturer approved and certified for any wire system they propose to install for the State of Minnesota. A copy of the manufacturer approval/certification must be submitted to the Office of MN.IT Services (MN.IT) following the telecommunications wiring contractor notification/acceptance meeting.

All wiring systems must have a minimum of a 15-year warranty. A warranty statement will be provided to the Division of State Building Construction at the completion of each job.

Approved Products:

- Approved 4-pair UTP Cat 6 cable: Berk-Tek, Mohawk, TE Connectivity, Belden or approved equal
- Approved optical fiber cable manufacturer: Berk-Tek, Mohawk, Siecor or approved equal
- Approved UTP (Cat 6) connection product manufacturer: Ortronics, TE Connectivity, Commscope, Panduit, Leviton or approved equal offering a minimum of a 15-year system warranty.
- Approved fiber optic termination connectors/splices/couplers: Standards compliant
- Approved rack and cabinet manufacturer: Ortronics, TE Connectivity, Homaco or approved equal
- Approved Patch Panel manufacturer: Ortronics, Leviton, Commscope, TE Connectivity, Panduit or approved equal
- Approved UTP Patch Cord manufacturer: Ortronics, AMP, Panduit or approved equal

1.3 Work Included:

The work included under this document consists of furnishing all labor, equipment, materials, and supplies and performing all operations necessary to complete the installation of this structured cabling system in compliance with standards, specifications and drawings. The telecommunications contractor will provide and install all of the required material to form a complete system whether specifically addressed in the technical specifications or not.

The work will include, but not be limited to the following:

- Vendor to pre-register this project with the wiring system manufacturer.
- Furnish and install a complete voice and data-wiring infrastructure.
- Furnish, install, and terminate all UTP and Optical Fiber cable
- Furnish and install all wall plates, jacks, patch panels, and patch cords.
- Furnish and install all required cabinets and/or racks as required and as indicated.
- Furnish any other material required to form a complete system.
- Perform permanent/basic link/channel testing (100% of links) and certification of all components.
- Furnish test results of all cabling to the owner on compact disc and/or paper format, listed by closet, then by workstation ID. Results will include the cable ID
- Furnish and install a cable tray from the wall rack to the freestanding equipment rack.
- Adhere and comply with all requirements of the manufacturer's warranty program.
- Provide owner training and documentation on compact disc in Microsoft Word format. Testing documentation and as-built drawings on Excel and Visio and/or CAD formats depending on State requirements.

1.4 Submittals:

Under the provisions of this document and prior to the start of work the telecommunications contractor will, upon request:

- Submit copies of the manufacturer's certification for all technicians that will complete the installation.
- Submit appropriate cut sheets for all products, hardware and cabling.

The telecommunications contractor must receive approval from the State on all substitutions of material. No submitted materials will be installed except by approval in writing from the State.

1.5 Quality Assurance:

The telecommunications contractor will be a company specializing in communications cable and/or accessories. The contractor must have at least one person with documented experience in installation of cable and/or accessories similar to those specified below. The contractor must also designate one person that will be assigned as an installation project manager/foreman that will take charge of the overall project and be on-site and available when the work is in progress. This person will be required to attend any meetings that are required by a general contractor when appropriate. This person will attend all safety meetings that may be held at the work site.
For larger projects, the contractor will have a BICSI (Building Industry Consulting Service International) Registered Communications Distribution Designer (RCDD) on staff for project supervision and quality assurance. This person will provide progress reports to the MN.IT Account Manager involved with the project.

Noncompliance/Variance Agreement: The successful telecommunications wiring contractor at the time they determine that work cannot continue, must contact the MN.IT Account Manager and submit a written request for non-compliance variance. The Account Manager is required to review and approve/deny the request within five business days of receipt.

1.6 Delivery, Storage and Handling:

Delivery and receipt of products will be at the site. The telecommunications contractor will contact the general contractor's designated project manager on site to confirm delivery and unloading times.

Cable will be stored according to manufacturer's recommendations as a minimum. In addition, cable must be stored in a location protected from vandalism and weather. If

cable is stored outside, it must be covered with opaque plastic or canvas with provision for ventilation to prevent condensation and for protection from weather. If air temperature at cable storage location will be below 40 degrees F., the cable will be moved to a heated (50 degrees F. minimum) location. If necessary, cable will be stored off site at the contractor's expense.

1.7 Miscellaneous:

The telecommunications contractor will verify all dimensions at the site and be responsible for their accuracy. When available, the State will provide a set of drawings for the telecommunications contractor.

The telecommunications contractor will call to the attention of the State any materials or apparatus the telecommunications contractor believes to be inadequate and to any necessary items of work omitted as soon as these items are discovered.

Work Elements: The elements of the work will include, but are not limited to:

- Complete System: The telecommunications wiring contractor will provide and install all required materials to form a complete system whether specifically addressed in the technical specifications or not.

- Agreement: The successful telecommunications contractor agrees that the scope of work included under this document will consist of furnishing all labor, equipment, material/supplies, and performing all operations necessary to complete the installation of a structured cabling system that is in compliance with standards, specifications and drawings, and that meets all existing trade and/or governmental requirements.

- Substitution of Materials**:** The telecommunications-wiring contractor will request in writing and receive approval in writing from the MN.IT Account Manager for any substitution of materials. The Account Manager is required to review and approve/deny the request within five business days.

- If requested, the telecommunications wiring contractor will provide the following prior to the start of the work:

  Copies of the certification of the company, with the names of staff listing their training, and years of experience to provide proof of compliance to manufacturer’s certification requirements.
  Appropriate manufacturer’s product description for all products, hardware and cabling.

- Conflicts: If there are bid documents that are in conflict, this document will take precedence.

- Work Site Safety: The telecommunications wiring contractor has the responsibility to call to the attention of the State Division of Building Construction-Project Manager and the MN.IT Account Manager in writing of any materials, apparatus or condition that the vendor believes to be inadequate or unsafe to the completion of the project. Verbal notification should also be made of any items that are causing immediate danger.

- Trade Conflicts: Any and all trade or inter-company conflicts that impact the job will be brought to the attention of the Account Manager and the Department of State Building Construction Project Manager as soon as the conflict becomes apparent.

- Blueprints and Drawings Required: When available, the State will provide to the wiring contractor a set of drawings (1/8" = 1", ¼" = 1", or ½" = 1") that identify all wire runs, jack type/locations, cable tray requirements/location, conduit locations and other information needed to complete the project.

- Conform to Code: The telecommunications wiring contractor will assure all workmanship and material to conform in every detail to the rules and regulations of the National Fire Protection Association, local Electrical Codes and any/all local building codes and present manufacturing standards.

- U.L. Approval: The telecommunications wiring contractor will assure that all materials will be listed by UL and will bear an UL label.

Telecommunications Infrastructure

2.1 Building Entrance:

Entrance conduit will be provided into the building based on the number of pairs of cable that will be required to provide telecommunications service. The company that provides dial tone determines the number of pairs that will be installed into the building. To determine the amount of entrance conduit required for their installation, the State will assume 1 cable pair for each 100 square feet of floor space. All entrance conduits will be continuous, and will be installed from the designated property line, to the Main Point of Presence (MPOP). The following schedule will be used for entrance conduit.

NUMBER OF PAIRS	CONDUIT REQUIRED
1-99	one 2" and one spare 2"
100-300	one 3" and one spare 3"
301-1000	one 4" and one spare 4"
1001-2000	two 4" and one spare 4"
2001-3000	three 4"and one spare 4"
3001-5000	four 4" and one spare 4"
5001-7000	five 4" and one spare 4"
7001-9000	six 4" and one spare 4"

If the entrance cable will include fiber optics, three inner-ducts (two 1 ½ " and one 1 inch) will be placed inside of a separate 4" conduit designated for fiber. CATV or other signal grade service will be placed in separate entrance conduits.
All copper entrance will be terminated on properly grounded solid state 3 -stage gas tube protection.

2.2 Conduit Bends:

Any conduit bends will have a radius not less than:

- Six times the internal diameter of conduits 2" or smaller.
  OR
- Ten times the internal diameter of conduits larger than 2".

2.3 Pull Boxes:

Pull boxes will be installed in any conduit run that is 98 feet or more in length, has more than two 90-degree bends or a reverse bend. For conduits that are 2 1/2" and larger terminating in a pull box, the minimum length of the pull box will be 16 times the diameter of the largest conduit terminating in the pull box. All pull boxes will be in an easily accessible location.

2.4 Main Equipment Room:

- The building will be equipped with a room designated as the Main Equipment Room (ER) where all underground telecommunications facilities and riser cables will terminate. This room should be located as close as possible to the center of the building to minimize the horizontal copper cable lengths (maximum of 90 meters [295 ft.]). This room will be dedicated to telecommunications equipment only. It will have the following requirements:
- Minimum size of 10 x 15 feet. Depending on the size of the building, this may increase.
- Lighting that will provide a minimum of 50-foot candles measured 3 ft. above floor level.
- Dimmer switches are not allowed.
- Light fixtures to be a minimum of 8’5” above finished floor.
- Emergency lighting is recommended. Provide emergency lighting as required by applicable building codes.
- Access to the building-grounding electrode, as described in National Electrical Code handbook.
- Grounding wire will be with a minimum of #6 AWG STRANDED wire, and a copper ground bar will be provided, to allow for multiple ground bonds. The ground bar will be connected to the building-grounding electrode with a minimum of #2 AWG wire.
- A minimum of 4 dedicated, separately fused 20-amp branch circuits, each with an 110V 2-gang electrical outlet, with four receptacles for network equipment. A minimum of 1 separately fused 20-amp branch circuit with a 110V 2-gang electrical outlet with four receptacles will be provided as a “convenience outlet”.
- Smoke and heat sensors, connected to the main building security system.
- Connecting blocks will be mounted no less than 3' above and no more than 7' above finished floor.
- Adequate ventilation that will provide heat dissipation for all installed equipment.
- Overall temperature will be between 64 and 75 degrees.
- Relative humidity from 30 to 55 percent. NOTE: Measurements for temperature and humidity are taken at 5' above the finished floor- in front of, or between equipment.
- Maintain positive pressure with a minimum of one air change per hour.
- Walls to be 3/4-inch plywood, painted with two coats of a light colored fire retardant paint and meeting all applicable fire codes.
- Ceiling height to be a minimum of 8 feet 5 inches.
- The entry door will be at least 36" wide, opening outward. The door will be lockable.
- There will be no electrical transformers, or any other type of equipment that can cause electromagnetic interference (EMI) or radio frequency interference (RFI) in any Equipment Room.
- The ER can be connected to the building fire suppression system.

- If sprinkler heads are used, install a wire protection cage to prevent accidental operation. Pre-action or dry sprinkler systems are preferred in this area.
- Drainage troughs should be installed under any sprinkler pipes to prevent them from leaking onto telecommunications equipment.
- The ER will not contain any ceiling tiles.

2.5 Riser Conduits:

Riser conduits will connect the ER to each Telecommunications Room (TR) located on each floor. Four 4" sleeves or conduits plus one additional sleeve or conduit per 40,000 square feet of usable floor space. ALL RISER CONDUITS SHALL BE VERTICALLY ALIGNED TO ALLOW FOR EASY CABLE INSTALLATION, ALL TR's WILL BE "STACKED" VERTICALLY. IF THERE IS MORE THAN ONE TR PER FLOOR, ONE "STACK" OF TR's WILL BE VERTICALLY ALIGNED WITH THE ER.

If slots are used in place of sleeves, the following guidelines will be allowed for slot size:

- The size of the pathway using slots should be one slot sized at 60 square inches for up to 40,000 square feet of useable floor space served by the backbone system. The slot area should be increased by 60 square inches with each 40,000 square foot increase in usable floor space served by the backbone.

2.6 Equipment Room/Telecommunications Room (ER/TR) Security:

Each ER/TR will be secured with a locking door. The room will be a single-purpose room, and will not serve as an access to any other room. Locks may include key-cards/bio-metrics connected to the building automation system

2.7 Horizontal Subsystem:

A horizontal subsystem will be installed, that will provide a cable route from each TR to each workstation on the floor. The subsystem could include conduit, cable trays, raised floor, under floor ducts, cellular floors, poke throughs or cable ladders to allow for placement of all cable to each workstation. The subsystem will be sized to allow at least

twice the total number of cables that perfect layering would allow at time of initial installation.

2.8 Workstation Conduit:

A minimum of one 3/4-inch conduit will be installed from the subsystem to each proposed voice and data location for hard wall offices.

2.9 Workstation Electrical Boxes:

A two-gang, 4" x 4" electrical box with a single-gang mud ring will be provided for each voice and data outlet located in a permanent wall. The box and any cover used must accommodate a standard cover plate that will be provided by the state. Outlets will be located in the work area so that the cable required to reach work area equipment will be no more than 4 m (13ft.) long. They should also be located at the same height of, and within 3 feet of an electrical outlet.

2.10 Work Station Outlets:

All telecommunications cabling will terminate in an appropriate faceplate that can accept different types of technology terminations. A minimum of one outlet will be used for office locations. A minimum of two outlets, one for voice and the other for data will be used for modular furniture locations. All labels will be typewritten and color-coded so they are the same at the workstation and the TR. Labeling schemes will follow TIA/EIA Labeling Standards.

2.11 Work Area Outlets:

Work area cables will each be terminated at their designated workstation location in the connector types described in the subsections below. Included are modular voice and data jacks. These connector assemblies will snap into a faceplate. The State Wiring Contract lists types of outlets that are normally used, including Ortronics, TE Connectivity, Leviton, Panduit and Commscope. Appropriate inserts for voice/data/video/fiber optic will be used in the outlets. The Telecommunications Outlet Assembly will accommodate: A minimum of two modular jacks and/or fiber optic connector ports in a faceplate when installed on a wall-mounted assembly.

- A minimum of four (4) modular jacks and/or fiber optic connector ports in a faceplate when installed on a floor mounted assembly.
- A blank filler will be installed when extra ports are not used.

Multiple jacks that are identified in close proximity on the drawings (but not separated by a physical barrier) may be combined in a single assembly. The telecommunications contractor will be responsible for determining the optimum compliant configuration based on the products proposed.

The same orientation and positioning of jacks and connectors will be utilized throughout the installation. Prior to installation, the telecommunications contractor will submit the proposed configuration for each outlet assembly for review by the State Telecommunication Analyst.

The modular jack will incorporate printed label strip on the dust cap module for identifying the outlet. Printed labels will be compliant with TIA/EIA 606-A-A standard specifications. Labels will be printed using a label program or using a printer such as a Brady hand held printer.

Faceplates:

Faceplates will:

- Be UL listed and CSA certified.
- Meet all FCC Part 68 specifications.
- Be constructed of high impact, ABS plastic UL 94V-0 construction (except where noted otherwise).
- Match the faceplate color used for other utilities in the building or match the color of the raceway if installed in surface raceway.
- Be compliant with the above requirements along with the following when incorporating optical fiber:
  - Be a low profile assembly,
  - Incorporate a mechanism for storage of cable and fiber slack needed for termination,
  - Position the fiber optic couplings to face downward or at a downward angle to prevent contamination,
  - Incorporate a shroud that protects the optical couplings from impact damage.
- Be available as single-gang or dual-gang.
- Provide blank modules for all unused module locations. .
- Will include a clear plastic cover to protect labels in the designation window.
- Comply with TIA/EIA 606-A-A-work area labeling standard.
- Allow for the UTP modules to be inverted in place for termination purposes.
- Be manufactured by an ISO 9001 registered company.

All standard formats on outlets and the associated jacks will be of the same manufacturer throughout the project.

Voice / Data Jacks:

Six or eight-position voice jacks and eight-position data jacks will be installed that will support Category 6(a), or higher performance as defined by the references in this document including ANSI/TIA/EIA-568-C, and ANSI/TIA/EIA-568-C.2. All pair combinations must be considered, with the worst-case measurement being the basis for compliance. Modular jack performance will be end to end tested in accordance with testing documentation provided by the state.

Jack modules will:

- Terminate on 110D-type IDC PCB mounted connector.
- Have contact plating that is a minimum of 50 micro inches of gold in the contact area over 50 micro-inch of nickel, compliant with FCC part 68.5.
- Be a minimum of 6 position, un-keyed, for UTP.
- Be capable of T568A or T568B wiring schemes. Wiring scheme will be consistent throughout the project.
- Support termination of 23 and 24 AWG solid conductor, four pair, unshielded twisted pair copper cable.
- Terminate insulated conductors with outside diameters up to 0.050".
- Be compatible with single-conductor 110-impact termination tools.
- Maintain the paired construction of the cable to facilitate minimum untwisting of the wires. (0.5-inch/13 mm maximum untwisting).
- Have a performance marking indelibly labeled on the jack front (by the manufacturer), readable while installed in the faceplate.
- Be compliant with TIA/EIA-606-A-A labeling specifications.
- Have the ability to accept color-coded icons or labels to designate voice or data application.
- Provide blank modules for all unused module locations.
- Be manufactured by an ISO 9001 registered company.

2.12 Horizontal Cable Runs:

A minimum of one voice and one data cable will be installed from each TR to each workstation. Each cable will be Cat 6 unshielded, 4 twisted pair, and will have an overall cable sheath that meets the appropriate code for the building installation. Cable sheaths for voice and data will have a different color. All horizontal data station cable and voice cable will terminate on modular patch panels (copper or fiber), 110 cross-connecting

blocks (copper), or patch/splice cabinets (fiber) in their respective Telecommunications Room or Equipment Room as specified on the drawings.

Copper Cable: Horizontal cabling will be 23 and 24 AWG, 4-pair UTP, and plenum-rated as needed. Individual conductors will be FEP insulated. Cable jacketing will be lead-free. Approved horizontal copper cable will be manufactured by Berk-Tek, TE Connectivity, Belden, Mohawk or approved equal. Data and voice cables will have a minimum transmission rating of Category 6(a) as described by Underwriters Laboratories LAN Cable Certification Program. All cable will meet all standards and specifications as stated in Item 1.2, Regulatory References.

2.13 Horizontal Cable Lengths:

Horizontal cable runs will not exceed the following lengths:

- From the horizontal cross-connect to the outlet/jack, the cable will not be more than 90 meters (295 ft.)
- The cable used for patch cords and jumpers in the TR will be no more than 6 meters (20 ft.)
- The cable used to connect the jack to the active equipment at the workstation will be no more than 4 meters (13 ft.). The combined length of equipment cables, work area cords and patch cords in the work area and TR must not exceed 10 meters, (33 ft) except when longer work area cords are permitted in conjunction with the use of a multi-user telecommunications outlet assembly (MUTOA).

In no case will the combined cable length be greater than 100 meters (330 ft.).

2.14 Horizontal Cable Installation:

Horizontal cabling is to be installed in a star topology, with each jack cabled directly to a horizontal cross-connect in the appropriate TR. Splices or bridge taps are not allowed.

2.15 Backbone Riser Cable:

Backbone cabling will be 24 AWG, 25 pair (minimum) UTP, UL/NEC CMR rated, with PVC jacket.

Riser Cable:

Non-spliced riser cable will be required from the ER to each TR. Two pair of riser cable for each workstation served by the TR will be required. All riser cable will be terminated and tagged at each end, with a labeling scheme provided by the State. Riser cable will be 24 AWG, with standard telecommunications color-coding. A data riser cable may also be required, depending on Agency requirements. Data riser will be fiber optic cable.

Tie Cable:

Multiple TR's on any floor may be connected with a minimum of 25 unshielded twisted pair, 24 AWG Category 3 cable for voice. The cable will have standard telecommunications color-coding, and be in a jacket that will meet code.

2.16 Firestopping:

A firestop system is comprised of the item or items penetrating the fire rated structure, the opening in the structure and the materials and assembly of the materials used to seal the penetrated structure. Firestop systems comprise an effective block for fire, smoke, heat, vapor and pressurized water stream.

All penetrations through fire-rated building structures (walls and floors) will be sealed with an appropriate firestop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating item i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. will be properly firestopped.

Firestop systems will be UL Classified to ASTM E814 (UL 1479) and will be approved by a qualified Professional Engineer (PE), licensed (actual or reciprocal) in the state where the work is to be performed.

2.17 Grounding and Bonding:

The facility will be equipped with a Telecommunications Bonding Backbone (TBB). This backbone will be used to ground all telecommunications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor. The TBB will be installed independent of the building's electrical and building ground and will be designed in accordance with the recommendations contained in the ANSI J-STD-607-A. Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, 2002.

The main entrance facility/equipment room in each building will be equipped with a telecommunications main grounding bus bar (TMGB). Each telecommunications room

will be provided with a telecommunications ground bus bar (TGB). The TMGB will be connected to the building electrical entrance grounding facility. The intent of this system is to provide a grounding system that is equal in potential to the building electrical ground system. Therefore, ground loop current potential is minimized between telecommunications equipment and the electrical system to which it is attached.

The TMGB will be a minimum of 20" long and 4" wide, and equipped with 2-hole grounding lugs for #2/0 AWG cable and 1-hole grounding lugs for #6 AWG cable. A minimum of a #2 AWG solid copper cable will connect the TMGB to the building electrical entrance grounding facility. A #2/0 or 3/0 green jacketed stranded copper cable will connect the TMGB to a TGB located in each of the TR's. Connectors will be irreversible copper compression type in a 2-stud hole configuration. Connections within the TR will be made with a #6 AWG green-jacketed stranded copper cable.

The TGB will be a minimum of 10' long and 2" wide, and equipped with 2-hole grounding for #2/0 AWG cable and 1-hole grounding lugs for #6 AWG cable All backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the TR or ER will be grounded with an intentional ground to the respective TGB or TMGB using a minimum #6 AWG green jacketed stranded copper cable and compression connectors.

All wires used for telecommunications grounding purposes will be identified with a green insulation. Non-insulated wires will be identified at each termination point with a wrap of green tape. All cables and busbars will be identified and labeled in accordance with the System Documentation Section of this specification.

2.18 Connecting Blocks and Patch Panels:

The State recommends that all Cat 6 data connections terminate in a Cat 6-rated patch panel. Where this is not possible, data connections will terminate in a Cat 6 compliant connecting block such as the 110 block. Manufacturer's warranty on the complete wiring system will still apply. Cat 6 wiring that is used for voice will also terminate in a Cat 6 rated patch panel or block.

2.19 Modular Patch Panels:

Modular patch panels will conform to the following specifications:

- Be specified as 24, 48, or 96 port configurations.
- Use Category 6(a),ANSI/TIA/EIA-568-C.2 RJ45 jack in 6-position or 8-position modules.

- Patch panel jack (8-position / 8-conductor) will terminate to an 110d-type IDC PCB mounted connector.
- Patch panel jack will be 8 position, un-keyed.
- Patch panel jack will be available in T568A or T568B wiring schemes.
- Patch panel jack will support termination of 23 and 24 AWG solid conductor, four pair, unshielded twisted pair copper cable. `
- Be designed to maintain the cable's pair twists as closely as possible to the point of mechanical termination.
- Have universal hole pattern for mounting onto any rack.
- Have cable management bar to ensure proper bend radius and strain relief.
- Have front silk-screened port identification.
- Have front write-on designation areas.
- Have the ability to accept color-coded identification tabs and port protecting shutters.
- Be compliant with TIA/EIA-606-A-A labeling specifications.
- Have plastic cover to protect printed circuit boards in the rear.
- Have designation strips on front and rear.
- Be manufactured by an ISO 9001 registered company.
- Be manufactured by Amp, Ortronics, Leviton, Panduit or approved equal.

2.20 Modular Furniture Locations

At locations where modular furniture will be fed from a below floor subsystem, a minimum of a two-inch access hole will be required for each group of 8 modules (8 voice/data locations). If each location has its own conduit, the conduit size will be a minimum of ¾ inch.

2.21 Copper (UTP) patch cords:

If copper patch cords are used, they will meet the following:

- Have contact plating will be a minimum of 50 micro inches of gold in the contact area over 50 micro-inch of nickel, compliant with FCC part 68.5.
- Be ANSI/TIA/EIA 568-A compliant.
- Use 8-position connector, un-keyed.
- Be capable of universal T568A or T568B wiring schemes.
- Modular connector will maintain the paired construction of the cable to facilitate minimum untwisting of the wires.

- Meet all Cat 6 requirements.
- Have a performance marking indelibly labeled on the jacket (by the manufacturer).
- Category 6(a), draft 6, 110 patch cord will be manufactured in the standard length of 2ft (0.6m) and special ordered lengths from 2-ft (0.6m) to 9-ft (2.7 m).
- Have the ability to accept color-coded labels compliant with TIA/EIA-606-A-A labeling specifications.
- Have "snagless" protection for the locking tab to prevent snagging and to protect locking tab in tight locations.
- Have strain relief boot to protect UTP cable from excessive bending stress.
- Be manufactured by an ISO 9001 registered company.

2.22 Racks/Cabinets

The equipment rack or cabinet will provide vertical cable management and support for the patch cords at the front of the rack and wire management, support, and protection for the horizontal cables inside the legs of the rack. Waterfall cable management will be provided at the top for patch cords and for horizontal cables entering the rack channels for protection and to maintain proper bend radius and cable support. Wire management will also be mounted above each patch panel and/or piece of equipment on the rack/cabinet. The rack/cabinet will include mounting brackets for cable tray ladder rack to mount to the top. Velcro cable ties or equivalent will be provided inside the rack channels to support the horizontal cable. Racks/cabinets will be mounted to allow access from both front and back. Racks/cabinets will be manufactured by Amp, Ortronics, Homaco or approved equal.

2.23 Free-Standing Rack will:

- Provide the necessary strain relief, bend radius and cable routing for proper install of high performance cross connect products, meeting all specifications of ANSI/TIA/EIA-568-C.
- Have top cable trough with waterfall and built in patch/horizontal cable distribution separator.
- Have EIA hole pattern on front and rear.
- Be available with a 6.5" (165 mm) channel depth.
- Be available with hook and loop straps for securing bulk cables in the vertical U-channels.
- Assemble as 19" (483 mm) or 23" (584 mm) with no additional hardware.
- Provide floor and ceiling access for cable management and distribution.
- Provide pre-drilled base for floor attachment of rack.
- Be manufactured by an ISO 9001 registered company.
- Racks will be manufactured by TE Connectivity, Ortronics, Homaco or approved equal

2.24 Wall Mounted Racks will:

- Provide the necessary strain relief, bend radius and cable routing for proper install of high performance cross connect products, meeting all specifications of ANSI/TIA/EIA-568-C.1.
- Have top cable trough to route patch and distribution cables between racks.
- Have EIA hole pattern on front and rear.
- Rack height will be specified as 7 ft / 2.13 m (44 rack units) or 4.0 ft/1.22 m (22 rack units).
- Be available with a 6.5" (165 mm) or 14" (356 mm) channel depth.
- Be available with hook and loop straps for securing cables in the vertical U-channels.
- Be available with vertical cable management rings for cord routing organization and strain relief.
- Be available with vertical U-channels to protect and conceal distribution cables.
- Provide floor and ceiling access for cable management and distribution.
- Have wall mount braces with locator posts for easy wall mounting.
- Have side access points that allow for access to manage/install distribution cables in the vertical channels.
- Be available in standard color of black.
- Be manufactured by an ISO 9001 registered company.
- Wall mounted racks will be manufactured by Ortronics, Amp, Homaco or approved equal.

2.25 Campus Environment:

In locations where there will be more than one building on the same continuous property, conduit equal to the amount of entrance conduit described above will be required between any new proposed building and the location of the ER.

2.26 Video Locations:

Each Conference Room and all classrooms in any State educational facility will have a separate, 1 " inch conduit for a video cable. The cable will terminate in a 2-gang 4" x 4" electrical box, in a location suitable for the Agency. In addition, provisions for video will be necessary for any other locations that an Agency requires. In the event of multiple IDFs per floor, all video cable on the floor will pull to ONE of the IDFs.

Before any deviations on the above specifications can be made, the Department of Administration, Building Construction Division must be notified.
Contact 651-201-2550 for further information. These specifications will be reviewed as needed by the Office of MN.IT Services to determine any changes that may be needed due to industry advancements. .

References: Telecommunications Distribution Methods Manual, Building Industry Consulting Service International (BICSI) Used with permission.
BP2740ZO.SPC

ACRONYMS

ACR Attenuation to Crosstalk ratio

ANSI American National Standards Institute

ASTM American Society for Testing and Materials

BICSI Building Industry Consulting Services International

dB Decibel, unit of sound pressure

EIA Electronics Industry Association

ELFEXT Equal Level Far End Crosstalk

FEXT Far End Crosstalk

FOTP Fiber Optic Test Procedure

ISO International Standards Organization

kHz Kilohertz (1000 Hertz)

NEC National Electrical Code

NEXT Near End Crosstalk

PSELFEXT Power Sum Equipment Level Far End Crosstalk

PSNEXT Power Sum Near End Crosstalk

SRL Structured Return Loss

TR Telecommunications Room

TDR Time Domain Reflectometer

TIA Telecommunications Industry Association

GLOSSARY

ACR The difference between the crosstalk attenuation and the attenuation of the link in decibels

ATTENUATION The reduction in power level due to leakages, induction, etc, resulting in the received signal being lower in volume than the original transmitted signal. In optical fiber systems there are other causes of attenuation, such as absorption, scattering, and losses into radiation modes. In optical fibers, it is measured in decibels per kilometer at a specified wavelength.

BACKSCATTERING The return of a portion of scattered light to the input end of a fiber; the scattering of light in the direction opposite to its original propagation.

BEND LOSS A form of increased attenuation in a fiber that results from bending a fiber around a restrictive curvature (a macrobend) or from minute distortions in the fiber (microbends).

BEND RADIUS, MINIMUM Radius to which a fiber or cable can be bent before breakage or excessive signal attenuation occurs.

CABLE BEND RADIUS Cable bend radius during installation infers that the cable is experiencing a tensile load. Free bend infers a lower allowable bend radius since it is at a condition of no load.

CABLE PLANT The cable plant consists of all the optical elements, for example, fiber, connectors, splices etc., between a transmitter and a receiver.

CHANNEL The path for transmitting or receiving telecommunications signals.

CROMATIC DISPERSION Spreading of a light pulse caused by the difference in refractive indices at different wavelengths.

CLADDING: The outer concentric layer that surrounds the fiber core and has a lower index of refraction.

CONSOLIDATION POINT: A location for the interconnection between horizontal cables that extend from building pathways and horizontal cables that extends into work areas.

CORE: The central light-carrying part of an optical fiber; it has an index of refraction higher than that of the surrounding cladding.

CROSSTALK: The phenomenon in which a signal transmitted on one circuit or channel of a transmission system creates an undesired effect or interference in another circuit or channel.

dBm: Decibel, referenced to a milliwatt.

DECIBEL: A standard logarithmic unit for the ratio of two powers, voltages or currents. In fiber optics, the ratio is power.

DISPERSION: A general term for those phenomena that cause a broadening or spreading of light as it propagates through an optical fiber. The three types are modal, material and waveguide.

EARTH GROU|ND: A connection to earth obtained by a grounding electrode.

EIA, **ELECTRONIC INDUSTRIES ASSOCIATION:** A USA trade organization that issues its own standards and contributes to ANSI; developed RS-232.

ELECTROMAGNETIC INTERFERENCE (EMI): Any electrical or electromagnetic interference that causes undesirable response, degradation or failure in electronic equipment. Optical fibers neither emit nor receive EMI.

EQUIPMENT ROOM: A centralized space for telecommunications equipment that serves the occupants of the building. An Equipment Room is considered distinct from a Telecommunications Room because of the nature or complexity of the equipment.

FAR-END CROSSTALK (FEXT): A measure of the unwanted signal coupling from a transmitter at the near-end into a neighboring pair measured at the far (receiving) end relative to the received signal level measured on that same pair.

FIBER-OPTIC TEST PROCEDURE: Standards developed and published by the Electronic Industries Association (EIA) under the EIA-RS-455 series of standards.

FRAME, MAIN DISTRIBUTION (MDF): Frame on which external distribution cables terminate, together with their associated protective devices (on the vertical side) and with internal cables to the central office line units (on the horizontal side). Interconnection is made by running jumper wires between the termination blocks.

FREQUENCY: The number of complete cycles of a periodic activity which occur in a unit of time, i.e., the number of times the quantity passes through its zero value in the same sense in unit time.

GRADED INDEX FIBER: An optical; fiber whose core has a non-uniform index of refraction. The core is composed on concentric rings of glass whose refractive indices decrease from the center axis. The purpose is to reduce modal dispersion and thereby increase fiber bandwidth.

GROUNDING: A conducting connection whether intentional or accidental, between an electrical circuit (telecommunications) or equipment and the earth, or equipment and the earth, or to some conduction body that serves in place of the earth.

IMPEDENCE: The total passive opposition offered to the flow of an alternating current.

INSERTION LOSS: The difference between the power received at the load before and after the insertion of apparatus at some point in the line.

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE): The U. S. organization for professional electrical engineers.

INTERMEDIATE CROSS-CONNECT: A Cross-Connect between first level and second level backbone cabling.

MAIN CROSS-CONNECT: A Cross-Connect for first level backbone cables, entrance cables, and equipment cable.

MULTI-MODE OPTICAL FIBER: An optical fiber that will allow many bound modes to propagate. The fiber may be either a graded-index or step-index fiber.

MULTIPLEXING: The process by which two or more signals are transmitted over a single communications channel.

MULTI-USER TELECOMMUNICATIONS OUTLET ASSEMBLYN (MUTOA): A grouping in one location of several telecommunications outlet/connectors:

NANOMETER: A unit of measurement equal to one billionth of a meter.

NEAR-END CROSSTALK (NEXT): The optical power reflected from one or more input ports, back to another input port.

OPTICAL TIME DOMAIN REFECTOMETER (OTDR): A tool used to evaluate optical fibers based on detecting backscattered (reflected light). Used to measure fiber attenuation, evaluate splice and connector joints, and locate faults.

PATCH CORD: A length of cable with connectors on one or both ends used to join horizontal telecommunications circuits to backbone telecommunications circuits.

PATCH PANEL: A Cross Connect system of mateable connectors that facilitates administration.

PLENUM: The air handling space between walls, under structural floors, and above drop ceilings, which can be used to route intra-building cabling.

PLENUM CABLE: A cable whose flammability and smoke characteristics allow it to be routed in a plenum area without being enclosed in a conduit.

POKE-THRU SYSTEM: Penetrations through the fire resistive floor structure to permit the installation of horizontal telecommunications cables.

POWER SUM: A formula for evaluating the link performance of cable that takes into account the cross-talk influence from all the pairs on the pair being measured. This method simulates performance during the heaviest periods of use.

POWER SUM EQUAL LEVEL FAR-END CROSSTALK (PSELFEXT): A computation of the unwanted signal coupling from multiple transmitters at the near-end into a pair measured at the far-end relative to the received signal level on that same pair.

RACEWAY: Any channel designed for holding wires or cables; e.g. conduit, sleeves, slots, under-floor raceways, cable troughs, etc.

REPEATER: A device that receives, amplifies (and perhaps reshapes), and retransmits a signal. It is used to boost signal levels when the distance between equipment is so great that the received signal would otherwise be too attenuated to be properly received.

RISER CABLE: An indoor cable that passes between floors, normally in a vertical shaft or space.

SINGLE MODE OPTICAL FIBER: An optical fiber that will allow only one mode to propagate. This fiber is typically a step index fiber.

STEP INDEX FIBER: An optical fiber, either multi-mode or single mode, in which the core refractive index is uniform throughout so that a sharp step in refractive index occurs at the core-to-cladding interface. It is usually refers to a multi-mode fiber.

TIGHT BUFFER: Type of cable construction whereby each glass fiber is tightly buffered by a protective thermoplastic coating to a diameter of 900 microns.

TRANSCEIVER: A combination of a transmitting and receiving equipment in one housing.

TWISTED PAIR: A pair of insulated wires that are twisted together which are usually covered with an outer sheath.

Voice over IP (VoIP): A system in which voice signals are converted to data packets and transmitted over a network using TCP/IP (transmission control protocol/Internet protocol).