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**Policy:** To ensure maximum safety, capacity, and efficiency, the Company network infrastructure shall be engineered and installed in accordance with appropriate industry standards and state and local building and electrical codes.

**Purpose:** To delineate specific standards regarding the installation of network infrastructure including cabling and equipment.

**Scope:** This standard applies to all Company Wide Area Networks (WAN) and Local Area Networks (LAN) and all infrastructure support devices attached to those networks.

**Responsibilities:**

The Network Manager is responsible for the design, installation, and management of the Company network infrastructure. The Network Manager will be responsible for the coordination of all aspects of the cable plant installation. In addition, the Network Manager will be the approval authority for the coordination of any additional adds, moves, or changes to the Company network infrastructure.

The LAN Administrator is responsible for the installation and operation of the LAN and WAN equipment and software installed within their LAN. The LAN Administrator will coordinate with the Telecommunications manager for all issues related to corporate WAN Links or other Telecommunications equipment such as telephones as associated systems. The LAN Administrator will coordinate all adds, moves, or other changes with the Network Manager.

The Telecommunications Manager, or Telecom Manager, is responsible for the installation of TCP/IPand operation of all Company WAN circuits and associated support equipment. The Telecom Manager provides direction to the LAN Administrator regarding operation, configuration and troubleshooting of all WAN equipment.

In addition, the Telecom Manager is responsible for the installation, operation, and troubleshooting of all Company voice, fax, and video communications systems.

The Technology Support Manager, or Tech Support Manager, is responsible for installing and maintaining network infrastructure in accordance with commonly accepted Network Infrastructure standards.

**Procedure:**

**1.0 NETWORK INFRASTRUCTURE STANDARDS DEVELOPMENT**

1.1 All Company network infrastructure standards shall conform to IEEE 802 standards, wherever applicable.

1.2 The Network Manager communicates the need for network infrastructure standards to Information Technology Management. They review the proposed standards with respect to:

* ITAD101-1 INFORMATION TECHNOLOGY PLAN;
* Industry standards, best practices, and benchmarks; and
* Applicable federal, state, and local regulations.

1.3 Once the need for standards has been recognized and formally agreed on, the Network Manager shall define the general content and scope of the future standards and present them to Information Technology Management.

1.4 Once agreement has been reached on the basic standard, the Network manager shall develop detailed standards specifications and present these to Information Technology Management.

1.5 When agreement on the detailed standards has been reached, Information Technology Management shall present the standards to Top Management for approval.

**2.0 NETWORK INFRASTRUCTURE STANDARDS IMPLEMENTATION**

2.1 Once approved by Top Management, network infrastructure standards shall be communicated by the Network Manager to the LAN Administrator, the Telecommunications Manager, and the Tech Support Manager personnel.

2.2 The Network Manager shall have primary responsibility for maintaining ITAD106-1 NETWORK INFRASTRUCTURE STANDARDS LIST.

**3.0 NETWORK INFRASTRUCTURE STANDARDS REVIEW**

3.1 At regular intervals (annually, at a minimum), the Network Manager shall review the current set of Company network infrastructure standards to verify that they continue to meet Company requirements. The Network Manager should review ITTS102-1 TECH SUPPORT LOG to determine if there are patterns or trends of Information Technology-related trouble that indicate outdated or incomplete standards.

3.2 If the Network Manager determines that infrastructure standards require updating, they shall meet with Information Technology Management to review their findings and required updates and determine to what extent ITAD101-1 INFORMATION TECHNOLOGY PLAN will be impacted.

If ITAD101-1 will be impacted by a change in standards, this issue shall be included in the next Technology Plan review, in accordance with procedure ITAD101, INFORMATION TECHNOLOGY PLAN.

**Forms:**

* ITAD106-1 NETWORK INFRASTRUCTURE STANDARDS LISTS

**References:**

**A. INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE) STANDARD 802 STANDARD FOR LOCAL AND METROPOLITAN AREA NETWORKS**

IEEE 802 is a family of standards that pertains to local area and metropolitan area networks; specifically, networks carrying variable-size packets. Services and protocols specified in these standards map to the lower two layers (Data Link and Physical) of the seven-layer OSI networking reference model. IEEE 802 subdivides the OSI Data Link Layer into sub-layers named Logical Link Control (LLC) and Media Access Control (MAC). One of the more familiar parts of the standard is 802.11, which pertains to wireless networks.

The IEEE 802 family of standards is maintained by the IEEE 802 LAN/MAN Standards Committee (LMSC). For more information on standard 802 or for copies, see <http://standards.ieee.org/about/get>, the IEEE Standards Association website.

**Additional Resources:**

None.

**Revision History:**

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| **Revision** | **Date** | **Description of Changes** | **Requested By** |
| 0 | mm/dd/yyyy | Initial Release |  |
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**ITAD106-1 NETWORK INFRASTRUCTURE STANDARDS LIST**

### 1.0 CABLE PLANT STANDARDS

The Company network infrastructure is vital to company business operations. The following paragraphs detail the basic mandatory installation procedures that are intended to assure a high quality, dependable, network cable plant infrastructure.

The Company network infrastructure includes all local and wide area networks (LAN/WAN) and all associated equipment and software required for their continued operation and management. LAN infrastructure is red in a hierarchy composed of a Main Distribution Frame/Closet (MDF) and one or more Intermediate Distribution Frames/Closets (IDF). In some smaller locations the MDF and IDF are co-located or there may be no MDF and only and IDF is required.

There shall be as few IDF locations as possible, but at least one per floor. If possible, centrally locate the IDF.

Infrastructure connecting the MDF to the IDF locations will be regarded as part of the network backbone. The backbone is the main portion of the network and serves to distribute communication across the corporate infrastructure. The cable infrastructure from the IDF to individual network hosts, including user workstations, is referred to as the horizontal cable plant. Each portion of the cable plant has specific standards that must be followed to ensure reliable communication.

All installations shall be performed in accordance with ITAM102 – IT ASSET MANAGEMENT.

### 2.0 HORIZONTAL CABLE PLANT

The horizontal cable plant consists of all equipment and cabling found from the IDF to the network interface on a given network host.

**3.0 TELECOMMUNICATIONS RACK**

All equipment in an IDF shall be properly installed in an industry standard communications rack or enclosure. Equipment that cannot be directly mounted to the rack shall be installed on a rack mounted shelve. Equipment shelves shall not be excessively loaded. Equipment shall not be double stacked on equipment shelves.

The rack or enclosure shall be installed in a space or location that is not in the immediate vicinity of hot water heaters, hazardous equipment or material or equipment that could cause power fluctuations or electromagnetic interference (EMI) including heating and air-conditioning equipment, power transformers or distribution equipment.

The telecommunications closet or enclosure shall remain locked at all times. Only personnel from the Information Systems Department are authorized access to these spaces.

All cabling in the IDF/MDF will be dressed neatly with appropriate wire management (cable ties/wraps), as necessary, to protect and aesthetically manage the physical cabling.

1. Dedicated Communications Closet.

For installation locations with a large dedicated communications closet, the IDF shall be installed in an open Aluminum 19” telecommunications rack of at least seven feet in height.

The rack shall be solidly bolted to the floor with not less than four bolts. The rack shall be anchored sufficiently to comply with all local earthquake standards or other applicable building codes. The rack shall be fitted with a horizontal and vertical wire management system.

1. Small Telecommunications Closet

A wall mounted 19-inch telecommunications rack shall be used for locations with small telecommunications closets that preclude the installation of a traditional 19-inch rack.

To support the installation of telecommunications equipment a piece of industrial plywood shall be anchored to the wall of the closet. This plywood shall be not less than 0.75 inch in thickness and not less than 4 feet by 4 feet.

The wall-mounted rack shall be solidly anchored to the plywood.

c. No Telecommunications Closet

For locations without a suitable telecommunications closet, the IDF equipment shall be installed in an enclosed lockable Telecommunications Cabinet (freestanding or wall mounted as appropriate). The LAN Administrator shall control the keys and access to this cabinet.

### 4.0 POWER

The communications closet shall provide sufficient electrical power for all installed equipment. The available electrical load shall not be less than 150% of the required current for all installed equipment.

IDF racks or enclosures shall be electrically grounded in accordance with all applicable government (local, state and federal) laws.

The IDF shall be fitted with surge protected electrical power strips. The number of available outlets shall be 125% of number of outlets required by the installed equipment.

### 5.0 VENTILATION

Proper environmental controls are important to ensure the proper and continued operation of the Company network. All MDF/IDF locations shall have sufficient air conditioning to maintain continuous airflow and a temperature between 65 to 70 degrees Fahrenheit.

### 6.0 CABLE SPECIFICATIONS

6.1 All components proposed for the cable plant installation will meet or exceed all UL and EIA-TIA specifications, and will be installed along industry standard guidelines, within applicable OSHA, city, and federal fire code restrictions.

All Company cabling shall be installed in accordance with the guidelines contained in ANSI/EIA/TIA-568-1991 Commercial Building Telecommunications Wiring Standard and two associated bulletins:

* Additional Cable Specifications for Unshielded Twisted-Pair Cables EIA/TIA Technical System Bulletin TSB-36, Nov. 1991 (Transmission Characteristics of Category 3-5 UTP cables).
* Additional Transmission Specifications for UTP Connecting Hardware EIA/TIA Technical System Bulletin TSB-40A, Dec 1993 (Performance of Connectors and Patch Panels Above 20 MHz).

This standard defines a generic telecommunications wiring system for commercial buildings that will support a multiproduct, multivendor environment. It also provides direction for the design of telecommunications products for commercial enterprises. The purpose of this standard is to enable the planning and installation of building wiring with little knowledge of the telecommunications products that subsequently will be installed. This standard establishes performance and technical criteria for various wiring system configurations for interfacing and connecting their respective elements.

EIA/TIA Category Specification provides for the following cable transmission speeds with specifications. Note: prior to Jan94 UL and Anixter developed a LEVEL system, which has been dropped or harmonized with the CATEGORY system

Category 1 = No performance criteria

Category 2 = Rated to 1 MHz (used for telephone wiring)

Category 3 = Rated to 16 MHz (used for Ethernet 10Base-T)

Category 4 = Rated to 20 MHz (used for Token-Ring, 10Base-T)

Category 5 = Rated to 100 MHz (used for 100Base-T, 10Base-T)

All Company copper cabling (network and telephone) shall adhere to the standards for Category 5. Telephone cabling is normally cabled with Category 2. While more expensive, the use of Category 5 cable not only ensures maximum signal quality, but also ensures a growth path for future implementation of advanced technology such as ISDN.

EIA/TIA 568 specifies two different methods of installing cables. All company network cabling shall be installed in accordance with EIA/TIA 568A. EIA/TIA-568 defines 568A pinouts as follows:

Pair Pin Wire Color

3 1 White/Green

1. 2 Green

2 3 White/Orange

1 4 Blue

1 5 White/Blue

2 6 Orange

4 7 White/Brown

4 8 Brown

6.2 Cable Plant Labeling

Color coded cable plant labels meeting the EIA/TIA 606 standard will be installed on all termination points including patch panels, punch blocks, and wall plates. In addition, color-coded labels shall be installed on each end of all installed cable, approximately 6” from each end.

Cable plant labels will be computer generated professionally and permanently affixed to each location, all reflecting the unique identification according to a pre-approved project labeling plan.

The color of label used on a cross connect field identifies field's function. The cabling administration standard (CSA T-528 & EIA-606) lists the colors and functions as:

* Blue - Horizontal voice cables
* Brown - Interbuilding backbone
* Gray - Second-level backbone
* Green - Network connections & auxiliary circuits
* Orange - Demarcation point, telephone cable from Central Office
* Purple - First-level backbone
* Red - Key-type telephone systems
* Silver or White - Horizontal data cables, computer, & PBX equipment
* Yellow - Auxiliary, maintenance, & security alarms

6.3 General Cable Installation Guidelines

* Each network drop location shall contain not less than two network ports and at least one telephone port.
* Each drop location shall be placed eighteen inches above floor level.
* Each drop location shall be at least 24 inches away from electrical outlets.
* Each end of a cable run shall have additional slack or service loop. There shall be no less than three and no more than ten feet of service loop at the IDF end of the horizontal cable run. There shall be at least 12 inches of service loop at the network node end of the horizontal run.
* All cabling will maintain bend radius, as prescribed by the EIA/TIA 568A standard.
* For locations with hollow gypsum walls (drywall), cable shall be routed inside the wall. Cables shall terminate in a flush-mounted wall plate.
* For locations with solid walls, such as concrete block or slab, cable shall be run inside approved wire molding. The color of the molding shall be as consistent as possible with the color of the wall. The wire molding shall be run in such as manner as to be as unobtrusive as possible.
* Cable run within the ceiling shall not be draped over ceiling tiles. All cable run through ceilings shall either utilize cable trays or hooks. The cable run shall be at close to the upper limit of the space between the false ceiling and the hard ceiling.

6.4 Vertical/Backbone Cable Plant

* Fiber Optic Cable

Multi-mode (MM) Fiber

Multi-mode fiber used in Company networks shall have a core diameter of 62.5 microns and cladding of 125 microns. Multi-mode fiber shall be used for backbone cable runs or for local area network connections that require reliable and secure communications at distances less than 2 km.

Single Mode (SM) Fiber

Single mode fiber has a very small core. Typical values are 5-10 microns. Single mode fiber has a much higher capacity and allows longer distances than multi-mode fiber. Single mode fiber has a maximum transmission distance of 40km. Single mode fiber shall typically be used for campus or wide area networks such as telephone company switch to switch connections and cable TV (CATV).

* Fiber Connectors

There are several different types of fiber connectors. All fiber connections within the Company infrastructure shall use the following connector types.

FSD - Fixed Shroud Duplex. This type of connector shall only be used for FDDI connections

* SC - SC is the international standard. The SC connectors are recommended in SP-2840A. SC connectors shall be used on all multi-mode data fiber runs.
* ST - Keyed, bayonet-style connector. This type of connector shall be used on all single-mode fiber runs.
* SMA Shall not be used.

6.5 Cable Plant And Drop Location Numbering Scheme

To facilitate efficient management of the cable plant infrastructure all cables and drop locations shall be assigned a unique serial number. The serial number shall be constructed of three sets of alpha-numeric characters separated by a dash.

IDF-Panel-Port

IDF – The three character identifier for the IDF location

Panel – A character denoting the specific patch panel

Port – The port number on the patch panel

### 7.0 INFRASTRUCTURE TESTING

Proper cable plant testing, certification, and documentation are imperative for the successful operation of existing information systems, as well as the future planning and maintenance of the cable plant expansions.

7.1 Cable Plant Testing

Twisted pair testing and certification will be performed with a cable analyzer to obtain the following information:

\* Cable Length \* Connectivity

\* Cable Attenuation \* Category 5 Compliance

\* NEXT (Near End Cross Talk) \* Ambient Noise Levels

Testing will be performed at 100 MHz ranges.

All information derived from the testing procedures will be included as part of an overall documentation.

7.2 Fiber Optic Cable Plant Testing

It will be the responsibility of cable installer (company or contractor) to assure that the quality and transmission integrity remains intact throughout the installation, from delivery of the fiber to the project site, until the fiber is tested in its completed stage.

To provide this assurance, as well as useful comparison documentation, the installer will certify the fiber optic cable in three separate stages.

Pre-Installation Certification – The initial check will test each fiber strand upon delivery to the project site and match the test results to the manufacture specifications sheets provided on the reels. This will be performed with an O.T.D.R. (Optical Time Domain Reflectometer) on the bare fibers on the reel.

This information will provide verification of the cable lengths and show that the integrity of the cable has not been compromised during shipping.

Post- Installation - The second fiber test procedure is performed after the installation and prior to termination of the fiber strands. This test will reveal damage to the fibers (if any) and provide accurate total lengths of each segment.

Post-Termination - The final certification will be performed after the fiber has been terminated and installed into the fiber panels, and the cable plant has been dressed for aesthetics and protection. This final certification will ensure that each connector mating does not exceed the tolerances prescribed by industry standard, and that no additional damage to the fiber segments has occurred during the dressout.

Actual OTDR printouts representing each of the test procedures at both industry accepted windows will be generated and retained.

7.3 Documentation

The LAN Administrator shall maintain a comprehensive cable plant documentation package for each LAN under their purview. The documentation package shall, at a minimum, contain the following information:

* Detailed “as-built” drawings and schematics of the cable plant
* Category 5 test results for each copper cable
* Test results for each fiber optic cable
* A table detailing the cable drop location/port number scheme.

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