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AETC
FIRST 400 FEET STANDARD GUIDANCE
AT
ALL AETC BASES

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10 Mar 2006
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FIRST 400 FEET STANDARD GUIDANCE
Luke AFB Supplement

(Update 1 - Sep 08)
(Update 2 - Apr 09)
(Update 3 – Mar 10)
(Update 4 – 5 May 15)
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EXECUTIVE SUMMARY

The purpose of this policy is to provide minimum requirements for intra-building telecommunications wiring in support of Command, Control, Communications, Computer, and Intelligence (C4I) Systems requirements. This intra-building wiring is referred to as First 400 feet and includes the internal building media for distributing voice, video and data to include all equipment from the primary telecommunications closet/first patch panel to the end user hardware and software. The First 400 feet requirements may include but are not limited to necessary wiring and equipment supporting the following: local area networks, administrative and non-administrative telephone systems (including Voice Over IP), video, teleconferencing, cable television (CATV), alarms (other than fire), and office automation systems, (e.g., desktop video teleconferencing and educational applications). All require higher performance/throughput, greater network predictability, higher network availability, and enhanced security than is currently available in the existing communications infrastructure.

Due to bandwidth restrictive wiring for facilities at all of our AETC bases, improvement to the First 400 feet (from the hub/switch to the patch panels to the wall plate) as well as elimination of the traditional shared-Ethernet hubs and replacement with switched Ethernet must take place. Currently, the Information Transport System (ITS) component of Combat Information Transport System (CITS) provides only fiber to the majority of facilities on base and high-speed connectivity to the core buildings. However, the ITS does not incorporate upgrades within the buildings' infrastructure. Many buildings on AF bases do not have the right cabling infrastructure to support high-speed access capability. In order to achieve our enterprise end state, these buildings need upgrading to Category (CAT) 6 cabling as well as replacing the traditionally shared Ethernet hubs with switched Ethernet. To date, the First 400 feet and switched upgrade has been accomplished in ad- hoc fashion using wing O&M funds or fall out dollars. The publication of this document does NOT establish a program with central funding to execute structured CAT 6 wiring for the First 400 feet and provide users with switched Ethernet capability across the command, however, should funding become available this document will have the technical guidelines for how to proceed.

The standardized building wiring system should accommodate present communications requirements, support future expansion requirements, and minimize or eliminate building defacement due to future distribution system expansion or retrofit. These factors make the choice and layout of horizontal cable types very important to the design of the building cabling. In addition to satisfying today's telecommunications requirements, the horizontal cabling should facilitate ongoing maintenance and relocation. It should also accommodate future equipment and service changes.

Careful consideration was given to multimode fiber for horizontal wiring; however, based on the current cost of electronics it was deemed cost prohibitive to recommend multimode fiber optic cable for horizontal building interconnects in the near term.

Furthermore, new standards for properly installed copper cable systems support Gigabit Ethernet Standards. However, when facilities have multiple telecommunications rooms (TRs) the backbone data uplinks shall be multimode fiber.

The information presented within this document is a compilation of data from USAF guidance, commercial standards (ANSI/TIA/EIA and others), and actual experience of USAF engineers working with bases and design agencies in planning and designing C4I requirements. The intent of this document is to primarily follow the standards and installation practices from ANSI/TIA/EIA, BICSI and the National Electric Code. Where instances occur that this document exceeds the standards presented in EIA/TIA, BICSI or the NEC this document should be followed.

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1 OVERVIEW

1.1 Scope

This document details the AETC standard for planning, engineering, and installing premise wiring infrastructure for the First 400 Hundred Feet. This document was purposely written to be directive in nature. Statements using words such as 'shall' and 'must' are required items by all organizations.

The Air Force has a broad spectrum of information technology devices that require connectivity via a common communications infrastructure. A generic-wiring scheme for all facilities is critical to support a mixed environment of equipment, services, and classification levels. Industry-recognized, standards-based installation and management results in uniform wiring across locations, improved management of building space resources and reduced costs for wiring installation, support, and management. A common wiring system also improves network management, trouble-shooting, and isolation of data transmission problems. Careful and proper application of standards can also produce a predictably long-lived cabling system. Specifications are intended for telecommunications installations in the typical office configuration.

Any deviation from the requirements in this document must have prior written authorization from AETC if the standard is less than what is documented in this document.

The information in this document applies to AFI 32-1021, Planning and Programming for MILCON Projects, and AFI 32-1023, Designing and Constructing MILCONs, or when the need arises for new voice, video, and data cabling. This document is not intended to justify wholesale replacement and upgrade of existing premise wiring, facility backbone uplinks, or voice-video-data electronics. However when the requirement arises for existing facilities to be upgraded that are not in compliance with this guidance the CSI-B and base SCX shall assess the current infrastructure and identify this assessment within the CIPS.

This document follows the guidelines of ANSI/TIA/EIA standards; ANSI/TIA/EIA-568, Commercial Building Standards for Telecommunications Wiring and ANSI/TIA/EIA-569, Commercial Building Standard for Telecommunications Pathways and Spaces, ANSI/TIA/EIA-606A, Administration Standard for Commercial Telecommunications Infrastructure, ANSI/TIA/EIA-607, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications. In addition to these standards, the BICSI-TDM manual is recommended to enhance the understanding of pre-wire design methods and concepts and the 2003 - National Electric Code (NEC)(NFPA-70).

When completing SIPRNet technical solutions, the user's work area (office) should be surveyed to determine if a network drop exists to service the SIPRNet terminal. If a port is available on an existing network jack, this jack may be used to service the cypher text (black side) of the TACLANE encryption device. The category of facility and user's needs (i.e., 24-hour a day controlled area and number of SIPRNet workstations required) may dictate a different premise wiring scheme to provide the necessary LAN drop configuration. The wing IA office should be an integral part of the survey and development of the premise wiring configurations. Refer to Emission Security Information Message (ESIM) 03-11 and AFMAN 33-214 for further reference.

1.2 Purpose

The purpose of this document is to define standards and architecture for the first 400 feet. To provide guidance in performing assessments, developing requirements, technical solutions, and costs for a voice and data telecommunications cabling system that will support a multi-product, multi-vendor environment.

This document shall be used by all AETC Bases to plan, design, review, and evaluate telecommunications cabling and distribution systems. Air Force Engineering Technical Letter (ETL) 02-12, requires pre-wiring in all new facility construction, additions, and renovation projects.

(Luke Supplement Begins)

This supplement further identifies Luke specific wiring requirements as defined by the wing CSO. It provides an overview of key telecommunication areas to be addressed and must be used for planning telecommunications cabling, distribution systems, and manhole/ducting to support Military Construction Projects and O&M construction/renovation efforts on Luke AFB. This standard is not intended to replace referenced industry standards; it will be used to further define approved industry standards for Luke AFB. Where there are conflicts between this document and referenced industry standards it is up to the installer to request in writing clarification from 56 CS.

Upon project inception, 56 CES/CEC, 56 CS/SCX, and the customer will address the following areas for inclusion into the design package/work order:

Local minimum communications standards.

Building communications and distribution system.

Switch and Patch panel requirements

Telephone/LAN entrance cables.

Communications equipment rooms/closets.

Telecommunications cabling and termination (NIPRNET and SIPRNET)

Telecommunications outlets.

Testing requirements.

Manhole/ducting.

56 CS/SCX will assist with preparation of the DD form 1391, Military Project Construction Data, by providing 56 CES/CEC with the cost estimate for telecommunications. Additionally, 56 CS/SCX will perform the necessary design reviews as applicable throughout the design phase to ensure all applicable aspects of telecommunications have been addressed.

Personnel involved in design and installation of telecommunications wiring shall have expertise in engineering and installation of telecommunications, cabling, and distribution systems. If requested by the wing CSO, contract personnel shall provide adequate credentials as proof of

their individual skill by demonstrating their technical expertise and methods of testing and documentation.

As stated in ETL 02-12, “pre-wiring shall be included in all military facility construction projects accomplished with 3400 series funding.” 56 CS/SCX will provide cost estimates for inclusion into the DD Form 1391. The customer will fund all telecommunication equipment/materiel not funded with 3400 series funding.
(Luke Supplement End)

1.3 First Four Hundred Feet Definition

The first four hundred feet is defined as the internal building media for distributing voice, video, and data to include all equipment from the facility equipment room to the end user hardware and software.

1.4 Background

New requirements for telecommunications have proliferated rapidly over the past decade. Wiring and building designers are being challenged to better accommodate cable, telecommunications, and electronic systems in a rapidly changing technological environment. In the past, voice systems have had a large influence on building design but today telecommunications systems include voice, data, video, audio, security, and environmental control - all of which are needed in order to transport information throughout modern buildings.

Users are becoming painfully aware that they can no longer use the old voice methodologies because telecommunications and buildings are highly synergistic. Today, facilities and wiring systems must be planned in an integrated manner. The following compilation of telecommunications distribution standards provides state-of-the-art guidelines for effective and adaptable installations.

Proper adherence to these guidelines will reduce long-term building operation costs by providing a better infrastructure that is adaptable to change. The following telecommunications building design standards are intended for building wiring planners, designers and installers as well as architects, engineers, and vendors.

1.5 Document Technical Summary

The following is a summary of the policies established in this document for new construction, Military Construction Projects (MCP), and Restoration and Modernization, as defined in AFI 32-1021 and AFI 32-1023**.**

- All new premise wiring shall be Category 6 (Cat 6) to support Minimum 100/1000 Mbps to the desktop.
- **(Luke Supplement Begins)**
- All cable used for telecommunications outlets shall be four pair, #24 AWG, solid copper conductor, CAT 6 plenum rated, UL tested and certified. All CAT-6 terminations are to be 568-B. Each cable shall be dedicated to only one device per outlet.
- **(Luke Supplement Ends)**
- Plenum rated cable shall be used.
- All Communications Outlets shall be quad outlets.
- A quad telecommunications outlet or equivalent is required for every 15 linear feet (4.6 meters) of wall space in office areas or 2000 square feet (186 sq meters) for warehouses or hangars.

- When facilities have multiple telecommunications rooms (TR) the backbone cabling shall be multimode fiber. Should the situation arise where a TR requires redundant links to another facility, a hybrid single mode and multimode fiber optic cable may be installed.
- Backbone cable plant shall consist of 62.5/125 or 50/125 12 strands, minimum, multimode graded-index fiber optic cables.
- **(Luke Supplement Begins)**
- For Base Fiber Optic Outside Plant Backbone Connections (ITN to ITN): Switched/Gigabit Ethernet Connections 48-strand SM FOC 8.3/125 micron will be used.
- For Base Fiber Optic Outside Plant Edge Buildings Switched Ethernet Connections, 12-strand SM FOC 8.3/125 micron will typically be used. Strand count subject to increase depending on facility requirements.
- All copper Outside Plant cable conductors shall be #26 AWG in cable sizes above 2100 Pair. All Outside Plant cable will be filled core type, and meet RUS PE-39 or PE-89 specifications. All copper conductors for cables less than 2100 pair shall not be less than #24 AWG.
- **(Luke Supplement Ends)**
- Patch cords and cross connect jumpers shall be rated at same performance category as the cabling it connects.
- All new fiber optic patch panels shall be the base standard as defined by the local communications squadron (SC, ST, or sub-miniature type connectors) and mounted in cabinets with 19 inch racking.
- Voice Backbone Cabling shall be plenum rated Cat 6 multi-pair cat-5e backbone cable.
- Equipment cabinets shall be equipped with wire management panels.
- Multi-story buildings shall include a minimum of one TR room per floor. Horizontal cabling shall terminate on respective floor TR patch panels in multi-story facilities, e.g. second floor outlets terminate in second floor TR.
- Label all telecommunication infrastructure and equipment components IAW Labeling Scheme, Appendix C.
- TR designed to ANSI/TIA/EIA 569A for new construction, modified to conform as closely as possible to ANSI/TIA/EIA 569A for facility Restoration and Modernization.
- Cost to remove all abandoned telecommunications cables, voice and data, shall be included in all technical solutions for new cable installations. Reference NEC sections 800.2, 800.52 (B), 800.53 (A), and 800.53 (B)(1).
- Minimum requirements are identified to populate cable records database.
- Drawing package shall be included to accurately depict network configuration and cable plant, reference Appendix E, Drawings.
- Network Hardware installations should support at a minimum 100 Mbps to the desktop and should be SNMP version 2 or higher and IPv6 compliant.

(Luke Supplement Begins)

All cable will be installed from facility to the nearest tie-in point-of-presence for telephone (usually a manhole) and LAN connectivity (nearest ITN). Cable will be sized with sufficient vacant pairs to provide each facility with currently required circuits plus 50 percent spare pairs for future growth. Copper cable will be curled in a 20-foot length and left in the manhole. Any/all splicing into the base's infrastructure will be performed by the Luke BTS O&M contractor as managed by 56 CS/SCX; construction contractor responsible for payment. Fiber optic cable will be terminated with SC connectors on both ends and installed on the back side of duplex bulkheads in a fiber optic distribution panel.

- Administrative telephone wiring will be based on the single-line instrument concept with individual cable running from the wall outlet to the CER or TC communications cabinet, if required, and terminate on a RJ-45 patch panel as determined by Base Comm. Cat-6 wiring will be terminated onto a rack mounted patch panel located inside a lockable cabinet. A rack mounted 110- type punch down block will be installed above or below the patch panel in the cabinet. The 110-type punch down block will provide an interface from the cable head to the patch panel. The 110-type block needs to be tied into a 66-type block that is located outside the cabinet near the cable head. Utilize standard 25-pair cables to connect between the 110 block(s) and the 66 block(s). The number of blocks needed are determined by quantity of phone lines plus 50% spares.
- When cable runs are being installed maintenance loops will be installed at both ends to accommodate future cabling system changes. The minimum length requirements are:
  - UTP
    - At the TC or CER: 10 ft
    - At the user outlet: 1 ft
  - Fiber
    - At the TC or CER: 10 ft
    - At the user outlet: 3.3 ft

- Inspection: During construction/installation (i.e., trenching, boring, MH/HH, etc), in-progress inspections by 56 CS/SCX are required. For example, trenches will not be covered without an in-progress inspection to verify conduit size and quantity, cable type, earth cover compliance with installation requirements and accuracy of “red line” base cable record or contract drawings. The installation activity/contractor is solely responsible for requesting in progress inspections before backfill, installation of sheetrock, during cable certifications, etc. A final inspection of all communication installations is required before facility turn-over or acceptance. Deviations from this will affect future communication support requirements.

- Classified Systems (SIPRNet): Classified requirements may vary and will be taken on a case-by-case basis. Customer units must identify classified LAN and telephone requirements to 56 CS/SCX during preliminary design planning. Due to the specific nature of security and COMSEC requirements for these systems, it is difficult to address these requirements in generalized terms.

(Luke Supplement Ends)

2 FIRST FOUR HUNDRED FEET INFRASTRUCTURE COMPONENTS

The three primary First Four Hundred Feet components are the cabling infrastructure, electronic network equipment, and processing equipment.

2.1 Cabling Infrastructure Designation

Cabling infrastructure generally includes copper and fiber optic cabling within and into AF facilities. Cabling within the facilities may be separated into two types, backbone (also called vertical or riser) and horizontal. Backbone cabling is the distribution from central wiring locations to the Telecommunications Rooms (TRs), while horizontal cabling runs from the TRs to the work areas.

2.2 Networking Equipment Designation

Networking equipment includes routers, shared Ethernet hubs, repeaters, switches, and other electronics equipment not directly associated with a single AF system. Some facilities still have a combination of routers, shared media hubs and older low end switches in place, which supports Ethernet connectivity from various manufacturers. All networking hardware installations must support at a minimum switched 100 Mbps to the desktop with consideration of switched 100/1000 Mbps for high-end bandwidth requirements for servers and applications. Only network equipment that is SNMP version 2 or higher as well as IPv6 compliant should be considered for re-usage or new procurement.

23 Processing Equipment Designation

Processing equipment is both AF system-specific and general supplied administrative equipment. Administrative equipment includes personal computers (PCs), servers and printers. Based upon the organizational user located at the site, administrative equipment and PCs associated with specific AF systems will constitute the majority of the processing equipment attached to a facility network. In other words, as networks are activated, a majority of the processors active on the networks will be PCs, either associated with an AF system or used for administration. While this document includes no specific processor or Network Interface Card (NIC) recommendations, the processors are a key part of the overall capability required from the network. The processor data throughput necessary to meet user requirements is the driving force behind the need for faster networking equipment and better transmission media.

3 STRUCTURED CABLING SYSTEM COMPONENTS

The ANSI/TIA/EIA-568-B.1 standard dissects the cabling system into six distinct subsystems:

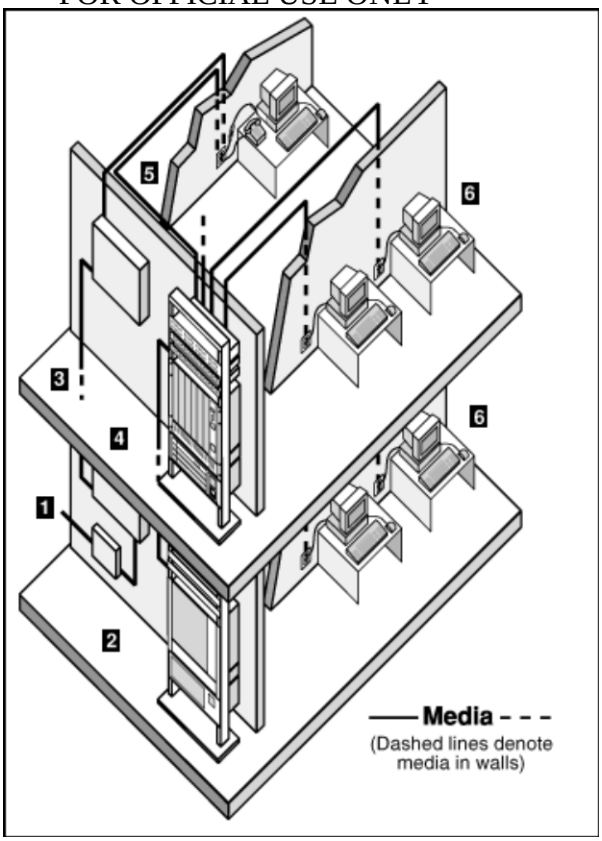

Figure 1 ANSI/TIA/EIA Guidance 6 Subsystems

1. Entrance Facilities
2. Equipment Rooms
3. Backbone Cabling
4. TRs
5. Horizontal Cabling
6. Work Area

3.1 Cabling Infrastructure Designation

3.1.1 Copper Cabling

Air Force facilities still exist that have a mix of 10BaseT (UTP) copper cabling (level 3/4/5) for their networks. ANSI/TIA/EIA-568-B.2 and Addendum 1 is the only recognized cable standard for any new or replacement communication wiring. Therefore, this document only focuses on Cat 6 copper cabling.

Voice cabling is commonly found with a large number of multiple pairs, from 25, 50, or even into the 100's of pairs. Large cable pairings, typically over 25-pair, are used for main distribution, backbone applications, while smaller pairs are used for horizontal distribution runs.

In contrast, data-rated cable is a higher grade and cost of cable. Data-rated cables now come in multiple categories. The only recognized categories designated in ANSI/TIA/EIA Standard 568-B.2, Section 4 are Category 3, Category 5e and Category 6. The cable categories indicate the amount of allowable attenuation over a specified frequency spectrum, with a smaller usable frequency spectrum available for the lower numbered category cables. Based upon the higher rating of the cable, there is more bandwidth potential available from the cable. Currently, Category 3 cable is rated up to 16 megabits per second (Mbps)/ 16 MHz, Category 5e up to 1000 Mbps/100 MHz and Category 6 1000Mbps up to 250MHz. Category 1, 2, 4, and 5 cables are not recognized as part of the referenced standard. Category 5 transmission characteristics, used in “legacy” cabling installations, are provided for reference in annex N of the EIA/TIA Standard. Within each category, multiple pairings of the conductors are provided, depending on the specific cable vendor.

3.1.2 Fiber Optic Cabling

Two types of fiber optic cable exist, multimode and single mode. Mode refers to the path the light takes to travel down the fiber. Multimode has multiple propagation paths, while single mode only has one propagation path. Fiber optic cable has a core, cladding, and buffer, with the fiber optic core being either multimode or single mode. The size of the fiber optic cable is annotated as core/cladding/buffer (sometimes just provided as core/cladding) because each mode of cable has multiple sizes associated with it. For example, multimode fiber optic cable has core sizes of 50 and 62.5 microns; cladding sizes of 125 microns; and buffer sizes of 250 and 900 microns available. Additionally, multimode cable can be purchased as either step-index or graded-index, with graded- index fibers providing longer distance and higher bandwidth capability than step-index fibers. It is also recommended that laser-optimized multimode fiber be purchased when high bandwidth requirements are expected in the future.

Multimode fiber optic cable is normally used for distribution within a building or in a campus environment where the distances are limited to within approximately two kilometers ([km] -i.e., 1.2 miles). Single mode fiber provides the best possible distance and bandwidth capability, and is used for either longer distances or high bandwidth applications that are beyond the range of multimode fiber. Consequently, the electronics equipment attached to single mode fiber is typically more expensive than multimode fiber optic equipment.

4 COMMUNICATIONS ROOMS

41 Equipment Room

Equipment Rooms (ERs) are defined in TIA/EIA-568-B.1, Chapter 8. The primary ER for the typical facility is the service entrance for the building's distribution and communications systems. It is the primary location for C4I switching and transmission

equipment, main distribution frame(s), and other equipment needed for termination of the building's interior wiring systems and to interface them with the exterior (outside plant) cable system. The ER also provides the primary distribution point for communications cables and wiring within the building and associated cross-connect cable/wiring. The location of the ER should ensure the horizontal cable distance to a user outlet is no more than 90 meters (295 ft) per ANSI/TIA/EIA-568-B.1, paragraph 4.3 Horizontal Distances.

(Luke Supplement Begins)

The Communications Equipment Room (CER) will be located on the first floor along an exterior wall where possible. As a minimum, the CER should have ¾" plywood backboards on at least two walls, from no greater than 1' above the finished floor level to no less than 7' above the finished floor level. The size of the CER will not be less than the following specification:

Table 1

Building Usable Area (Square Feet)	CER Size (Square Feet)	Number of 4 inch Entrance Conduits
<20,000	400	3
20,000 to 100,000	500	4
100,000 to 200,000	900	5
Every additional 200,000	600+	+1
NOTE: No less than a 2:1 ratio in length to width.		

Adequate installation and maintenance space (See Table 1), environmental control and power, typical to an office environment (heated and cooled), shall be included to support this equipment and any necessary cable entry requirements. No other building support equipment, including mechanical equipment, plumbing equipment and electrical panels, will be placed in the CER. Maintenance space and access space will not be utilized for any other purpose and will be free and clear of all obstructions to a height of 8' to allow for adequate cooling and servicing of equipment. Storage is prohibited in the CER and TC.

The TCs will be provided with space as required for CER rooms and will be so located that the distance, measured along the routing path of the cable will not exceed 295', including vertical distances to wall telecommunications outlets, to maintain the integrity of the digital data signal as stipulated by CAT 6 wiring requirements. Where multiple TER rooms are required, attention must be given to their strategic placement to support interconnection via 4" conduits or 6" wide by 2" deep (minimum) cable trays between each room as well as to the primary CER in which the cable head/fiber connections are to be located. Where it is necessary to interconnect more than one remote TC/CER to the primary CER, Plenum rated #24 AWG copper wire cable between the TC and the CER will be used for voice services. Cable will be sized to meet user's voice requirements plus 50% spares for future growth.

Circuit connectivity from the telecommunications outlet jacks to the TC or the CER will be provided through ¾" (min) conduit stubbed to 12" above the finished ceiling, using the most direct route available, complete with pull cords. A 6" wide by 2" deep (minimum) cable trays between each room as well as the primary CER in which the cable head/fiber connections are to be located. Where it is necessary to interconnect more than one remote TC to the primary

CER for network connectivity (distance limitations/between floors), MM fiber optical cable will be used. A 1” plenum inner duct will be provided inside the 4” conduit or conduit raceway, with pull cord as a dedicated, direct path between each TC and the primary CER. For telephone interconnection, provide not less than #24 AWG copper wire cable between the TC and the CER. Copper cable will be sized to meet user’s voice requirements plus 50% spares for future growth.
All CER’s/TC’s will have cable supports (cable ladders/racks/trays) for all cables that enter the room from the wall to the rack(s)/cabinet(s). Outlet cables shall enter the CER/TC from the wall. The supports are used to relieve cable tension as they enter the room to be terminated on contractor provided rack mounted patch panels that are installed in cabinets. All cables/patch panels mounted in the cabinet(s) will be supported by the cable supports.

Single cat-6 wall jacks with mounting ears will be provided for wall-mounted telephones in the CER, electrical/mechanical rooms and communications closets mounted 60” above the finished floor.

Secured interior and exterior access to CER workspace should be provided to allow 24-hour access. Locking door knobs shall be utilized with key ways and locks keyed alike to match the 56 CS master key. Only building custodians and personnel with written authorization from the BCSO may possess communications room keys.

Environmentally controlled temperatures will be provided in the CER and TC areas, equal to that maintained throughout the building with a constant temperature of not less than 68 degrees (F) or greater than 78 degrees (F).

Four-gang 120 VAC power outlets on a separate 20 amp circuit with isolated ground will be provided on each wall as well as in or above each cabinet for use in powering telecommunications devices. An additional duplex convenience outlet will be located away from the telecommunications outlets to provide power to operate service and maintenance equipment. Switched lighting will be provided in all CER areas, adequate to promote work with small fiber items and miniature letting devices.

Ground all devices, cable sheaths, protectors and other equipment in accordance with T.O. 31-W-3-10-22, ANSI/EIA/TIA 607, MIL STD 188-124B, and the NFPA 70. Provide a single-point ground for all communications/electronic equipment for the building within the CER. Provide a TMGB a minimum of 6” high by 24” long installed 7’ above the floor along a wall. The ground riser from the ground plate to the single main electrical service entrance ground must be a #1 AWG or larger copper conductor directly connected to the ground plate with no taps. The resistance of the ground riser must be 5 ohms or less measured from the main building ground point. All connections of wire-to-wire and/or wire-to-ground rod must be exothermic-welded. Extend #6 AWG or larger copper ground wires from the CER ground plate to each TC within the building and connect a TGB in the TC. Bond each TMGB and TGB to non-current-carrying metal building parts, such as metal framing, in the CER and TC as required by the NEC. All bonds for ground conductors will have a resistance of less than 1 milliohm. A copy of facility ground

Resistance and bonding results will be provided for building grounding system historical

records.

Telecommunications Closet (TC).

TCs will only be provided as required to serve approximately every 10,000 Sq. ft per floor of usable floor space when CERs cannot provide adequate cable coverage. The closets will serve as a secondary interconnection point between the telephone/LAN modular jack outlets and the main communications frame in the CER. Wall and floor space will be provided for installation and maintenance of equipment such as frames or backboards. Such equipment will be concealed and secured as required for primary CERs and will not be installed in common use areas and must be fully accessible and maintainable as outlined for CER room equipment.

All cable in the TC will be tagged according to room and jack number to indicate its associated jack number and location. Cross-connect closets will not be used for LAN wiring. All LAN runs must be continuous from wall outlet to contractor provided rack mount patch panels in the TC or CER inside the communication cabinet. Installation of plugs and plugging house cable into active electronic equipment is strictly prohibited.

Lockable floor mounted equipment cabinets shall be bolted securely to the floor using four (4) fasteners appropriate for use in concrete. Lockable equipment cabinets shall be positioned and installed to allow a minimum clearance of 36 inches in the front and back and a 30 inch clearance on the sides. In a narrow or crowded communication closets, equipment racks may be mounted adjacent to a wall on one side, front and back clearance shall remain 36 inches. Wall mounted lockable cabinets shall be secured using appropriate mounting hardware and methods suitable for anchoring cabinets to walls to support weight loads of installed hardware. Cabinets shall be equipped with wire management panels on top and bottom of each patch panel. Ground all racks and cabinets IAW NFPA 70 NEC, MIL-STD 188-124B and TIA/EIA-607 requirements.
(Luke Supplement Ends)

4.1.1 Building Entrance Facilities

The building service entrance provides an entry point for outside plant cable(s) into the building. This is typically located in the ER, however, the entrance facility could be in a Mechanical/Civil Engineering Equipment Room where outside plant fiber optic and copper cables are terminated, then cross connected to the ER. Outside plant cable shall not extend beyond 50 feet into facility unless complying with National Electrical Code (NFPA 70) guidelines and restrictions, 2002 NEC, Section 800-50. Voltage Surge protection shall be IAW ETL 02-12 section 8.3.3.2.5

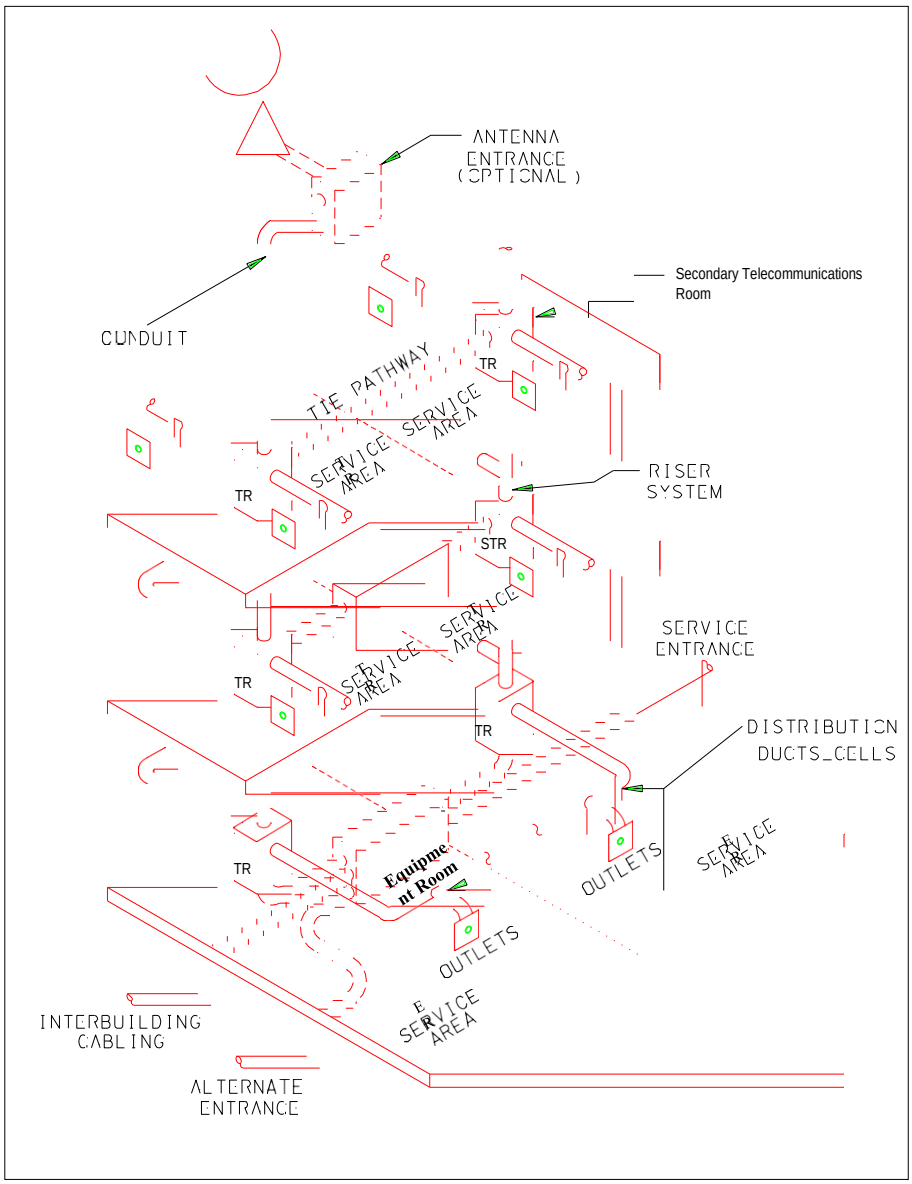

Figure 2 Distribution System, Duct/Cellular Floor

(Luke Supplement Begins)

Building Entrance Cable (Copper)

The contractor shall obtain written approval from the BCE for the specific location of entry points for cables or conduit/ducts into each facility. Unless specified otherwise by BCE, and pending approval by 56 CS/SCX, existing openings, which contain cable to be replaced, shall be used to the maximum extent possible. Prior to installing new cable in existing building entrances, the contractor shall ensure that there is adequate space to prevent damage to the new and existing cable. Conduit/ducts, openings, etc., containing power cables shall not be used. Where an outdoor conduit or cable enters a facility, the point of entry shall remain

hidden below ground. However, if below ground entrances are not feasible, then written permission shall be obtain from BCE to use above ground entrances which shall be placed as close to the ground as possible.

All Building Entrance Terminals (BETs) will be provided with 3-pin element, plug in orange gas tube protective modules and will provide equal protection IAW RUS PE-80 specifications. The inside diameter of the entry conduit/duct shall not be less than 4 inches in diameter. The minimum bending radius for entry conduit/ducts shall be no less than 10 times the inside diameter of the conduit. Sleeves installed on an exterior wall shall be sloped downward so the outdoor opening is a minimum half-inch below the indoor opening. All openings through floors and through established fire walls shall be fire stopped IAW NFPA. Cables passing through walls shall either be in conduit or enclosed in a metal sleeve installed flush with the surface.

BETs used for the termination of outside TP cables, 300 pair or less in size, will have a built in splice chamber with 710 type splice modules. Equipment side (house) of the BET will use 25 pair Telco type connections to station equipment. BETs of this type will not be stacked more than three high.

BETs used to terminate cable sizes greater than 400 pair, will be of the #24 AWG stubbed 355 series type blocks with 3B1E type gas protectors and be mounted in a vertical buss arrangement.

#24 AWG copper cable will be installed and terminated from near BET location on 66 blocks in CER to 110 type blocks installed inside cabinet(s) in CER/TC. Cables will be sized to meet projected user requirement with 50% spares for future growth. User counts will be defined by occupants. Facilities with multiple floors will meet the same requirement on a per floor basis with the cable on the other floor(s) TC/CER feeding down to and terminating in the primary CER next to the BET.

Building Entrance Cable (Fiber Optic)

12 strand (ITN to end building)/36 strand (ITN to ITN) SM FOC (8.3/125 micron) will be designed as part of a new facility construction project. Facility use/user requirements will dictate whether more fiber optic cable is required.

All FOC will be home run from the closest primary or secondary ITN to the new facility. Fiber optic cable will not be spliced in any manholes.

All FOC entering the building will terminate in the CER in a 19” rack mounted FOC patch panel bulkhead with SC style connectors. The connectors shall have less than 0.5 decibel .5dB) loss per mated coupling. Unused optical connectors shall be connected to the back of the bulkhead and equipped with protective covers on the front of the bulkhead.

Fiber optic cable splices shall consist of a fusion splice where two fibers are thermally fused together forming a continuous fiber length. Fusion splices shall have a maximum loss of .10 dB per splice.

Any/all FOC terminations onto the base's infrastructure will be performed by the Luke BTS contractor as managed by 56 CS/SCX.
(Luke Supplement Ends)

4.1.2 Equipment Room Standard

The general requirements identified in ANSI/TIA/EIA-569A Chapter 8, Equipment Room for structural, lighting, room size, electrical, environment, battery, fire protection, earthquake, and local exchange and call termination services shall be followed and modified as necessary to include the local requirements and building construction codes. Guidance is also available in BICSI TDM Manual, 10th edition, Chapter 8, Equipment Rooms and ETL 02-12.

Physical security measures (e.g. solid walls, solid doors, locks, etc.) are required to secure ER's.

4.2 Telecommunications Room

Telecommunications Rooms (TRs) are an integral part of the distribution system elements (see Figure 2). TRs must have sufficient cross-connect hardware to terminate all distribution pairs to the floor area that the TR serves. TR's provide exclusive space to extend communications services to the workstations on respective floor. The location of the TR should ensure the horizontal cable distance to a user outlet is no more than 90 meters (295ft) per ANSI/TIA/EIA-568-B.1, paragraph 4.3 Horizontal distances. These TRs are required to supplement the ER with multiple floor or large facilities where distance limitations are a factor.

4.2.1 Telecommunications Room Standard

The general requirements identified in ANSI/TIA/EIA-569B, Chapter 7.11, Equipment Room for structural, lighting, room size, electrical, environment, battery, fire protection, earthquake, and local exchange and call termination services shall be followed and modified as necessary to include the local requirements and building construction codes. Guidance is also available in BICSI TDM manual, 10th edition, Chapter 7, Telecommunications Room Standards and ETL 02-12.

Physical security measures (e.g. solid walls, solid doors, locks, etc.) are required to secure TRs.

4.2.1.1 Multi-Story Buildings

In multi-story buildings, a minimum of one room shall be located on each floor (small facilities, i.e., air traffic control towers, firing ranges, etc., may use one room for the entire facility). Rooms on successive floors should be vertically stacked wherever possible.

4.3 Design Requirements

The following are general design requirements to consider for all TRs.

- **Grounding:** All communications shall be grounded according to ANSI/TIA/EIA-607-A, NEC/NFPA 70, and BICSI TDM Manual, 10th edition, Chapter 10, Grounding, Bonding, and Electrical Protection.
- **Location:** Rooms should be located away from sources of electromagnetic interference. Large electrical distribution panels and transformers shall not be allowed in TRs or anything else not related to telecommunications requirements.
- **Perimeter:** No false ceiling unless an in-floor distribution system is used; all surfaces treated to reduce dust; walls and ceilings painted white or light in color to improve visibility.
- **Limited Access:** Single or double 36" x 80" lockable doors.
- **Other:** No piping, ductwork, mechanical equipment or power cabling should be allowed to pass through the TRs. No unrelated storage.
- **HVAC:** 24 hours/day, 365 days/yr., 64°-75°F (18°-24°C), 30%-55% humidity, and positive pressure with a minimum air change rate of once per hour.
- **Lighting:** 8.5 feet high, providing 50 foot-candles @ 3 feet above floor.
- **Electrical:** A minimum of two dedicated 20A, 120VAC duplex outlets on separate circuits are required. Actual electrical supply requirements shall be based upon UPS electrical requirements. Convenience duplex outlets shall be placed at 6-foot intervals around the perimeter. Emergency power outlets and emergency lighting are a mandatory requirement in TRs. IAW ETL 02-12, if the telecommunications equipment must always remain operational due to mission requirements (i.e. C2 system or major base ITN etc.) then CE shall provide a permanently installed standby power generator (real property installed equipment [RPIE]) to prevent the loss of power to the equipment.
- **Dust:** Less than 100-micrograms/cubic meter/24-hour period. Consider installing tile instead of carpet and treating floors, walls, and ceiling to minimize dust.
- **Fire-stops:** Packing used to re-establish the integrity of fire-rated structures when cables have penetrated these barriers shall meet the standards specifications for UL ratings against NFPA, ASTM and NEC codes. All penetrations created by or utilized by the communications cabling upgrade shall be fire-stopped to original fire rating.
- **Fire-protection:** Per ANSI/TIA/EIA standards, the preference for protecting electronic equipment areas is the use of dry fire protection systems. But, most installations use wet-pipe automatic sprinkler systems. In the case of automatic sprinkler systems, the ANSI/TIA/EIA standards recommend the installation of sprinkler head cages to protect against accidental discharge and the installation of drainage troughs under wet pipes to prevent accidental leakage over electronics.

- **UPS sizing:** UPS shall be sized to support 125% of anticipated load (new and reused electronics) and should support a minimum run time of 60 min. All UPS units purchased or reused shall have SNMP version 2 capability installed or utilized.
- **Equipment Rack/Cabinet Clearance**
  - 3 Feet - Front Rear and Sides

5 BACKBONE CABLING

5.1 Definition

Within a building, the intra-building connectivity for extending the voice, video, and data networks between the entrance facility/equipment room, to a telecommunications room, will be considered backbone cabling. Refer to Figure 3.

The current CITS Baseline Directive has addressed cabling between TRs for Data and states the wiring between TRs within an End Building Node (EBN) or Information Transport Node (ITN) should use fiber optic cable. These links are considered backbone links and are surveyed as such in current CITS Program.

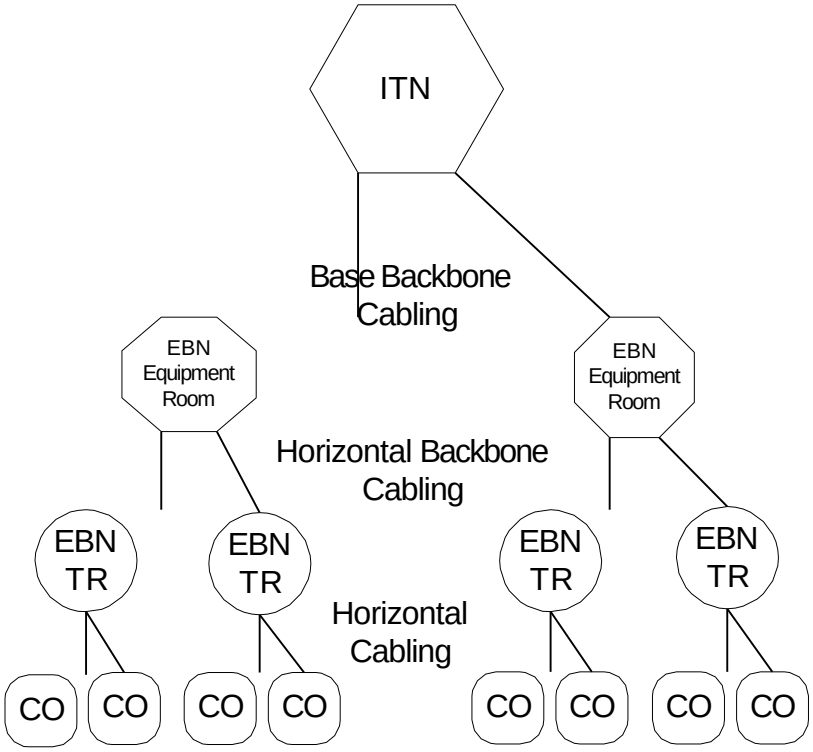

Figure 3 Physical Topology of Structured Cabling System

5.2 Standard for Data

ANSI/TIA/EIA 568-B.1 specifies the use of 50/125-micron or 62.5/125-micron, multimode graded-index fiber as options for backbone runs. Most manufacturers of both 62.5/125 or 50/125-micron optical fiber cabling meets or exceeds all the performance requirements of the existing and known forthcoming national and international cabling standards and will support the most stringent laser- and LED-based applications. This includes IEEE 802.3z Gigabit Ethernet Standard.

Therefore, it is recommended that intra-building wiring be 62.5/125 µm, or 50/125µm (laser optimized) 12 strand multimode graded-index fiber suitable for the installation. It is recommended the decision process be based upon current and planned backbone cabling in the Base Area Network. Plenum rated cable should be used only if the cable is run through the air return of a central air handling system, either ductwork or open space over a suspended ceiling. This would also include the area under a raised floor if that area was used for fresh air supply or fresh air return. Should the situation arise where a TR requires redundant links to another facility a hybrid single mode and multimode fiber optic cable may be installed. All backbone, fiber optic cable shall be terminated in fiber optic enclosures (patch panel) employing the SC type connectors. All new fiber optic patch panels shall be SC type connectors. These enclosures shall be mounted in the standard 19" equipment racks/cabinets, if possible.

All installed fibers shall have a minimum of 20 feet of maintenance loops at each termination location. Maintenance loops shall be neatly dressed and protected on solid/slotted cable trays, ladder racks or other suitable supporting system or enclosure. Fibers shall be adequately supported using cable trays or ladder racks from the maintenance loop location to the fiber optic patch panel. Fiber optic strength members shall be connected to the fiber optic patch panel to protect the fiber.

5.3 Standard for Voice

Voice backbone cabling will consist of house cabling between ER's and TR's. It shall be a multi-pair cable with cable jacketing suitable for the installation. The number of pairs for voice cross connect cables should equal 50%, rounded to the next pair count, of the total of the outside plant feeder cable.

5.4 Backbone Pathways

Backbone pathways consist of intra-building pathways. The term backbone is used for riser, house and building-tie terminology. Backbone pathways may be either vertical or horizontal. Intra-building backbone pathways are contained within a building. Suitable ducts, raceways, cable trays, etc. shall be used.

6 HORIZONTAL CABLING

6.1 Horizontal Cabling

ANSI/TIA/EIA 568-B.1-5 defines horizontal cabling as “The portion of the telecommunications cabling system that extends from the work area telecommunications outlet/connector to the horizontal cross-connect in the telecommunications room. The horizontal cabling includes the horizontal cables, the telecommunications outlet/connector in the work area, the mechanical termination, and patch cords or jumpers located in the telecommunications room”.

The horizontal cabling system extends from the work area telecommunications outlet to the TR/ER and consists of the following:

- Horizontal Cabling
- Telecommunications Outlet
- Cable Terminations
- Cross-connections
- Patch Cords

Cable length shall be no more than 100 meters (328 feet) at 250 MHz. This includes the total length of the first patch cord from the switch to the first patch panel or punch down block, the distance to the wall jack, and the patch cord to the host computer. The maximum horizontal run length is 90 meters (295 feet), (five meters (16.405 feet) at each end) for work area and ER/TR patch and jumper cables.

A maximum of two connections per 100 meters (328 feet) is permitted. This means one punch down block in the wiring closet and one wall jack in the office (or cubicle). The term, "home run cabling," describes cabling that extends from the host connection to the wiring closet rack mounted patch panel, with no intermediate connections.

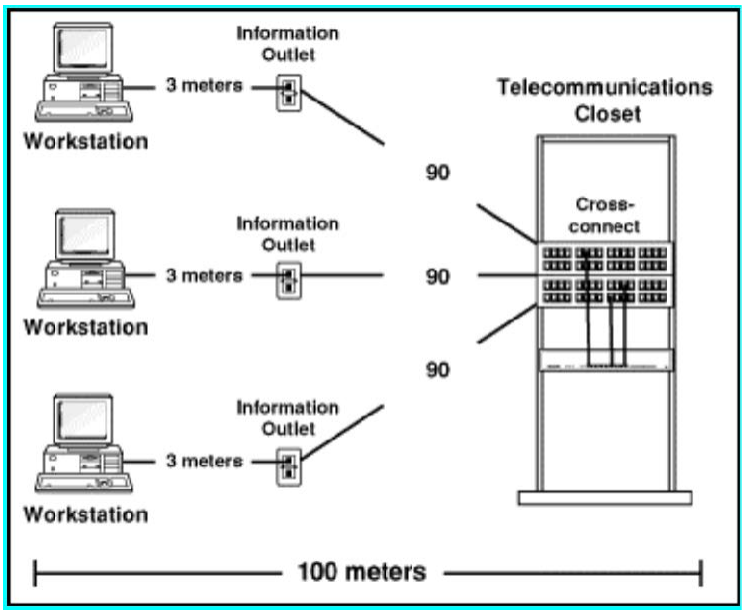

Figure 4 Maximum Distances for Horizontal Cabling

Voice and data telecommunications cabling should not be run adjacent and parallel to power cabling - even along short distances. For low voltage communication cables, a minimum 6-inch (0.12700 meters) distance is required from any fluorescent lighting fixture or power line over 2 KVA; and up to 24 inches (0.60960 meters) from any power line over 5 KVA. In general, telecommunications cabling is routed separately, or several feet away from power cabling. Similarly, telecommunications cabling is routed away from large motors, generators, induction heaters, arc welders, x-ray equipment, and radio frequency, microwave or radar sources.

All horizontal communications cabling shall be terminated on rack mounted Cat 6 modular termination patch panels (24 or 48 port) mounted in a standard 19” (0.48260 meters) lockable equipment cabinet.

All distribution, fiber optic cable shall be terminated in fiber optic enclosures (patch panel) employing the base standard type connectors. All new fiber optic patch panels shall be per the base standard as defined by the local CS. These enclosures shall be mounted in lockable cabinets with standard 19” equipment racking. All enclosures must be either lockable or in a Communications Squadron controlled space.

Verify that all components comply with Cat 6 or higher ratings. This includes connectors, punch down blocks, wall outlets and patch cords.

The telecommunications outlets and patch panels shall be clearly marked following the ANSI/TIA/EIA-606-A standard and the Network Implementation Plan - Cable Plan for both fiber and copper cabling.

ANSI/TIA/EIA 568-B.1 specifies the use of either 50/125-micron or 62.5/125-micron, multimode graded-index fiber for horizontal runs, although unique user requirements may dictate the use of other types of fibers in special circumstances.

6.1.1 Abandoned Telecommunications Cables

Funding to remove all abandoned telecommunications cables, voice and data shall be included in all technical solutions approved by the CS for new cable installations. Reference NEC sections 800.2, 800.52 (B), 800.53 (A), and 800.53 (B) (1). Abandoned cable shall be defined as cable which is no longer terminated at either end or cable that will not be reused in the future due to age, condition, or any other limitation.

6.2 Recommended Media

The current standard for horizontal wiring is plenum rated Category 6 UTP, defined by ANSI/TIA/EIA 568-B.2-1 Addendum 1. It is capable of operating at 250 MHZ and supports the IEEE 802.3ab Gigabit Ethernet standard.

Category 7 is available from vendors with claims it will comply with standards when published. As no standards for this category of cable have been published, a baseline to verify vendor claims is unavailable. Therefore, it is recommended that it not be used unless the specifications exceed the current Cat 6 specifications and the manufacturer can provide adequate documentation and verification.

6.3 Fiber to the Desktop

The cost of installation and materials for a fiber to the desktop solution is not that significant of an increase over a copper to the desktop solution. However, the port densities and electronics cost differential still make it cost prohibitive to recommend a fiber to the desktop solution. Fiber to the desktop can also be problematic in environments where office space is frequently reconfigured leading to increased maintenance cost. However, situations will occur when horizontal distribution systems may be better served by utilizing fiber optic cabling, therefore, any major building distribution project should consider both alternatives and the costs. Additionally, exceptions identified by users concerning high volume traffic or security concerns can be expected. In these circumstances, it is recommended that 62.5 or 50μm cores with dual wavelength capability, 850 and 1300 nm, be installed.

An alternate consideration is to replace one run of the Cat 6 with a multi-mode fiber pair per communication outlet. The fiber pair would remain dark until needed. This would allow for a fiber infrastructure to be in place and would save on re-cabling in the near future for high bandwidth requirements. Copper electronics would be used until fiber electronics are needed. Because the cost differential is associated with fiber electronics,

you would not see a significant cost increase in installing a fiber pair for later use. As fiber electronics come down in cost and new standards are implemented for fiber, a fiber to the desktop solution will be an easy migration because you have the fiber in place. SIPRNet drops are a special case where fiber to the desktop may be warranted. Using fiber to feed multiple LAN drops from one central TACLANE can eliminate any TEMPEST concerns.

6.4 Communication Outlets (CO)

The CO is a connecting device in the work area on which the horizontal wiring terminates. It includes the workstation outlet (outlet connector), outlet faceplate and outlet box. It provides the transport interface to information appliances.

COs shall use four-position (Quad) wall plates with labeling positions at the top and bottom of the wall plate.

6.4.1 Communication Outlet Port Density

The desired implementation is to provide sufficient user outlet density so the additions of new equipment and personnel relocations result in minimum disruption. The port density requirement is four ports at each outlet assembly

This quad outlet provides connectivity for data, video, and voice ports as required. One data port could be used for a SIPRNET connection with a Type 1 in-line IP encryption device.

6.4.2 Work Area CO Saturation

All administrative facilities and administrative spaces and other types of facilities shall be equipped with one standard CO for each 15 linear feet (4.6 meters) of wall space in office areas. Should an office area not have wall space (ie large open office area with cubicles) then the standard will be one quad outlet a quad equivalent per 96 sq ft). Outlet densities and locations for all special purpose spaces and non-administrative facilities shall be determined by the user and shall follow the guidelines in TIA/EIA-568-B.1, B.2, B.3, 569A and this document. The possibility of future reconfiguration of the office layout should be taken into consideration when designing jack placement.

The CO density presented below is for broad-gauge cost estimates. When specific information is required a detailed engineering solution must be accomplished by a designer who has proven design experience with communications cabling and all applicable standards.

CO – Communication Outlet
NFA – Net Floor Area
GFA – Gross Floor Area

GFA Formula:
GFA = Total square footage of area including hallways, restrooms, conference rooms, fixed walls, equipment rooms, office area, administrative area, etc.
NFA = Total square footage of area less permanent hallways, restrooms, fixed walls, stairwells, closets, elevator shafts, equipment rooms, and other areas unsuitable for occupancy
.8 x GFA = NFA
(NFA/100) = Number of COs

Example using gross square footage:
.8 x GFA = NFA
.8 x 10,000 = 8000
8000/100 = 80 CO

For planning purposes, when actual outlet locations are not known and cannot be determined with available information, reasonably accurate total outlet count estimations can be obtained based on the size and dedicated usage of the space. The following table identifies typical facility spaces and the minimum number of outlets for those spaces.

Facility Space Category	Gross Area per Quad
Laboratory/Technical	100 sq/ft (4.6 sq/m)
Medical/Clinic	100 sq/ft (4.6 sq/m)
Warehouse/Maintenance Hangars	2000 sq/ft (464.5 sq/m)
Clerical	100 sq/ft (4.6 sq/m)
Classroom/Instructional	80 sq/ft (7.4 sq/m)
General Use/Other	500 sq/ft (46.6 sq/m)

Table 1 Typical Spaces and Quad Outlets

(Luke Supplement Begins)
Communication outlet spacing in office areas shall be based upon one quad outlet for each 10 linear feet of useable perimeter wall space, or one for each 100 square foot of floor space, whichever provides a higher outlet density. All other locations will be provided with outlet density as determined by the 56 CS/SCX.

(Luke Supplement Ends)

6.4.2.1 Outlet Density for Other Services

Density and placement of outlet locations for other services such as CATV, CCTV, VTC, or wall-mounted phones will be determined by user requirements.

6.4.3 Outlet Box

For standard CO use a recess mounted 4-11/16" by 4-11/16" double gang electrical box with the faceplate flush with the wall surface. Double gang electrical boxes should be full depth to provide dedicated space for current and possible future fiber optic cable installation. Single gang mud/reducing rings shall be installed in the double gang electrical box, by the contractor, for use in the installation of the single gang quad outlets specified in this document. For single connector outlets, such as voice, data, CATV or CCTV, use a full depth, double gang, electrical box mounted flush with the wall surface with single gang mud/reducing rings to allow for sufficient cable slack/ maintenance loop required for the cabling installation.

6.4.4 Outlet Faceplate

For standard administrative outlets use a full (double gang) face plate with connector locations for all copper and (if used) fiber optic cable. For double gang outlet boxes equipped with single gang mud rings, use a single gang outlet faceplate with appropriate connector locations and, if required, 630-type wall plate for wall phones.

6.4.5 Maintenance Loops

When cable runs are being installed, additional slack shall be provided at both ends to accommodate future cabling system changes. Although the exact amount of slack required depends on the size and layout of the connecting hardware of the TR and the work area, the recommended amount of slack per standard: Reference; BICSI Telecommunication Distribution Methods Manual 10th Edition, Chapter 5 pages 5-113.

- UTP:
  - At the TC or CER: 3 m (10 ft)
  - At the user outlet: 1 ft
- Fiber:
  - At the TC or CER: 3 m (10 ft)
  - At the user outlet: 1m (3.3 ft)

Include the slack in all length calculations to ensure that the horizontal cable does not exceed 90 m (295 ft), copper only.

Only strip back as much cable jacket as required to terminate connecting hardware in order to maintain cable geometry.

Reference: TIA/EIA-570-B; Chapter 6, Installation Requirements.

6.4.6 Outlet Connectors

The following specifications pertain to copper and fiber optic connectors.

6.4.6.1 Copper Connectors

Copper connectors should be ANSI/TIA/EIA enhanced category 6 (Cat 6), 8-pin/8-position insulation displacement terminations wired per T568B to maintain system configuration uniformity. Copper connectors and plugs should be un-keyed unless the user requires keyed connectors and plugs for security, or other user specified reasons.

6.4.6.2 Fiber Optic Connectors

Fiber optic connectors shall be per the base standard as defined by the local CS, either ANSI/TIA/EIA SC, ST, or subminiature type connectors

6.4.7 Voice Outlets

A minimum of one outlet of the quad Cat 6 drop is designated for voice circuits. Voice outlets shall be terminated to Cat 6 patch panels and collocated with their respective data ports and labeled in accordance with Appendix C. A RJ-45 to 110-type patch cable shall be used to connect the voice ports on the voice/data patch panels to a 110 cross connect block. This is the recommended standard for voice connections to existing telephone switches in the Dial Central Office, DCO. This configuration allows for the option to change voice and data circuit at the CO by simply changing patch cords in the ER/TR and provides an option for Voice over IP (VoIP) at a future date. Refer to, Figure 5 Voice and Data Terminate to Patch Panels.

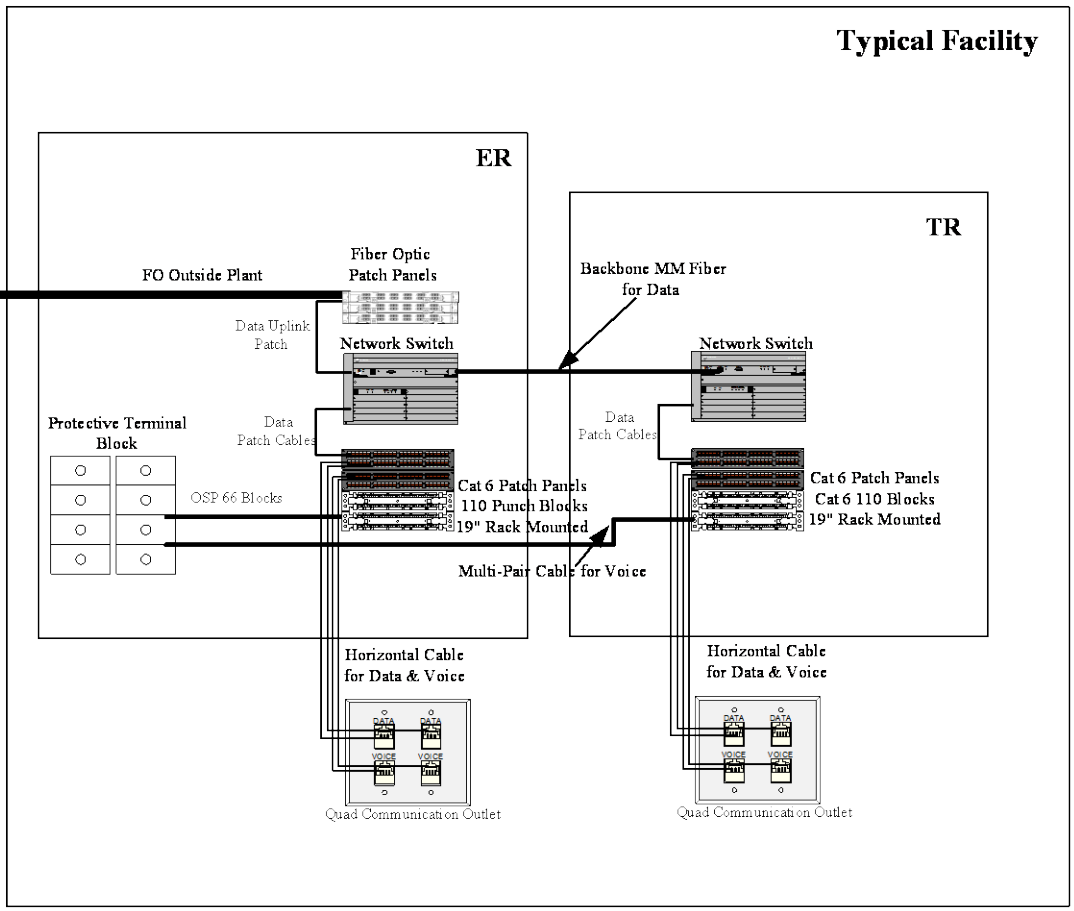

Figure 5 Voice and Data Terminate to Patch Panels

6.5 Cable Types and Specifications

6.5.1 Twisted Pair

The prevailing commercial wiring standard ANSI/TIA/EIA 568-B defines performance specifications for category 6 cable. Cat 6, 4-pair 24 American Wire Gauge (AWG), 100-ohm, solid, UTP cables should be installed to each standard connector outlet. Plenum cables should be specified when required. Plenum rated cables should only be used if the cables run through a plenum. A plenum is an air return path of a central air handling system, either ductwork or open space over a suspended ceiling. This would also include the area under a raised floor it that area was used for fresh air supply or fresh air return. If unsure if an area is a plenum or not, have the Bio-environmental or base Fire Marshall make a determination.

6.5.1.1 Twisted Pair Performance

Refer to ANSI/TIA/EIA-568B-2, Addendum 6 for Cat 6 performance specifications.

6.5.2 Optical Fiber

There are two general classes of optical fiber: multi-mode and single mode. The primary differentiating characteristic is the diameter of the inner core of the fiber strand. Single mode fiber has a core diameter on the order of eight microns and physically constrains the coupled light to a single mode (i.e. the light propagating through the fiber essentially "all" follows a single path "straight" along the axis of the core). Multi-mode fiber has a much larger core diameter.

It is important that the same core diameter be used throughout a multi-mode fiber implementation. For this reason a recommended multi-mode fiber is not defined, either 50/125µm or 62.5/125µm, with dual wavelength capabilities, 850 and 1300 nm, may be used to the CO to provide overall base system uniformity. Using 1300-nm lasers in electronic equipment will allow Gigabit Ethernet to be transmitted up to 550 meters using 62.5/125µm fiber, and although more expensive the overall uniformity of the complete system, outside plant to the desktop, may justify the increased cost.

Other media such as single mode fiber can be considered when advantageous to support specified mission needs.

6.5.2.1 Multimode Optical Fiber Performance

Two primary factors must be considered in fiber selection and system design: maximum system length and maximum channel attenuation. The first factor of maximum supported system length is based on bandwidth, transmitter and receiver specifications, propagation delay, jitter and numerous other factors. The second factor is maximum channel attenuation. The maximum channel attenuation is established by the minimum transmitter output, maximum receiver sensitivity and any power penalties established. The number of connections and splices, the cable length, the wavelength of operation and loss values of components also affects channel attenuation. Attenuation readings with an LED source will be higher than that of a laser such as those used with Gigabit Ethernet, ATM, and Sonnet.

Bandwidth, or information-carrying capacity, is specified as a bandwidth-distance relationship with units of MHz-km. The bandwidth needed to support an application depends on the data rate of transmission. As the data rate goes up (MHz), the distance that rate can be transmitted (km) goes down. So, a higher fiber bandwidth can enable you to transmit at higher data rates or for longer distances. This means a multimode cable rated at 500 MHz-km will propagate a 500 MHz signal one kilometer, a 1 GHz signal one/half kilometer, etc., before becoming indistinguishable.

For 850-nm Gigabit Ethernet, which uses VCSELs, the standard FDDI 62.5-micron fiber support link lengths of at least 220 meters and 550 meters over 50-micron fiber, refer to

Table 2 **Multimode Fiber Specification**.

Fiber Type	62.5/125µm		50/125µm Fiber		
Wavelength	**850 nm**	**1300 nm**	**850 nm**	**850 nm**	**1300 nm**
Attenuation	3.5 dB/km	1.5 dB/km	3.5 dB/km	3.5 dB/km	1.5 dB/km
Modal Bandwidth (MHz/km)	160 MHz·km	500 MHz·km	400 MHz·km	500 MHz·km	500 MHz·km
Distance Gigabit Ethernet	220 m (SX)	550 m (LX)	500M (SX) 550M (LX)	550 m (SX)	550 m (LX)

Table 2 Multimode Fiber Specification

ANSI/TIA/EIA-568B.3, Optical Fiber Cabling Components Standard

NOTE - When mixing 62.5/125 and 50/125µm cable plant, an average power db loss is expected to be 3.5 to 4.7 dB.

6.5.3 Patch Cords

Patch cords are a critical part of any installation. Cat 6 supports Gigabit Ethernet however, simply specifying a quality cable and installation is not sufficient. Quality patch cords are required as well.

Patch cords and Cross-Connect Jumpers are as critical to transmission performance as the permanent horizontal cable. These cables must be rated at the same or higher performance category as the cabling to which it connects and must meet the requirements described in ANSI/TIA/EIA-568-B.1.

6.5.4 Horizontal Pathways

Horizontal pathways extend between TRs and the CO. These pathways can be cable ladder (solid bottom), J-Hook, or conduit systems. The horizontal distribution system must be designed to handle all types of communications cabling (i.e., UTP, STP, and Fiber Optic). When determining the type, size and routing of the cable pathway, the quantity, size and type of the cables that the pathway is intended to house must be considered. Bend radii allowable for copper is not allowable for fiber therefore, pathway design must take into consideration all types of media. It is recommended multi-channel ducts and conduits be installed to allow for future expansion, cable upgrades or where required to support multi-classification environments.

Use one-inch (0.0254 meters) electrical metallic tubing (EMT) for the pathway run from the outlet box to the overhead/under floor communications duct/ladder system or directly to the TR/ER.

- Pathways shall be designed and installed to meet applicable local and national building and electrical codes or regulations.
- Grounding / Earthing and bonding of pathways shall comply with applicable codes and regulations.
- Pathways shall not have exposed sharp edges that may come into contact with telecommunications cables.
- The number of cables placed in a pathway shall not exceed manufacture specifications, nor, will the geometric shape of a cable be affected.
- Pathways shall not be located in elevator shafts.
- Horizontal pathways shall be installed or selected such that the minimum bend radius of horizontal cables is kept within manufacturer specifications both during and after installation.
- In open ceiling cabling, cable supports shall be provided by means that is structurally independent of the suspended ceiling, its framework, or supports.
- These supports shall be spaced no more than 1.5m (5 ft) apart.
- All horizontal pathways shall be designed, installed and grounded to meet applicable local and national building and electrical codes.
- The number of horizontal cables placed in a cable support or pathway shall be limited to a number of cables that will not cause a change in the geometric shape of the cables.
- Maximum pathway capacity shall not exceed a 40% fill ratio.
- Horizontal distribution cables shall not be exposed in the work area or other locations with public access.
- Cables routed in a suspended ceiling shall not be draped across the ceiling tiles.
- Cable supports shall be mounted a minimum of 6 - 12 inches above the ceiling tile grid.

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In all installations the sizing requirement to support cable is:

Cable Count	**Support type**
Less than 5	Any*
5 or more, but less than 20	Rings or hooks*
20 or more, but less than 60	Sleeves*
60 or more	Cable trays

(Luke Supplement Ends)

6.5.4.1 Ceiling Distribution System

Ceiling distribution systems can only be installed in false ceilings. Cables may be supported by cable ladders, rings or hooks suspended from the ceiling or wall structure.

Ceiling support wires or rods shall not be used to support cables. If ceiling air space is being used as the air return path for HVAC systems, plenum cable must be used as defined in NEC and applicable TIA/EIA standards.

6.5.4.1.1 Cable Ladder

Cable ladders should be supported by brackets or rods every 129cm (5ft). Cable ladder runs shall be designed using perpendicular paths; 90-degree turns shall be accomplished using two 45-degree bends. A minimum of 31cm (12in) clearance is required above and each side of the cable ladder over its entire route. Cable ladders shall be supported by two down rods outside the cable ladder. Coordination with electrical and HVAC engineers is required to avoid conflicts over space allocation. Only solid bottom cable ladders shall be used to prevent excessive weight from damaging or crimping lower layers of cable. To avoid interference with the removal of ceiling tiles a separation of 152mm to 305mm (6in to 12in) must be retained between the cable ladder and the ceiling support.

6.5.4.1.2 Rings and Hooks

Ring and hook cable support devices must be located on 1.3m to 1.7m (4ft to 6ft) centers. Cable sag should be minimized to reduce stress on cabling. To avoid interference with the removal of ceiling tiles a separation of 152mm to 305mm (6in to 12in) must be retained between the sag and the ceiling support.

6.5.4.2 Underfloor Distribution Systems

Under floor duct systems should be metallic, solid bottom, be accurately aligned and leveled. Junction boxes and duct lines shall be located to clear permanent and future nonpermanent partitions and foundations for equipment. Duct system installation shall comply with the requirements of NFPA 70.

Metal duct supports shall be located as close as practicable to duct joints, elbows, bends, terminations; and within 30 inches on each side of junction boxes and elsewhere at intervals of not over 5 feet.

7 INSTALLATION STANDARDS

Cabling installations aimed at gigabit speeds require adherence to standards. Of course, that in itself is a change, given the corner-cutting nature of many cabling projects. High-performance networks provide less of a margin for error and require greater installation care than in the past. To support high-speed networks in the gigabit and beyond range simply purchasing a quality cable, then installing the cable self-help, with an uncertified electrician, or Cat 2 level installer must end. Pulling tensions, bend diameters, fill ratios, separation from power circuits, grounding, termination techniques, and many other skills must be studied, practiced, and mastered. A quality installation team with certification from BICSI, certified training from a reputable manufacturer, or reputable organization with a proven past performance must be specified. The installers must then be required to follow the installation and testing standards specified within this document, in the referenced standards and as specified by the chosen vendor's products.

Components of the cable infrastructure shall be installed in a neat, orderly manner consistent with the best telephone and data installation practices.

7.1 Color Codes

Wiring color codes shall be strictly observed and termination shall be uniform throughout. Identification marking and systems shall be uniform, permanent and readable and in accordance with ANSI/TIA/EIA-606 standards and this document.

7.1.1 Mixed Classification Environments

Red, green, orange, blue and yellow cables are often used to identify different classifications in mixed classification environments. In these environments the color code scheme from ANSI/TIA/EIA-606 should not be used.
The following cable color code scheme is recommended for mixed classification environments. It follows the standard ADP Media Classification Label colors.

- **SF-706 Top Secret Label (Orange)**
  The SF-706 is used to identify and protect automated data processing media and other media that contain Top Secret information.
- **SF-707 Secret Label (Red)**
  The SF-707 is used to identify and protect automated data processing media and other media that contain Secret information.
- **SF-708 Confidential Label (Blue)**
  The SF-708 is used to identify and protect automated data processing media and other media that contain Confidential information.
- **SF-710 Unclassified Label (Green)**
  In a mixed environment in which classified and unclassified information are being processed or stored, SF 710 is used to identify automated data processing media and other media that contain unclassified information.
- **SF-712 SCI Label (Yellow)**
  The SF-712 is used to identify and protect automated data processing media and other media that contain SCI information.

7.2 Infrastructure Installation

Infrastructure installation shall be managed by an experienced project management staff and performed by engineers, functional area specialists, skilled technicians, and support staff. In house, “blue suit”, maintenance personnel must be trained on current installation standards and be required to follow them. All maintenance activities should obtain and maintain a current copy of the applicable TIA/EIA standards, the BICSI TDM manual, and the National Electric Code, NFPA 70.

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56 CS personnel will have a minimum of five working days to complete the cross connects, install equipment and verify the system prior to occupancy by the tenant. The tenant is required to submit the requirement 60 days in advance of projected move-in date to allow for

work load scheduling.

To clearly identify cables and their usage, each cable will be marked with an adhesive type strip marker at both ends, which will clearly identify the cable. Each outlet cover plate will also carry the outlet designation, as shall the termination jack on the patch panel or termination block. A permanent type label affixed to the cable or outlet jack cover to preclude damage due to age or other mechanical means will identify all cable and terminations. Hand written or manual embossing labels is NOT permitted. Automated embossed labels are preferred, such as Brothers P-touch systems utilizing ¼" labels, with 1/8" lettering.

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7.2.1 Install Backbone (Riser) Subsystem

The purpose of this section is to outline the specific requirements for the Backbone (Riser) subsystem. All fiber cable terminations shall be installed internally within a building. Each fiber cable run shall be installed in plenum rated inner-duct for protection. All terminations shall be labeled. All fiber optic cable installation shall conform to applicable TIA/EIA Standards.

- Installation Procedures

The Backbone (Riser) cable plant shall consist of 62.5/125 µm, 50/125µm, or 8.3/125 µm 12 strand multimode graded-index or single mode fiber optic cables and a hybrid cable where applicable for Base Comm requirements. Non-base comm requirements shall comply with system owners specifications. The specified fiber optic cables shall interconnect each ER with the TR except as otherwise noted in the final design. All fiber optic cables to be run in riser rated inner-duct along the cable trays, ladder racks or secured to the ceiling. All fiber optic cable, along with the associated inner-duct, shall terminate in lockable cabinets or wall mounted fixtures within the rooms on fiber patch panels. The fiber optic cables installed, as part of the backbone subsystem shall not exceed the maximum bend radius and tensile loads.

7.2.2 Install Horizontal (Drops) Subsystem

The contractor or engineering team (whichever is applicable) shall install cable drops using certified Cat 6 UTP cable, with a maximum running length of 295 feet (89.916 meters) including maintenance loops at the communications room termination points and the user outlet termination points. Where construction permits, drops shall be flush mounted in the walls with cable routed inside the wall. In facilities where construction prevents flush mounting of user drops, drops shall be surface mounted. Surface mount installations shall incorporate the use of surface raceway between room entry points and drop outlet.

7.2.2.1 Installation Procedures

This section outlines the installation guidelines, procedures, and requirements for all components of the horizontal (drops) subsystem.

7.2.2.1.1 ER/TR Terminations

The installation team, contractor or Air Force organic team, shall install all ER/TR termination hardware. This shall include the supply and installation of all ER/TR termination fixtures including but not limited to:

- Lockable cabinets with 19 inch racking
- Wall mounted 19 inch (0.48260 meters) swing out mounting enclosures
- 110-type IDC/RJ45 Modular Patch Panels
- Fiber Optic Patch Panels
- Wire Management Panels
- Wire Management Rings
- Velcro Cable Management Ties
- D Rings

All new fiber optic patch panels shall be per the base standard as defined by the local CS. These enclosures shall be mounted in standard cabinets with 19” racking. All enclosures must be lockable and in a Communications Squadron controlled space.

UTP horizontal cable in a given zone shall terminate in the TR serving that zone. UTP horizontal cable shall leave the distribution hooks and enter the ER’s via existing or newly installed ladder racking.

UTP horizontal cable shall terminate in fields in the TRs. The contractor or engineering team (whichever is applicable) shall create a field for A, B, C and D jacks. All voice and data horizontal UTP cable shall terminate on the specified modular patch panels. The lowest number “A” field shall start on the panels located at the top of the left (facing the front of the rack) hand rack or wall mounted fixture with other fields installed to the right of the “A” field. Installation shall follow a flow of lowest number “A” field followed by the lowest number “B” field etc., see (Figure 13 Example Patch Panel Numbering Scheme).

All cables shall be neatly dressed and secured to cable trays, ladder racks or equipment racks/cabinets with cable ties or other appropriate fastening device without changing the geometric shape of the installed cable.

All UTP cables shall be tied together or tied in bundles as it leaves the ladder racks, traverses to either side (or both sides) of the racks and terminate behind the panels.

7.2.2.1.2 Untwisted Pairs

All Category 6 UTP terminations on IDC-type CO's and connecting hardware specified in the Horizontal Subsystem shall be made in such a way as to minimize the extent to which each twisted pair is unraveled at the point of its physical termination. Specifically, no more than 0.5in. (0.01270 meters) of exposed untwisted or unjacketed pairs should be present at these locations.

7.2.2.1.3 Equipment Cabinets

Lockable floor mounted equipment cabinets shall be bolted securely to the floor of the TR using four (4) fasteners appropriate for use in concrete. Side panels between cabinets shall be removed when cabinets are placed side by side.

All cabinets/racks shall be properly grounded and bonded to the Telecommunications Main Grounding Bus bar per TIA/EIA 607 Commercial Building Grounding and Bonding Requirements for Telecommunications, Section 5.4, Telecommunication Main Grounding Busbar (TMGB).

In addition, the top of all cabinets/racks shall be secured by means of a bracket or other attachment to the nearest wall to prevent movement. Adequate cabinets shall be installed to support cabling, network, telephone, and UPS requirements plus a minimum of one spare cabinet for expansion. Cabinet(s) shall have power strip.

7.2.2.1.4 Wall Mounted Enclosures

Wall mounted swing out enclosures shall be mounted as indicated on the final design.

7.2.2.1.5 Wire Management Panels

Each cabinet/rack that will terminate horizontal cables shall be equipped with wire management panels, on the top and bottom of each patch panel, as necessary to present organized and clear accesses. All patch cable shall use Velcro type ties for cable management purposes.

7.2.2.1.6 Category 6 Modular Patch Panels

Category 6 modular patch panels shall be installed in the equipment cabinets/racks, as indicated in the final design. Each panel shall be securely attached to the cabinet racking using a minimum of four (4) screws.

7.2.2.1.7 Category 6 Patch Cord (Patch Panels)

Each patch cord used shall be tested and certified per CAT-6 UTP specifications using an RJ-45 to RJ-45 patch cord. Voice applications may use a patch cord tested and certified per Cat 6 UTP specifications, but still be configured as one or two-pair 110-type to 110-

type connection or as one or two pair 110-type to RJ45 connection. If the voice application requires a fully certified Cat 6 installation, use the RJ-45 to RJ-45 patch cord.

7.2.2.1.8 D-Rings

Where D-rings are required, rings of between 4 and 6 inches (0.10160 and 0.15240 meters) in height and a minimum of three inches (0.07620 meters) in depth shall be used. All rings shall be constructed of a non-ferrous metal.

7.2.2.1.9 Cable Support

The contractor or installation team shall install all cable support system hardware. This shall include the installation of all cable support fixtures including but not limited to:

- Hangers or hooks spaced 36 to 60 inches (0.914 to 1.52 meters) apart, not to exceed 60 inches, or as appropriate, for proper cable support.
- All cables and inner-duct shall be properly supported within the ceiling spaces. At no time shall cables or inner-duct use drop ceiling grids or tiles for support.

7.2.2.1.10 Cable Bends and Pulling Tensions

Reference EIA/TIA 568-B.1 Addendum 1 and Chapter 10 section 10.2.2 for pulling tensions and bend radii for copper and fiber optic cable. Additional reference is BICSI Chapter 4 Section - Cabling Management-Horizontal and Backbone Cable Management. Beyond the above recommended practices always follow vendor specific guidance on bend radii and pulling tensions or a maximum tension of 110N (25 ibf) shall be used for 4 pair 24 AWG UTP cable. The minimum size pathway must not force the cable bend radius to be less than 25 mm (1 in) under conditions of maximum cable fill.

7.2.2.1.11 Separation from Sources of Electromagnetic Interference (EMI)

Co-installation of telecommunications cable and power cable is governed by applicable electrical code for safety. For minimum separation requirements of telecommunications cable from typical branch circuits (120/240V, 20A), reference article 800-52 of ANSI/NFPA 70 (Ref D.3), and EIA/TIA 569 Chapter 10.

7.2.2.1.12 Routing

Whenever possible, cabling shall be installed over corridor areas or along lines that are parallel to the contours of buildings. Fiber optic backbone (riser) cables shall be routed to the appropriate the TR via diverse routes if required for mission support.

7.2.2.1.13 Grounding and Bonding

All applicable regulations for grounding and bonding as defined by National Electric Code, local building codes for electrical materials, TIA/EIA-607, and construction methods shall be strictly adhered to. The local Civil Engineer group shall provide a ground system that is connected to the facility electrical entrance ground point to each TR as well as in the TRs for the grounding of equipment cabinets/racks. The installed ground system shall then be terminated by the installation team on project supplied grounding bus bars.

7.2.2.1.14 Cores and Sleeves

The Contractor or Organic Installation Team (whichever is applicable) shall install all specified cores and sleeves. All cores/sleeves shall be of 4.5-inch (0.1143 meters) outside diameter. Sleeves shall protrude a minimum of one-inch (0.0254 meters) and a maximum of three-inches (0.762 meters) above the finished floor, wall or ceiling. Cores must be installed a minimum of 1 inch (0.0254 meters) and a maximum of 6 inches (0.1524 meters) away from the wall. If possible, cores should be positioned to avoid blocking access to backboard space. All core/sleeves shall be fire stopped in accordance with the next section.

7.2.2.1.15 Fire Stopping

All conduits, inner-duct, sleeves, and penetrations shall be fire stopped in accordance with ANSI/TIA/EIA-569-A Annex A and all applicable local codes.

7.2.2.1.16 Horizontal Outlets

The Contractor or Organic Installation Team (whichever is applicable) shall install all workstation-end termination hardware. Although there are variations in cable counts that must be supplied to each faceplate as well as variations in the specified mounting height of face plates, all workstation-end horizontal wiring shall terminate on one of the following devices:

- Flush mounted information outlet
- Surface-mounted information outlet

The specific configuration of each faceplate shall be indicated by a symbol on the plan. Information outlets vary in configuration because of the specific mounting height and cable count requirements. The standard outlet configuration for most projects is mounted at 18 inches (0.4572 meters) above the finished floor (AFF) and contains four Cat 6, RJ- 45 Modular jacks that serve as the termination points for installed Cat 6, 4-pair horizontal cables. The standard outlet noted above may be surface or flush mounted depending upon field conditions.

The standard mounting height is 18 inches (0.4572 meters) AFF as noted above, however, there are three distinct mounting heights associated with information outlets. Alternate faceplate mounting heights are 36 (0.9144 meters) and 48 inches (1.21920 meters) AFF.

All surface-mounted information outlets and surface raceway shall be fastened to the wall surface with an appropriate mechanical fastener.

Flush-mounted information outlets shall be attached to the wall surface with a mounting collar or ring that firmly anchors the faceplate to the wall.

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7.3 Telecommunications Distribution System

- All primary backbone conduits shall be installed in locations as determined by the wing CSO, and shall provide adequate size and quantity to meet current requirements, plus 100% growth for future use where duct exists. Where existing

duct is not installed, the duct run shall consist of four - 4 inch schedule 40 PVC. Schedule 80 will be used under roadway, railroad, runway and other heavy traffic areas.

- Whenever new construction or renovation takes place, the design, installation and all related costs necessary to extend the conduit and manhole system to the new location shall be included in the project in accordance with ETL 02-12. Multiple service entrance locations will be required for all facilities housing command and control systems to provide redundant, survivable service.

- Manholes will have a minimum of two 4 inch: conduit/duct bank lateral system with tracer and pull rope will be used for required cables plus 100 percent spare ducts (not less than 1 spare) for expansion and maintenance in all primary duct banks.

- Manholes shall be installed for all connections to the existing cable plant as required to maintain a maximum manhole spacing of 475 feet. Additional manholes may be required to provide adequate control of connection and distribution of the cable plant. See attached detail sheet (Figure 4) for specific manhole construction criteria.

- All manholes shall be designed and constructed to meet the requirements of T.O. 31-W-3-10-22, and provide a minimum clear floor space of 8 feet by 12 feet. All manholes shall provide a clear height of not less than 7’. Conduits shall enter the MHs 4 to 5 feet from floor. Mandatory items include grounding bus bar and rod and related conductors and wiring, a ladder or steps, cable rack supports, a 50 cubic foot sump (French drain), pull in irons/anchors, frame and a manhole cover cast with the word “COMMUNICATIONS” exposed to the surface. All manhole covers will be round and provided with a locking bar or other locking device to allow use of a padlock or other restriction to unauthorized entry.

- IAW T.O. 31-W-3-10-12, power and communications cables will be separated by 12” of well tamped, fine earth protection. The cable at the top of the crossing, whether power or communications cable, will receive the same additional protection (see item 8 below). Gas and water mains will be separated and protected by 3” of concrete or 12” of fine earth. In addition, if the cable crosses over the main, extend additional cable protection 3’ from each side of the crossing. Where highway, railroad and runway crossings occur, cable at such crossings must be placed in underground metallic conduit. PVC conduit may be direct buried if 36” of cover is provided. If steel pipe conduit is used, boring procedures will be followed that ensures protection of existing resources. Where PVC conduits are installed, a metallic #10 AWG copper tracer wire will be installed within the conduit or 6” above the duct bank to assist in future location efforts, with bonding to occur inside each manhole and at CER grounding frame.

- Stub up a minimum of 2 each, 4” lateral conduits 6” above finished floor level in the corner of the CER, adjacent to the telephone punch down board, continuous from the nearest manhole. Provide 50 percent of lateral (entrance) conduits with three 3-inch 3-cell fabric mesh inner ducts from CER to the interconnect manhole location within the existing backbone conduit system for fiber optic cable connection and for future requirements.

- Provide 36” minimum cover for all conduit duct banks and 36” minimum cover for laterals measured to top of conduit. Termination of cable connections in the manhole will require the use of the 56 CS BTS O&M contractor. 56 CS will perform any necessary cross-connection in the CER.

- When determined necessary to simplify installations, conduit will be curved to provide gentle sweeps, with a minimum radius of 25 feet, for a total bending radius not to exceed 180 degrees between manholes, hand holes or pull locations.

- All conduits shall be sloped toward each opposing manhole at a slope of 3” per 100 feet of run to promote drainage of any accumulated liquids. All conduit/ducts and innerducts shall be capped, plugged or sealed. In addition, all vacant conduit/ducts and innerducts shall be provided with a waterproof corrosion resistant pull rope for use on future cable installation. The pull rope shall extend into the manhole and be secured to the cable rack or pulling iron.

- Handholes, when specified, will be minimally 4’x4’x4’ inside dimensions and be provided with a grounding rod, cable rack supports, sump drain and pulling irons. Handhole covers will have a locking bar or other locking device to allow use of a padlock or other restriction to unauthorized entry. Covers shall be round and cast with “COMMUNICATIONS” exposed to the surface for easy identification.

- A ¾-inch x 10-foot copper clad steel ground rod shall be installed in the floor of each manhole provided. Four inches of the rod, plus or minus ½ inch shall extend above the finished floor level. The rod shall not enter the manhole more than 3 inches nor less than two inches out from the vertical surface of the adjacent wall. The installed ground shall have an impedance of 25 ohms or less. Pre-cast manholes provided may require the ground rod to enter the duct window. Cable bonding shall be provided IAW T.O. 31W3-10-22, Chapter 7, Section XI.

- Cable pulling-in irons shall be installed on the wall opposite each main conduit entrance location placed and embedded during the construction of the manhole wall, and located 6 inches to 9 inches from the manhole floor, in line with the conduit entrance.

- The sump shall be cast into the floor of the manhole. The floor shall slope toward the sump to provide drainage from all areas into the sump. The sump shall be approximately 13 inches square and 4 inches deep and covered with a removable perforated or punched steel plate to permit drainage. The cover shall be fastened to the housing by a chain or hinge.

- Cable racks shall be provided in manholes, hand holes, or cable vaults, and shall be located on the two long walls of the manhole, or cable vault. Cable hooks shall be provided to support cables. The cable hooks shall be secured using cable rack locking clips. All splice enclosures shall be supported using racking clips, cable racks, and cable hooks.

- The duct used by metallic cable (or jointly used by both metallic and fiber optic cables) shall be corrosion resistant and 4-inch inside diameter (minimum) round. The conduit shall be EPC-40 Polyvinyl Chloride (PVC) (Schedule 40) IAW NEMA TC 2. The duct shall be clearly labeled “Schedule 40” as appropriate. A minimum of a 4-hole, 4-inch inner diameter (minimum) round duct system shall be installed when the duct is between manholes. For routing under roads, railroads, runways and other heavy traffic areas EPC-80-PVC (Schedule 80) IAW NEMA TC-2 or galvanized steel conduits shall be used. Ducts shall have a sleeve or bell end type coupling and shall be watertight when assembled. Ducts shall enter the manhole/hand hole perpendicular to entry side and parallel to adjacent side wall to facilitate routing/racking of cables. The bending radius for conduits between manholes and buildings shall be no less than 10 times the inside diameter of the conduit. The bending radius between manholes shall be not less than 25 ft. A waterproof corrosion resistant pull rope shall be provided in each duct opening that extends three feet beyond the end of the duct and shall be secured. End bells shall be provided on all duct ends terminated in manholes, buildings or cable vaults.

- Fabric mesh 3” 3-cell shall be use as innerduct to provide physical protection of fiber optic cables when installed in ducts. To prevent the egress of water and other contaminants into the conduit, Split-Termination Plugs shall be used.

- Outdoor filled cable shall not extend into a facility beyond 50 feet in cable length unless enclosed in metallic conduit. For locations where outdoor filled cable extends beyond 50 feet into a facility, the cable shall be spliced to a plenum fire-rated or stub cable, and shall be enclosed in a sealed splice closure without encapsulent, to prevent leakage of filling compound. If an outdoor filled cable cannot be spliced within 50 feet of building entrance, the cable shall be enclosed in conduit to within 50 feet of its termination point. Filled cable shall not be used between floors and shall not be terminated on any distribution frame, cross-connect block, or termination or protector block without the use of blocking caps to prevent leakage of filling compound. All building entrance terminals shall be stenciled with the terminal number, the cable number, and the cable count.

- Removal of underground cables shall be performed IAW T.O.31W3-10-12, section V. All necessary precautions shall be taken to avoid exceeding the tensile strength of the cable during the removal process. When more than one cable is in a conduit/ duct, the necessary precautions shall be taken to ensure the cables to be left in place are not damaged. If the cable cannot be removed without damaging the other cables, it shall be cut and abandoned in place. The associated splice closures shall be removed from the manhole or cable vault. The cable shall be cut in such a manner so that a minimum of 3 feet of cable extends from the conduit/duct into the manhole.

- Cables pulled through manholes or cable vaults and cable at terminals shall be tagged IAW T.O. 31W3-10-22 Chapter 7. Innerducts shall be tagged with the data for the fiber optic cable installed within the innerduct or the word “VACANT”. All cables entering and leaving splice cases shall be tagged with the cable number and count as a minimum. All tags shall be permanently labeled and corrosion resistant.

7.4 Modular Furniture

- Although furniture systems are designed for quick reconfiguration of office space, experience has shown that furniture pre-wired with power and telecommunications connections cannot be reconfigured easily. Telephone and LAN wiring systems in areas with pre-wired workstations, furniture systems or modular walls must have sufficient flexibility and connectivity to enable rearrangement without modification to the permanent communications wiring in the facility. Suitable connectors must be provided; permanent splices/connections are prohibited.

- Where modular furniture is to be installed, modular quad outlet jacks will be installed in each work area and in each area identified by the tenant unit for administrative use requiring automation equipment or telephone equipment, in such a way as to maintain the UL listing of the modular furniture. Each of the quad outlet jacks shall be numbered by room and jack number and will be wired with four pairs (eight conductors) according to the wiring diagram located on the side of the jack, by the contractor.

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8 ADMINISTRATION DOCUMENTATION

8.1 Approach

Cable management is the planning, designing and accounting of cables routed throughout the building. Good cable management must be applied in all facilities, regardless of the types of cabling systems and numbers of user outlets required. Management of twisted pair and telecommunications cabling systems from the ER to the user outlets is extremely important, especially in large building systems. Placement of any cable system in the building should follow a well organized/designed cable management plan. By keeping a record of cable pair counts and assignments and the routing of riser, tie, and distribution cables, future rearrangements or alterations to the wiring system will be easier. Cable management records must be kept current throughout the life of the building. The overall cable management should be implemented in accordance with ANSI/TIA/EIA-606 (Administration Standard for the Telecommunications Infrastructure of Commercial Buildings).

8.1.1 Considerations

Communications distribution facilities discussed in Section 3 inherently provide for good cable management; however, some floor distribution systems and cabling systems permit random and unorganized placement of cable. These include the raised access floor and ceiling plenum floor distribution systems and the on-floor wiring system. Considerations for managing cable and wiring in these systems are discussed in the paragraphs below. A system should be implemented for identifying, labeling, and recording pathways and spaces in accordance with ANSI/TIA/EIA-606.

8.1.2 Labeling

Label all telecommunications infrastructure and equipment components. All installed UTP and Fiber Optic cabling, outlets and UTP/Fiber Patch panels shall be numbered following a site cable plan and documented in as-built drawings and documentation. Labeling and color coding systems should conform to the ANSI/TIA/EIA-606 standard.

8.1.2.1 Cable Identification

Cabling systems installed in any type of floor distribution system can be managed and accounted for by number and alphabetical coding of cables and hardware. The coding should indicate which TR or ER the cable originates from and what floor area it serves. This can be accomplished by tags, markings, stickers, etc. See Appendix C for recommended numbering schemes.

8.1.2.2 Communication Outlets

As a minimum, a unique identifier shall be marked on each outlet to identify it as connecting hardware. Outlet and patch panel labeling shall show the TR number serving the outlet and the outlet circuit number. The outlet number should reflect its relative physical location in the building. See Appendix C for recommended numbering schemes.

8.1.2.3 Racks, Panels, Blocks

A unique identifier shall be marked on each piece of connecting hardware to identify it as connecting hardware. See Appendix C for recommended numbering schemes.

8.1.2.4 Network Equipment

The labeling scheme for network equipment will depend on manufacturer and slot/port configuration of the device. See Appendix C for recommended numbering schemes. Refer to BICSI Telecommunication Distributions Method Manual, Ch - 13, for additional guidance.

8.1.3 Building Cable Record Database

All records shall be created by the installation contractor or engineering team and turned over at the completion of work. The format shall be computer based and both soft copies and hard copies shall be part of the as-built package. The minimum requirements include:

- Cable Identifier
- Cable type

- Termination Position at both ends
- Splice Data
- Damaged Pairs/Conductors
- Connecting Hardware and Position
- Reference to cable identifier attached to connecting hardware

Test documentation on all cable types shall be included as part of the As-built package.

8.1.4 Building Drawings

The building architect should furnish a set of drawings to the AF which includes the planned installation of the telecommunication wiring system before construction of the building begins. After the building is built, the contractor/architect must furnish a set of drawings, in both paper and electronic media, to the AF which reflect the actual "as built" set of drawings that includes all of the dynamic changes that were made during the construction of the building, including the changes in the telecommunications wiring system. Copies of the electronic and paper drawing files must be provided to the base Communications and Information Systems Installation Records (CSIRs) manager to facilitate the updating of the CSIR records IAW AETC CSIR policy. The only acceptable electronic formats for CSIR drawings are Microstation (V7 or V8) or AutoCAD 2003 or less. The following URL provides specific EDSC instructions and policy on providing electronic updates to drawings: https://wwwmil.tinker.af.mil/38eig/edsc/. It is not acceptable to have the drawings only on paper. All new infrastructure-drawing packages shall include drawings that accurately depict the network configuration and the cable plant. As-built drawings and management records shall show location of all outlets, equipment, and cabling to include down to the individual network jack and how each telecommunications room is connected.

Reference Appendix D, Drawings, for additional drawing requirements. Note: The AETC policy memorandum on CSIR management provides very detailed and specific instructions, and will be incorporated into the new AETC supplement to AFI 21-404.

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Paper drawings are not required. Drawings shall be in MS Visio for inclusion in the base drawing records.

Outside plant infrastructure features and communications pathways information shall be collected and provided to Base Comm as identified in Appendix D, GPS Cable Template document.

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9 TESTING

All UTP and fiber optic cabling shall be tested end-to-end and certified to meet TIA/EIA performance standards. All equipment shall be tested to meet contract specifications. All test results and certifications shall be provided to the BCSI responsible for system

operations and maintenance.

Testing shall verify basic electrical and optical parameters as well as the performance of the cable plant as installed. All tests shall be conducted inclusive of all connecting hardware and patch cables. Testing shall verify the electrical and optical performance characteristics of the cable plant from the communication outlet to the TR terminations with all patch cords in place. This includes, but is not limited to the communication outlet, horizontal wiring, patch panel, patch cords and backbone wiring.

If testing reveals any cable plant component to be outside of the acceptable level of performance described in this plan, that component shall be repaired or replaced and retested for compliance.

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Testing shall include all connecting hardware and patch cables. All CAT 6 cables will be tested and certified up to 1000 Mbps (500 MHz) to ensure they are usable at higher data transmission speeds. UL testing standard for new cable, including fiber optic testing of single-mode and multi-mode cable will be followed. Test results and certifications will be provided to the 56 CS/SCX in both paper and electronic form. Where deficiencies of any type are discovered upon testing, the installation contractor will make all necessary repairs, including replacement if necessary, at no cost to the government. The primary field test parameters to be provided as part of test results are Wire Map, Length, Insertion Loss, NEXT Loss, PSNEXT Loss, ELFEXT, Return Loss, Propagation delay, and Delay Skew.

If a run barely passes (the result is within the tester's accuracy limit), the data must carry a warning (such as an asterisk) to indicate that the result was marginal. No marginal test results will be accepted.

All newly installed grounds shall be tested prior to being connected to the system. If a ground point fails, the contractor shall determine the cause of the failure, correct the failure and re-accomplish the test. Where the contractor uses an existing ground point, it shall also be tested prior to being connected to the system. If the ground point proves unsuitable, the contractor shall notify the designated government representative of the defective ground and install a separate ground for the system. The tests to be performed on the grounds shall measure the ground potential (ability to dissipate voltage through the ground point to the earth).

Tools

Category 6 Test Sets: for Category 6 UTP and Extended 150 ohm STP, test sets to verify performance to the upper limit of the cabling system characterization are defined by ANSI/TIA-568-B.2-10.

Tester Accuracy Levels: Cable tester accuracy will be at least level III for Category 6 cabling.

Tester Must-Have Features: A Category 6 Tester must be capable of measuring all required data (see Section 9), and have a 310 meter range to allow for approximate measurements of available cable on spools. The unit should also come with manufacturer's information on how to interpret data with the device. The unit must be able to connect to a PC to download test results IAW TIA/EIA standards

(Luke Supplement Ends)

10 CABLE TV

10.1.1 Coaxial Cable

When CATV or CCTV requirements are identified, either a 75-ohm broadband coaxial cable or single mode fiber optic cable system should be installed. When a coaxial system is installed, care should be taken to ensure the correct cable is used. The designer should coordinate with the cable service provider where franchised agreements are in place. Plenum cables should be specified when required. The table below lists cable type with corresponding distance limitation. This table is derived from vendor specifications (Anixter) for coaxial cable.

Cable	Distance
RG-6	<=250 feet
RG-11	<=400 feet

Table 3 Coaxial Cable Distance

Limits

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10.2 CATV

CATV distribution system will include entrance conduits and manholes into the facility, premise distribution, amplifiers, splitters and CATV jacks.

CATV system amplifiers will be installed in the CER in a wall-mountable steel or aluminum housing and vented or finned for cooling. These cable ports shall be stainless steel or brass threaded ‘F’ connectors for mechanically strong, corrosion resistant cable connections. External RF test ports shall be provided to monitor signals without opening the housing. Distribution cable from the amplifiers will be through rigid metal conduit.

CATV cabling will be separate from telephone/LAN cabling (will not be in the same conduits or cable trays). Power supply for CATV systems amplifiers shall be 100 percent plug-in modular construction and include lightning surge, short circuit and overload protection. Circuitry shall be fully protected by circuit breakers.

The cable distribution system shall utilize signal power splitters, directional couplers and isolation taps as required to meet the system performance requirements. Signal splitters shall have a power throughput of 6 amps (minimum) when amplifiers are to be powered through the cable.

All coaxial cable used for wiring within a building shall conform to NFPA 70. Main distribution cables between CATV amplifiers and splitters will be of RG-6 or RG-11 type.

Cables from splitters to CATV outlets will be of RG-6 or RG-60 type.

All CATV outlets with plates shall be wall-mounted and shall not protrude from the face of the wall more than ¼". Each outlet shall have an attenuation of less than 0.1dB and a VSWR of 1.15 to 1. Cable connectors shall be 75 ohm Type "F" composed of anodized brass, beryllium copper or phosphorus bronze. Outlet connectors shall be Type "F" female plug.

(Luke Supplement Ends)

11 Installation Warning System–Internal Public Announcement System.

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(1) IPAS requirements will be included in all new Military Construction (MILCON) projects and any renovation, modification, repair and/or restoration project where the costs exceed 50% of the replacement costs for the affected facility. This applies to all inhabited buildings (11 or more DoD personnel and one person per 40 gross square meters), billeting or any facility designated as a primary gathering (routinely occupied by 50 or more DoD personnel). It is imperative the user's of this facility document their IPAS requirement following the communications and information requirements process during the early stages of the construction design. Once documented, the 56 CS/SCX will provide the required technical solution for 56 CES/CEC to integrate the solution into the facility designs for subsequent construction program funds. The cost to develop the technical solution is HQ AETC/CE funded.

(2) This solution template for IPAS will provide the standard requirements to help design an IPAS system for a building. Specific IPAS specifications are detailed in AETC IWS.

(Luke Supplement Ends)

APPENDIX A
Applicable Standards/References

1 Government

UFC-3-580-01

CITS ITS Baseline Directive (current year release)

AFI 32-1021, Military Construction Projects

AFI 32-1023**,** Restoration and Modernization Projects

AFI 33-103, Requirements Development and Processing

AFI 33-112, Computer Systems Management

AFI 33-201, Communications Security (COMSEC)

AFI 33-202, Computer Security

AFI 33-203, Emission Security

AFI 32-1032, Planning and Programming Appropriated Funded Maintenance, Repair, and Construction Projects

AFMAN 33-223, Identification and Authentication

FIPS Pubs 140-1, Security Requirements for Cryptographic Modules

1.1 FIPS Pubs 140-2, Advanced Encryption Standard (AES) Commercial Technical and Design Standards

The following lists of standards and supplements are applicable to this effort. However, other standards may apply.

ANSI/TIA/EIA standards shall be the primary governing standards for all telecommunications cabling plant designs, testing and installations. The primary ANSI/TIA/EIA standards applicable to this infrastructure program are 568-B, Commercial Building Telecommunications Cabling Standard, and 569-B, Commercial Building Standard for Telecommunications Pathways and Spaces. These standards establish the minimum requirements for telecommunications cabling within an office environment. They recommend topology and maximum performance distance for various topologies. They establish media parameters, which determine network performance distance for various topologies. They specify connector and pin assignments to ensure

inter-connectivity. Moreover, they establish the useful life of telecommunications cabling systems as being a minimum of ten years. Designers and installation teams are responsible for adhering to these accepted industry standards. More stringent standards can be adopted, however, care must be exercised to ensure the more stringent characteristics are followed for the complete horizontal cabling system including connecting hardware, patch cords, equipment cords, work areas cords, and cross-connect wiring.

Although this document discusses many of the pertinent aspects of the ANSI/TIA/EIA standards, it is recommended that persons and organizations responsible for supervising or monitoring network infrastructure installation obtain copies of standards documents. These documents may be obtained through Global Engineering Documents, 1-800-854- 7179.

2 Industry

2.1 TIA-526-7-A, Measurement of Optical Power Loss of Installed Single mode Fiber Cable Plant – OFSTP-7

22 TIA-526-14-C, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant

23 TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises
TIA-568-C.0-1, Generic Telecommunications Cabling for Customer Premises – Addendum 1, Updated References for Balanced Twisted-Pair
TIA-568-C.0-2, Generic Telecommunications Cabling for Customer Premises – Addendum 2, General Updates

TIA-568-C.1, Commercial Building Telecommunications Cabling Standard
TIA-568-C.1-1, Addendum 1, Pathways and Spaces
TIA-568-C.1-2, Addendum 2, General Updates
This standard defines a generic telecommunications wiring system for commercial buildings that will support a multi-product, multi-vendor 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. Installation of wiring systems during building construction or renovation is significantly less expensive and less disruptive than after the building is occupied. This standard establishes performance and technical criteria for various wiring system configurations for interfacing and connecting their respective elements. In order to attain a multi-product wiring system, a review of the performance requirements for most telecommunications services was conducted.

The diversity of services currently available coupled with the continual addition of new services means that there might be cases where limitations to desired performance occur.

The user is advised to consult standards associated with the desired services to understand

any such limitations.

2.3.1 Supporting References ANSI/TIA/EIA-568-C.1

The following references and standards were updated and incorporated into or used as reference to develop the ANSI/TIA/EIA-568-B.1 standard.

2.3.1.1 TIA-569-D, Telecommunications Pathways and Spaces

The purpose of this standard is to standardize specific design and construction practices within and between (primarily commercial) buildings that are in support of telecommunications media and equipment. Standards are given for rooms or areas and pathways into and through which telecommunications equipment and media are installed. Part of the expected usefulness of this standard is that it be referenced in documents such as bid requests, specifications and contracts leading up to the construction of facilities. ANSI/TIA/EIA-569 should also prove useful to the team that is responsible for delivering a well-designed facility to the owner - the architects, communications installers, engineers, and the construction industry. ANSI/TIA/EIA-569 is the result of a joint Canadian and United States effort done by the Canadian Standards Association (CSA) and the Electronic Industries Alliance (EIA). Development of the standard in the U.S. was carried out with the support of the American Institute of Architects and the Construction Specifications Institute because the standard influences both the design and construction of commercial buildings.

2.3.1.2 TIA-570-C, Residential Telecommunication Cabling Standard

This standard describes a premise wiring system intended for connecting one to four exchange access lines to various types of customer premises equipment. Some requirements, especially those on wire and wiring topology, are new to the industry in anticipation of new telecommunication services. Technical criteria are given for installers and manufacturers in the appendices. This standard is intended to be used by a broad range of persons having an interest in telecommunications wiring such as local exchange carriers, equipment designers and manufacturers, building owners and contractors, and companies involved in the sale, installation, and maintenance of telecommunications equipment and services. This standard was developed by telecommunications industry representatives with the help of other industry organizations involved in telecommunications. This standard is intended to be implemented on new construction of, and additions to, residential and light commercial buildings, and their subsequent rearrangement.

2.3.1.3 TIA-606-B, Administration Standard for the Telecommunications Infrastructure

The purpose and intent of this standard is to provide a uniform administration scheme that is independent of applications, which may change several times throughout the life of a building. This standard establishes guidelines for owners, end users, manufacturers, consultants, contractors, designers, installers, and facilities administrators involved in the administration of the telecommunications infrastructure or related administration system.

2.3.1.4 TIA-607-B, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

TIA 607-B-1, Addendum 1 – External Grounding
TIA 607-B-2, Addendum 2 – Structural Metal
"Commercial Building Grounding and Bonding Requirements for Telecommunications," also known as ANSI/TIA/EIA-607, can be utilized with or without prior knowledge of the telecommunications systems installed in the building. This Standard supports a multi-vendor, multi-product environment, as well as the grounding practices for various systems that may be installed on customer premises. ANSI/TIA/EIA-607 will be useful to manufacturers of telecommunications equipment, purchasers, installers, or operators of equipment and devices for specifying the exact interface points between the building grounding systems and the telecommunications equipment grounding configuration, and for specifying building grounding configurations needed to support this equipment.

ANSI/TIA/EIA-607 will also help building owners and developers who want to build an advanced technology structure that is compatible with modern telecommunications equipment.

2.3.1.5 **TIA-758-B**, Customer Owned Outside Plant Telecommunications Infrastructure Standard
This standard provides requirements used in the design of the telecommunication pathways and spaces, and the cabling installed between buildings or points in a customer- owned campus environment. Customer-owned campus facilities are typically termed "outside plant" (OSP). For the purpose of this standard, they are termed "customer- owned OSP".

2.3.1.6 ASTM D 4566-05

American Society for Testing and Materials. Test Method D4566-98 Standard Test Methods for Electrical Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable (1998).
These test methods cover procedures for electrical testing of thermoplastic insulations and jackets used on telecommunications wire and cable and for the testing of electrical characteristics of completed products. To determine the procedure to be used on the particular insulation or jacket compound, or on the end product, reference should be made to the specification for that product.

2.4 TIA-568-C.2, Balanced Twisted-Pair Cabling and Components Standards
TIA-568-C.2, Errata
TIA-568-C2.2 , Balanced Twisted-Pair Telecommunications Cabling and Components Standard, Addendum 2: Alternative Test methodology for Category 6A Patch Cords
This standard specifies cabling components, transmission performance, systems models and the measurement procedures needed for verification of balanced twisted pair cabling. Requirements for four-pair balanced cabling systems are provided. This standard also specifies field test instruments and applicable reference measurements procedures for all transmission parameters.

The transmission performance for a cabling system depends upon the characteristics of the horizontal cable, connecting hardware, patch cords, equipments cords, work areas cords, cross-connect wiring, the total number of connections, and the care with which they are

installed and maintained. The development of high-speed applications requires that cabling systems be characterized by transmission parameters such as insertion loss, near-end crosstalk (NEXT), power sum near-end crosstalk (PSNEXT) loss, structural return loss (SRL), and power sum equal-level far-end crosstalk (PSELFEXT). System designers use these performance criteria to develop applications that utilize all four pairs in a cabling system for simultaneous, bi-directional transmission. This standard provides minimum cabling component performance criteria as well as procedures for component and cabling performance validation.

25 TIA-568-C.3, Optical Fiber Cabling Components Standard
TIA-568-C3.1, Optical Fiber Cabling Components Standard – Addendum 1, Addition of OM4 Cabled Optical Fiber and Array Connectivity

This standard specifies the component and transmission requirements for an optical fiber cabling system (e.g., cable, connectors), 50/125μm and 62.5/125μm multimode, and single mode optical fiber cables.

26 TIA -568-C.4, Broadband Coaxial Cabling and Components Standard

27 ANSI/TIA/EIA 569-D, Telecommunications Pathways and Spaces

The purpose of this standard is to standardize specific design and construction practices within and between (primarily commercial) buildings that are in support of telecommunications media and equipment. Standards are given for rooms or area and pathways into and through which telecommunications equipment and media are installed. Part of the expected usefulness of this standard is that it be referenced in documents such as bid requests, specifications and contracts leading up to the construction of facilities. ANSI/TIA/EIA-569 should also prove useful to the team that is responsible for delivering a well-designed facility to the owner - the architects, engineers, and the construction industry. ANSI/TIA/EIA-569 is the result of a joint Canadian and United States effort done by the Canadian Standards Association (CSA) and the Electronic Industries Alliance (EIA). Development of the standard in the U.S. was carried out with the support of the American Institute of Architects and the Construction Specifications Institute because the Standard influences both the design and construction of commercial buildings.

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29 BICSI

Building Industry Consulting Service, International Inc. (BICSI) Telecommunications Distribution Methods Manual; published by: Inch Cape Testing Services, Testmark, 629 Massachusetts Avenue, Foxboro, Massachusetts 01719, attention: BICSI.

210 National Electric Code 2002 – NFPA70

The purpose of this publication is to circulate information and opinion among those concerned for fire and electrical safety and related subjects.

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211 Luke AFB Additional References

Air Education & Training Command	First 400 Feet Standard Guidance at all AETC bases
National Fire Protection Association	NFPA 780, Standard for the Installation of Lightning Protection Systems
Unified Facility Criteria	UFC 4-021-01 Design and O&M: Mass Notification Systems
Rural Utility Service	RUS PE-39, Specifications for Filled Telephone Cable RUS PE-80, Specifications for Gas Tube Surge Arrestors RUS PE-89, Specifications for Filled Telephone Cable with Expanded Insulation
Air Force Instructions	AFI 21-404, Developing and Maintaining Communications and Information Systems Installation Records AFI 32-1022, Planning and Programming for Nonappropriated Fund Facility Construction AFI 32-1084, Facility Requirements AFI 33-101, Communications and Information Management Guidance and Responsibilities AFI 33-104, Base-Level Planning and Implementation AF TB 95-03, Cabling and Distribution Systems AFSSI 7010, Emission Security Assessment AFSSM 7011, Emission Security Countermeasures Review AFI 33-203, Emission Security AFI 65-601V1, Budget Guidance and Procedures
Joint Technical Architecture	JTA- Air Force, Building Wiring Architecture JTA - Air Force, Voice Switching Systems Architecture JTA - Air Force, Information Technology Infrastructure Architecture JTA - Air Force, Local Area Network Architecture

Air Force Technical Orders	TO 31-W-3-10-22, Telecommunications Engineering OPT TO 31-W-3-10-12, Outside Plant Cable Placement
Military Standard	MIL Std 188-124B, Grounding, Bonding, and Shielding of Communications Facilities
International Electrical and Electronics Engineers Association	IEEE 802.6, MAN System requirements IEEE 802.8, Fiber Optic Advisory Board Standards IEEE 802.9, Integration of Voice and Data Systems IEEE 802.10, LAN Security Measures IEEE 802.3U, 100BaseT and 100BaseX Standard

(Luke Supplement Ends)

APPENDIX B
Definitions and Acronyms

1 Definitions.

The following terms are used extensively in defining building communications and distribution systems. Not all of these terms are used in this technical bulletin but may appear in other documents, contractor designs, project books, and industry standards. Note that several terms are synonymous

Access floor - a floor distribution system consisting of completely removable and interchangeable floor panels supported by adjustable pedestals or stringers (or both) to allow access to the area beneath

Access unit - a device that allows access to a duct, cell or air space (e.g., a floor panel in an access floor)

Air plenum - any bounded space used to direct air movement for environmental purposes

Alternate entrance - a supplementary building service entrance using a different route through a different wall

Blank duct - standard or large size duct with no inserts; used only as a feeder duct

Building core - an area of a building where unusable floor space exists, such as restrooms, stairwells, elevators, maintenance rooms, etc.; usually centrally located on each floor

Building service entrance - the facilities provided for bringing cable into the building

Cable riser - facilities provided in the building for vertical distribution of cable from lower floors to higher floors

Cable system - the collection of all communication cables installed to provide communications within a building

Coaxial cable - a cable consisting of two concentric conductors separated uniformly by a dielectric media. Typically an inner wire and an outer braided sleeve are the two concentric conductors

Ceiling distribution system - a distribution system that uses the air space above a false ceiling or a ceiling air plenum for the placement of cable

Ceiling drop pole - a metallic pole extending from a ceiling distribution system to the floor used to conceal cables distributed to the user location

Cellular floor - a floor structure of prefabricated concrete or metallic load-bearing units composed of a series of longitudinal cells

Cellular floor distribution - the use of a cellular floor as part of a floor distribution system for the placement of cables

Conduit - a raceway of circular cross-sections

Connecting block - a device on which cable pairs are terminated, cross-connected, bridged, etc.; usually 50 pair per block

Cross-connect closet - a small room provided for connecting communications circuits between the building's cables or lines

Data communications equipment - equipment used for the transmission of data over a transmission medium such as twisted pair, twinax, coax, or optical fiber. Usually refers to equipment that has a digital interface for a modem or printer connection

Data terminal equipment - equipment which displays data and/or allows users to enter data to a computer

Demarcation point - a place designated within the building to distinguish between the terminal blocks in the communications ER where building cable pairs are connected to the building feeder cable), or a location where a change in ownership, responsibility, technical specifications, etc., takes place

Distribution cabinet - a small flush or surface mounted cabinet for distribution of inside wiring cable pairs for a particular floor

Distribution duct - an under-floor duct of rectangular cross-section provided with inserts to enable access to distribution cable

Distribution frame - wall or frame mounted connectors located in the Equipment Room (ER) or a Telecommunications Room (TR) for terminating and cross-connecting cable pairs

Distribution system - the collection of all provisions made and installed to accommodate the cabling system in a building

Emergency power - a stand-alone electrical supply source not dependent upon the primary electrical source (e.g., uninterruptible power source)

Equipment Room (ER) - a room providing communications services to the building; such as terminating outside plant feeder cables, housing switching and transmission equipment, terminating building riser and horizontal cables, providing the building service entrances, etc. Synonymous with telecommunication equipment room

Feeder cable - outside plant cable providing pair requirements to the building from the base distribution system

Feeder duct - an under-floor duct of rectangular cross-section used to distribute inside wiring cable from the ER to the distribution ducts or cells

Fill - the ratio of the combined cross-sectional area of all cables within a raceway to the interior cross-sectional area of the raceway

Fire stop - a material, device, or assembly of parts installed in a cable system in a fire-rated wall or floor to prevent passage of flame, smoke, or gases through the rated barrier (e.g., between rooms)

Floor distribution - any of the methods for distributing inside wiring cable from the Telecommunications Rooms (TRs) to the user outlet

Flush duct - a type of under-floor duct whose top and inserts are flush with the finished floor; (as opposed to other under-floor duct which is completely encased in the floor)

Grounding electrode - a conductor, usually a rod, pipe, or plate (or group of conductors) that provides a low impedance, direct connection to the earth

Horizontal cable - communications cable installed between telecommunications rooms (TRs) and work areas in a building

Infinite access floor - access floor, also called "raised floor"

Insert - a hole in the top of a distribution duct for installing an access unit

Insert duct - a duct with inserts; distribution duct

Inside wiring cable – multi-pair cable used for distributing communications services within a building

Integrated services digital network - a digital transmission and switching network providing or supporting a range of different telecommunications services

Jack - a female connector

Lateral duct - in an under-floor duct system, the duct interconnecting the ends of distribution duct runs; usually around the perimeter of a building

Modular furniture - office furniture comprised of self-supporting desks and partitions designed to house and conceal inside wiring cable

Modular outlet - an access unit housing modular jacks for connection of user equipment

Module lines - grid lines used by the architect to layout the building design; all columns, interior walls, mullions are located on module lines

On floor distribution - a type of floor distribution system using under carpet (flat) cable

Overhead distribution - a type of distribution system that uses the ceiling area

Perimeter duct - lateral duct

Plenum - a space that handles return environmental air in an un-ducted fashion

Plenum cable - cable rated by UL for use in plenums; low smoke producing and high flame resistance

Plug - a male connector

Pre-wiring - the installation of telecommunications cables during the construction of the building

Raceway - pipe, conduit, under-floor duct, floor cells, overhead duct and any other channel designed solely to hold wires and cables

Raised floor - access floor

Raised floor distribution - use of the air space created by an access floor to distribute cable from the Telecommunications Room (TR) to the user outlet

Riser cable - cable used to provide pair requirements from the primary communications ER to the various other floors above the communications ER

Riser conduit - conduit used to house riser cable

Riser shaft - a series of communications rooms vertically aligned with the communications equipment room; cable can be passed between floors by floor slots and conduit sleeves

Riser system - the method of distributing riser cable from the communications ER to the various upper level communications closets

Riser telecommunications closet - an ER that has direct access to the building riser system. See also definitions for TR and riser system

Service access unit - a device installed upon an under-floor duct insert to allow access to cable

Service fitting - an outlet box to house the connections for telecommunications services at the user workstation

Sleeve - an opening, usually circular, through the wall, ceiling, or floor to allow the passage of cables and wires

Slot - an opening through a wall, floor, or ceiling, usually rectangular, to allow the passage of cables and wires

Suspended ceiling - a ceiling that creates an area or space between ceiling material and the structure above. Synonyms: drop ceiling, false ceiling

Systems furniture - a type of modular office furniture used to distribute communications systems cabling within its integral raceway

Telecommunications cable - metallic and optical cable providing the transmission medium between information systems

Telecommunications Room - a small room that extends communications services to each workstation on a floor. Also known as a TR, riser room, apparatus room, cross-connect room, or a communications ER

Telecommunication service entrance - the point where telecommunication cables enter or leave a building

Tie cable - cable used to provide connectivity between communications rooms on the same floor or cable connecting communications rooms to the communications ER located on the same floor as the communications ER

Tie conduit - conduit used to connect communications rooms on the same floor or connect communications rooms to the communications ER located on the same floor

Under-floor distribution - a type of floor distribution system using ducts installed in the structural floor

Usable floor space - floor space within the building used exclusively for offices, workstations, etc.; used to determine the number of user outlets given a specified outlet density; (typically 80 percent of total floor space)

Utility column - a raceway placed between the ceiling and floor in conjunction with ceiling distribution systems. It is used for the concealment of telecommunication and electrical wiring from the ceiling space to the work area. Synonyms: ceiling drop pole, power pole

2 Acronyms

AF	Air Force
AFCA	Air Force Communications Agency
AFI	Air Force Instruction
ANSI	American National Standards Institute
ATM	Asynchronous Transfer Mode
BCE	Base Civil Engineer
BICSI	Building Industry Consulting Service International
NCC	Network Control Center
C4I	Command, Control, Communications, Computer and Intelligence Systems
CADD	Computer-Aided Design
CATV	Cable Television
CCTV	Closed Circuit Television
CITS	Combat Information Transport System
CO	Communication Outlet
CSIR	Communications & Information System Installation Records
DCO	Dial Central Office
DOD	Department of Defense
EA	Executive Agent
EBN	End Building Node
EDSC	Engineering Data Service Center
EIA	Electronic Industries Alliance
EIG	Engineering Installation Group
EMT	Electrical Metallic Tubing
ER	Equipment Room
ETL	Engineering Technical Letter
GFA	Gross Floor Area
HVAC	Heating, Ventilation, and Air Conditioning
ICEA	Insulated Cable Engineers Association
ICDMS	Interior Cable Distribution and Management System
IEEE	Institute of Electrical and Electronic Engineers
ITN	Information Transfer Node

IWC	Inside Wiring Cable
KVA	Kilovolt Ampere
LAN	Local Area Network
LED	Light-Emitting Diode
MAC	Medium Access Control
MCP	Military Construction Project
NEC	National Electrical Code
NEXT	Near-End Crosstalk
NFPA	National Fire Protection Association
NSA	National Security Agency
OSP	Outside Plant
PC	Personal Computer
O&M	Operations and Maintenance
PDA	Personal Digital Assistant
PHY	Physical Layer
PSELFEXT	Power Sum Equal Level Far-End Crosstalk
PSNEXT	Power Sum Near-End Crosstalk
R&M	Restoration and Modernization
RF	Radio Frequency
SFFC	Small-Form-Factor Connectors
SNMP	Simple Network Management Protocol
SSID	Service Set Identifier
SSAA	System Security Authorization Agreement
TR	Telecommunications Room
TDM	Telecommunications Distribution Methods
TIA	Telecommunications Industry Association
UL	Underwriters Laboratory
UTP	Unshielded Twisted Pair
VCSEL	Vertical Cavity Surface-Emitting Lasers
VPN	Virtual Private Network
VTC	Video Teleconferencing
WEP	Wired Equivalent Privacy

(Luke Supplement Begins)

AWG	American Wire Gauge
BCSO	Base Communications Systems Officer

BET	Building Entrance Terminal
CAT	Category
CER	Communications Equipment Room
COMSEC	Communications Security
CSI-B	Cyber System Integrator - Base
DRSN	Defense Red Switch Network
EMSEC	Emissions Security
FOC	Fiber Optic Cable
JTA-AF	Joint Technical Architecture-Air Force
MM	Multi Mode
NCC	Network Control Center
NIPRNET	Non-secure Internet Protocol Router Network
SIPRNET	Secure Internet Protocol Router network
SLC	Single Line (instrument) Concept
SM	Single Mode
TC	Telecommunications Closet
TGB	Telecommunications Grounding Busbar
TMGB	Telecommunications Main Ground Busbar
TP	Twisted Pair
USACE	U.S. Army Corps of Engineers
USOC	Universal Service Ordering Code
VAC	Volt Alternating Current
VSWR	Voltage Standing Wave Ratio

(Luke Supplement Ends)

APPENDIX C
Labeling and Numbering Schemes of Telecommunications Components

1 Purpose

The purpose of this Appendix is to establish basic labeling and numbering schemes for telecommunications components. The numbering schemes used to identify components are not standardized. The schemes described in this Appendix are recommendations. An overall labeling and numbering scheme should be adhered to for base wide consistency. An effective labeling and numbering scheme will ensure administration tasks are simplified, to include, moves, adds, and changes can be carried out with little guesswork, unused capacity can be easily identified and failed components can easily and quickly be identified during troubleshooting and repair activities.

2 Telecommunication Cables

21 Optical Fiber Cable Tagging

Fiber optic cable tag format shall be as identified in Figure 6 **Cable Tag Format**.

1. A = ARMORED SHEATH
   B = BLOWN FIBER
   F = INDOOR/OUTDOOR FIBER
   OTHERWISE LEAVE BLANK
2. FIBER COUNT
3. L = LOOSE TUBE BUFFER
   T = TIGHT TUBE BUFFER
4. 8.3, 9.2 OR 10 = SINGLE MODE*
   50 OR 62.5 = MULTIMODE**
5. F = FILLED CORE OR LEAVE BLANK
   D = DRY CABLE

* When Single Mode Fiber is unknown replace numeric value with 'S'
** When Multi Mode Fiber is unknown replace numeric value with 'M'

OPTION 1
FO 1234 -5678, 1-12
FO= FIBER OPTIC CABLE
1234 - 5678 = FROM - TO BUILDING NUMBERS

OPTION 2
FO 02, 1-12
FO=FIBER OPTIC CABLE
02=LOCALLY ASSIGNED CABLE NUMBER
1-12=CABLE COUNT

Figure 6 Cable Tag Format

22 UTP Cable Tagging

Copper cable tagging will be addressed in future revisions.

3 Communication Outlets

Each CO should have a unique identifying number. In the TR, this unique identifying number should be associated with the position on the patch panel or cross connect to which the outlet is connected. Each horizontal cable should be labeled both at the outlet and patch panel or cross-connect position in the communications closet.

Wall plate combinations can include copper only, fiber only, or a combination. Wall plates may be flat or slopped, site conditions and user preference shall be the determining factor. Wall plates shall be marked IAW the site cable plan. Below are recommendations

for new installations however it is not the intent of this document to require re-labeling of existing horizontal cabling to conform to this document.

Combination UTP and Fiber-Optic wall plates shall use a four position-1 gang plate that shall be configured to support three UTP and, one Fiber Pair.

In cases of higher fiber-optic density requirements, a separate wall plate, single gang or larger shall be used. The separated wall plate shall be located adjacent to the UTP wall plate. The preferred wall plate for combination installations shall be a 12-position multi-media wall plate. The 12-positon multi-media wall plate shall support a combination of UTP and base standard fiber connectors to support the requirement.

Figure 7 Four-Position Wall Plate Numbering Scheme and Figure 9 Five-Position Wall Plate Numbering Scheme are the specified typical configurations. The additional examples are included for reference should these situations arise.

Note: In areas that have multiple wall plates, wall plates shall be numbered left to right starting at drawing North on the floor plans and going in a clockwise direction.

3.1 Four Position UTP Wall Plate

The top position of the four-position UTP wall plate shall be marked with the following information. See

Figure 7 Four-Position Wall Plate Numbering Scheme.

In existing facilities with no Telecom Room numbers the TR room identifier shall be floor number, room number where room number starts with the letter A with additional TR labeled B, C etc.

TR	Actual TR or ER where the end of the wall plate cables terminate.
RACK/CABINET #	Actual Rack/cabinet number that contains the patch panel where the cable terminates.
PATCH PANEL #	Actual patch panel number.
PORT #'s	Actual port numbers in the patch panel, (in existing installations often the port number are not sequential, i.e. patch panel port numbers 1,3,4,5)

The bottom position of the UTP wall plate shall be marked with the Room Number that the wall plate is installed. This information is reflected in the site cable plan.

Top Position Example:
110-1-1-1 = TR 110
Rack # 1

Patch Panel # 1
Port #'s 1,2,3,4 (On the patch panel)

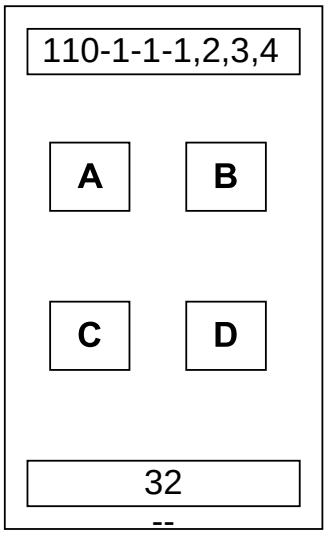
Bottom Position Example:

32 = Room Number (Actual room # from the cable plan and facility drawings at time of design)

Top Position Example: (no comm. room identifier)
1A-1-1-1 = TR 1A

Rack # 1
Patch Panel # 1
Port #'s 1,2,3,4 (On the patch panel)

Example of a Single Quad Data Outlet Located in room 32 and terminating in TR 110, Rack # 1, Patch Panel # 1 and starting in port # 1 of the patch panel.



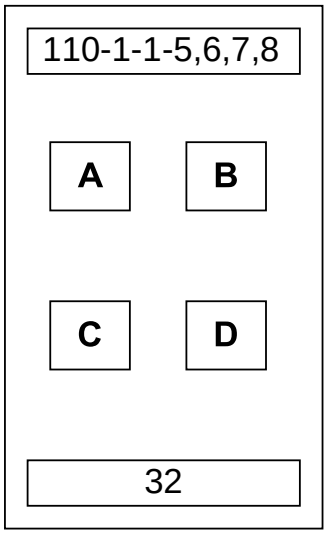
TR	110
RACK	1
PATCH PANEL	1
PORT #s	1,2,3,4

DATA OUTLETS (Color Coded. Site Specific Colors may be used in lieu of standard colors)

A - Outlet - White
B - Outlet - Blue
C - Outlet - Yellow
D - Outlet - Green

ROOM NUMBER (Actual room number from site cable plan and facility drawings at time of network infrastructure site cable plan development.)

Example of a Second Quad Data Outlet Located in room 32 and terminating in TR 110, Rack # 1, Patch Panel # 1 and starting in port # 5 of the patch panel.



TR	110
RACK	1
PATCH PANEL	1
STARTING PORT #	5,6,7,8

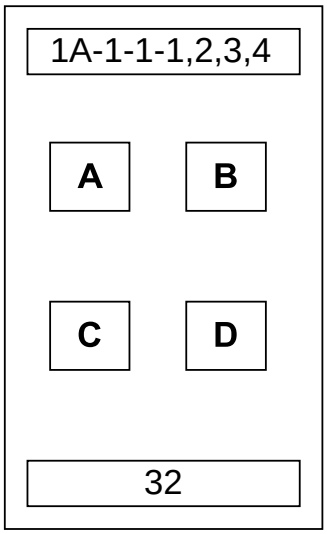
DATA OUTLETS (Color Coded. Site Specific Colors may be used in lieu of standard colors)

A - Outlet - White
B - Outlet - Blue
C - Outlet - Yellow
D - Outlet - Green

ROOM NUMBER (Actual room number from site cable plan and facility drawings at time of network infrastructure site cable plan development.)

Figure 7 Four-Position Wall Plate Numbering Scheme

Example of a Single Quad Data Outlet Located in room 32 and terminating in TR 1A, Rack # 1, Patch Panel # 1 and starting in port # 1 of the patch panel.



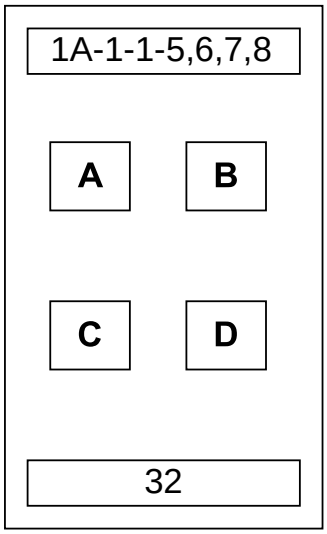
TR	1A
RACK	1
PATCH PANEL	1
PORT #s	1,2,3,4

DATA OUTLETS (Color Coded. Site Specific Colors may be used in lieu of standard colors)

A - Outlet - White
B - Outlet - Blue
C - Outlet - Yellow
D - Outlet - Green

ROOM NUMBER (Actual room number from site cable plan and facility drawings at time of network infrastructure site cable plan development.)

Example of a Second Quad Data Outlet Located in room 32 and terminating in TR 1A, Rack # 1, Patch Panel # 1 and starting in port # 5 of the patch panel.



TR	1A
RACK	1
PATCH PANEL	1
STARTING PORT #	5,6,7,8

DATA OUTLETS (Color Coded. Site Specific Colors may be used in lieu of standard colors)

A - Outlet - White
B - Outlet - Blue
C - Outlet - Yellow
D - Outlet - Green

ROOM NUMBER (Actual room number from site cable plan and facility drawings at time of network infrastructure site cable plan development.)

Figure 8 Four-Position Wall Plate Numbering Scheme (no TR room number)

3.2 Five Position UTP and Fiber Wall Plate

The five position wall plate consists of three UTP and one duplex SC fiber connector. The wall plate shall be marked with the following information. See Figure 9 Five- Position Wall Plate Numbering Scheme.

The top position of the wall plate shall be marked with the Room Number that the wall plate is installed.

TR	Actual TR or ER where the end of the wall plate cables terminate.
RACK #	Actual Rack number that contains the patch panel where the cable terminates.
PATCH PANEL #	Actual patch panel number.
PORT #'s	Port numbers in the patch panel.

The middle position of the wall plate shall be marked with the Room Number that the wall plate is installed. This information is reflected in the site cable plan.

The bottom position, duplex SC connector, of the wall plate shall be marked with the following information.

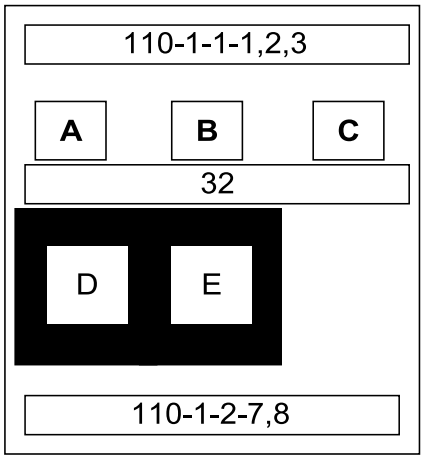
TR	Actual TR or ER where the end of the wall plate cables terminate.
RACK #	Actual Rack number that contains the fiber patch panel where the cable terminates
PATCH PANEL #	Actual fiber patch panel number
PORT #'s	Port numbers in the fiber patch panel
ROOM NUMBER	Actual room # from the cable plan and facility drawings at time of design

Top Position Example:
110-1-1-1, 2, 3 = TR 110
Rack # 1
Patch Panel # 1
Ports # 1, 2, 3 (On the patch panel)

Middle Position Example:
32 = Room Number (Actual room # from the cable plan and facility drawings at time of design)

Bottom Position Example:
110-1-2-7, 8 = TR 110
Rack # 1
Patch Panel # 2 (Fiber)
Ports # 7, 8 (On the fiber patch panel)

Example of a Single Five Position UTP and Fiber-Optic Data Outlet Located in room 32 with UTP terminating in TR110, Rack # 1, Patch Panel # 1 and starting in port # 1 of the patch panel and Fiber terminating in TR 110, Rack # 1, Patch Panel # 2 and starting in port # 7 of the patch panel.



UTP Section

TR	110
RACK	1
PATCH PANEL	1
PORT #	1,2,3

DATA OUTLETS (Color Coded. Site Specific Colors may be used in lieu of standard colors)

A - Outlet - White
B - Outlet - Blue
C - Outlet - Yellow
D - Not Used

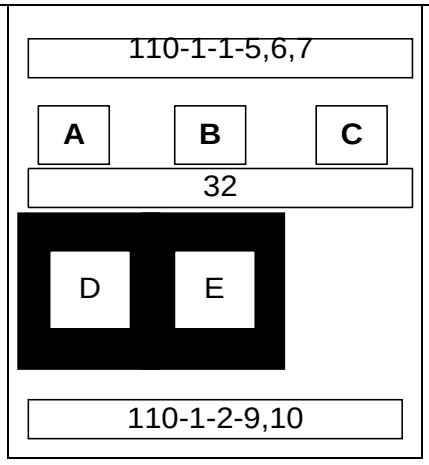
Fiber-Optic Section

TR	110
RACK	1
PATCH PANEL	2
PORT #s	7,8

FIBER DATA OUTLETS
D - E Outlets - Fiber Pair # 1

ROOM NUMBER 32

Example of a Second Five Position UTP and Fiber-Optic Data Outlet Located in room 32 with UTP terminating in TR 110, Rack # 1, Patch Panel # 1 and starting in port # 5 of the patch panel and Fiber terminating in TR 110, Rack # 1, Patch Panel # 2 and starting in port # 9 of the patch panel.



UTP Section

TR	110
RACK	1
PATCH PANEL	1
PORT #	5,6,7

DATA OUTLETS (Color Coded. Site Specific Colors may be used in lieu of standard colors)

A - Outlet - White
B - Outlet - Blue
C - Outlet - Yellow
D - Not Used

Fiber-Optic Section

TR	110
RACK	1
PATCH PANEL	2
PORT #	9,10

FIBER DATA OUTLETS
D - E Outlets - Fiber Pair # 1

ROOM NUMBER 32

Figure 9 Five-Position Wall Plate Numbering Scheme

33 Six Position UTP and Fiber-Optic Wall Plate

The six position wall plate consists of four UTP and one duplex SC fiber connector. The wall plate shall be marked with the following information; (See Figure 10 Six-Position Wall Plate Numbering Scheme.)

The top position of the combination UTP and Fiber-Optic 6-Position 2 gang (Four UTP and One fiber Pair) wall plate shall be marked with the following information.

TR	Actual TR or ER where the end of the wall plate cables terminate.
RACK #	Actual Rack number that contains the patch panel where the cable terminates
PATCH PANEL #	Actual patch panel number
PORT #'s	Port numbers in the patch panel
ROOM NUMBER	Actual room # from the cable plan and facility drawings at time of design

The middle position of the wall plate shall be marked with the Room Number that the wall plate is installed. This information is reflected in the site cable plan.

The bottom position of the combination UTP and Fiber-Optic 6-Position (Four UTP and One fiber Pair) wall plate shall be marked with the following information IAW the cable plan.

TR	Actual TR or ER where the end of the wall plate cables terminate.
RACK #	Actual Rack number that contains the fiber patch panel where the cable terminates
PATCH PANEL #	Actual fiber patch panel number
PORT #'s	Port numbers in the fiber patch panel
ROOM NUMBER	Actual room # from the cable plan and facility drawings at time of design

Top Position Example:
110-1-1-1, 2, 3, 4 = TR
110

Rack # 1
Patch Panel # 1
Port # 1,2,3,4 (On the patch panel)

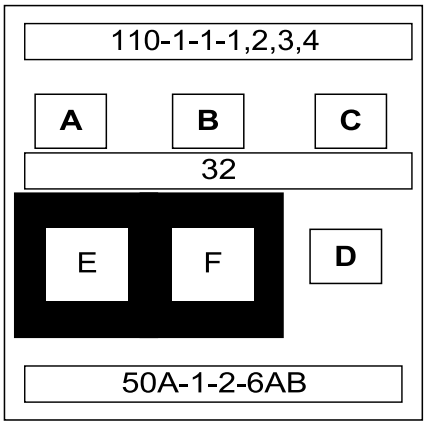
Middle Position Example:
32 = Room Number (Actual room # from the cable plan and facility drawings at time of design)

Bottom Position Example:
110-1-2-7 = TR 110

Rack # 1

Patch Panel # 2 (Fiber)
Port # 6AB (On the fiber patch panel)

Example of a Single Six Position UTP and Fiber-Optic Data Outlet Located in room 32 with UTP terminating in TR 110, Rack # 1, Patch Panel # 1 and port # 1,2,3,4 of the patch panel and Fiber terminating in TR 110, Rack # 1, Patch Panel # 2 and port # 6AB of the patch panel.



UTP Section

TR	110
RACK	1
PATCH PANEL	1
PORT #	1,2,3,4

DATA OUTLETS (Color Coded. Site Specific Colors may be used in lieu of standard colors)

A - Outlet - White
B - Outlet - Blue
C - Outlet - Yellow
D - Outlet - Green (not used in triple outlet)

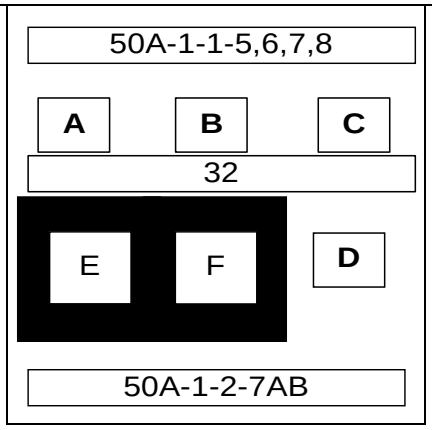
Fiber-Optic Section

TR	110
RACK	1
PATCH PANEL	2
PORT #	6AB

FIBER DATA OUTLETS
E - F Outlets - Fiber Pair # 1

ROOM NUMBER 32

Example of a Second Six Position UTP and Fiber-Optic Data Outlet Located in room 32 with UTP terminating in TR 110, Rack # 1, Patch Panel # 1 and port # 5,6,7,8 of the patch panel and Fiber terminating in TR 110, Rack # 1, Patch Panel # 2 and port # 7AB of the patch panel.



UTP Section

TR	110
RACK	1
PATCH PANEL	1
PORT #	5,6,7,8

DATA OUTLETS (Color Coded. Site Specific Colors may be used in lieu of standard colors)

A - Outlet - White
B - Outlet - Blue
C - Outlet - Yellow
D - Outlet - Green (not used in triple outlet)

Fiber-Optic Section

TR	110
RACK	1
PATCH PANEL	2
PORT #	7AB

FIBER DATA OUTLETS
E - F Outlets - Fiber Pair # 1

ROOM NUMBER 32

Figure 10 Six-Position Wall Plate Numbering Scheme

34 Four Position Fiber-Optic Wall Plate

The four position fiber wall plate consists of two duplex SC fiber connectors. The wall plate shall be marked with the following information; See;

Figure 11 Four-Position Fiber-Optic Wall Plate Numbering Scheme)

The top position of the four-position Fiber-Optic wall plate shall be marked with the following information;

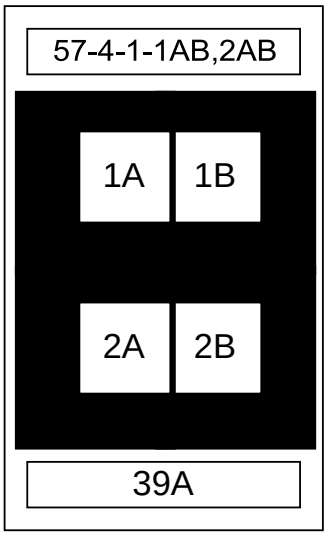
TR	Actual TR or ER where the end of the wall plate cables terminate.
RACK #	Actual Rack number that contains the patch panel where the cable terminates
PATCH PANEL #	Actual patch panel number
PORT #'s	Port numbers in the patch panel

The bottom position of the fiber wall plate shall be marked with the Room Number that the wall plate is installed. This information is reflected in the site cable plan. (See example wall plate layout in this section.)

Top Position Example:
57-4-1-1 = TR 57
Rack # 4
Patch Panel # 1
Port # 1 AB, 2AB (On the patch panel)

Bottom Position Example:
39A = Room Number (Actual room # from the cable plan and facility drawings at time of design)

Example of a Single Four Position Fiber-Optic Data Outlet Located in room 39A and terminating in TR 57, Rack # 4, Patch Panel # 1 and SC port # 1 fiber AB and SC port 2 fiber AB of the patch panel.



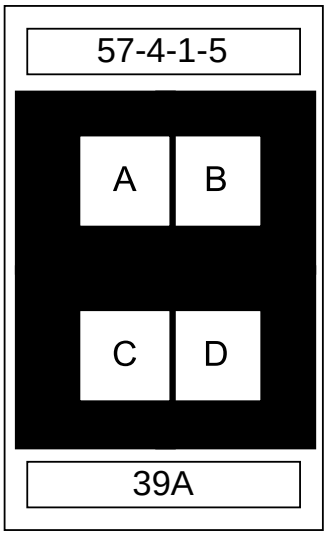
TR	57
RACK	4
PATCH PANEL	1
PORT #	1AB,2AB

FIBER DATA OUTLETS

A -B Outlets - Fiber Pair # 1
C - D Outlet - Fiber Pair # 2

ROOM NUMBER (Actual room number from site cable plan and facility drawings at time of network infrastructure site cable plan development.)

Example of a Single Four Position Fiber-Optic Data Outlet Located in room 39A and terminating in TR 57, Rack # 4, Patch Panel # 1 and SC port # 1 fiber AB and SC port 2 fiber AB of the patch panel.



TR	57
RACK	4
PATCH PANEL	1
STARTING PORT #	5

FIBER DATA OUTLETS

A -B Outlets - Fiber Pair # 1

C - D Outlet - Fiber Pair # 2

ROOM NUMBER (Actual room number from site cable plan and facility drawings at time of network infrastructure site cable plan development.)

Figure 11 Four-Position Fiber-Optic Wall Plate Numbering Scheme

35 Ten Position UTP and Fiber-Optic Wall Plate

The four position fiber wall plate consists of four UTP and three duplex SC fiber connectors; See Figure 12 Ten-Position Fiber-Optic Wall Plate Numbering Scheme.

The top position of the wall plate shall be marked with the following information; IAW the cable plan;

TR	Actual TR or ER where the end of the wall plate cables terminate.
RACK #	Actual Rack number that contains the UTP patch panel where the cable terminates.
PATCH PANEL #	Actual UTP patch panel number
PORT #	Actual starting port number in the UTP patch panel
ROOM NUMBER	Actual room # from the cable plan and facility drawings at time of design

The bottom position of the combination UTP and Fiber-Optic 10-Position (Four UTP and Three Fiber Pairs) wall plate shall be marked with the following information IAW the cable plan (See example wall plate layout in this section.)

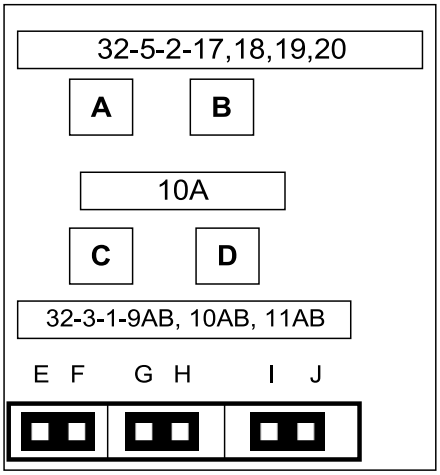
TR	Actual TR or ER where the end of the wall plate, fiber terminates.
RACK #	Actual Rack number that contains the fiber patch panel where the cable terminates.
PATCH PANEL #	Actual fiber patch panel number
PORT #	Actual starting port number in the fiber patch panel
ROOM NUMBER	Actual room # from the cable plan and facility drawings at time of design

Top Position Example:
32-5-2-17 = TR 32
Rack # 5
Patch Panel # 2 (UTP)
Port # 17,18,19,20 (On the UTP patch panel)

Middle Position Example:
10A = Room Number (Actual room # from the cable plan and facility drawing at time of design)

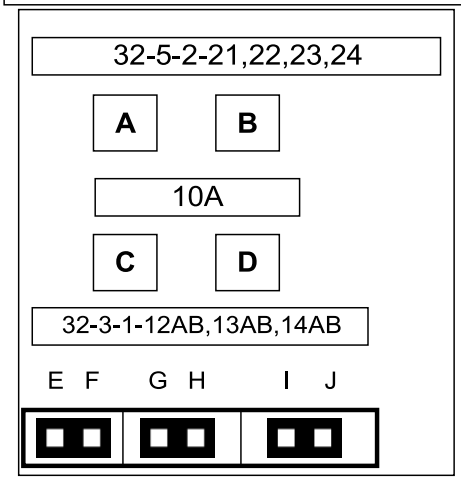
Bottom Position Example:
32-5-2-20 = TR 32
Rack # 5
Patch Panel # 2 (Fiber)
Port # 9AB, 10AB, 11AB (On the Fiber patch panel)

Example of a Single Ten Position UTP and Fiber-Optic Data Outlet Located in room 32 with UTP terminating in TR 32, Rack # 5, Patch Panel # 2 and port # 17,18,19,20 of the patch panel and Fiber terminating in TR 32, Rack # 3, Patch Panel # 1 and starting in port # 9AB, 10AB, 11AB of the patch panel.



UTP Section	
TR	32
RACK	5
PATCH PANEL	2
PORT #	17,18,19,20
DATA OUTLETS (Color Coded. Site Specific Colors may be used in lieu of standard colors)	
A - Outlet - White	
B - Outlet - Blue	
C - Outlet - Yellow	
D - Outlet - Green (not used in triple outlet)	
Fiber-Optic Section	
TR	32
RACK	3
PATCH PANEL	1
PORT #	9,AB,10,AB,11AB
FIBER DATA OUTLETS	
E - F Outlets - Fiber Pair # 1	
G - H Outlets - Fiber Pair # 2	
I - J Outlets - Fiber Pair # 3	
ROOM NUMBER	10A

Example of a Second Ten Position UTP and Fiber-Optic Data Outlet Located in room 10A with UTP terminating in TR 32, Rack # 5, Patch Panel # 2 and starting in port # 20 of the patch panel and Fiber terminating in STR 32, Rack # 3, Patch Panel # 1 and starting in port # 15 of the patch panel.



UTP Section	
TR	32
RACK	5
PATCH PANEL	2
PORT #	21,22,23,24
DATA OUTLETS (Color Coded. Site Specific Colors may be used in lieu of standard colors)	
A - Outlet - White	
B - Outlet - Blue	
C - Outlet - Yellow	
D - Outlet - Green (not used in triple outlet)	
Fiber-Optic Section	
TR	32
RACK	3
PATCH PANEL	1
PORT #	12AB, 13AB,14AB
FIBER DATA OUTLETS	
E - F Outlets - Fiber Pair # 1	
G - H Outlets - Fiber Pair # 2	
I - J Outlets - Fiber Pair # 3	
ROOM NUMBER	10A

Figure 12 Ten-Position Fiber-Optic Wall Plate Numbering Scheme

4 UTP/Fiber Patch Panels

4.1 UTP Patch Panel Markings and Numbering

UTP Patch Panels shall be marked IAW the site cable plan. Labels shall be used to identify the patch panel information and labels shall be used to identify the respective jacks and their related wall plates.

- All references should be to cable destination
- Mechanically printed labels shall be affixed on the UTP patch panel immediately below or above the data jacks depending on the position of the manufactures jack numbers on the UTP patch panel.
    - If the manufacturer's jack numbers are located above, the data jacks place the labels under the jacks without obscuring the next row of manufacturers jack numbers.
    - If the manufacturer's jack numbers are located below, the data jacks place the labels above the jacks without obscuring the next row of manufacturers jack numbers.
    - All jack labels shall reference the distance end wall plate. All marking shall be IAW the site cable plan. Labels shall be placed under clear plastic label protectors on the patch panels if available.

Example of a 48 port UTP patch panel with manufacturers jack numbers located above the data jacks. This UTP patch panel supports the following data jacks located in the following areas:

110 2 Quad Outlet 110-1 A B C D, 110-2 A B C D
111 1 Quad Outlet 111-1 A B C D
112 1 Quad Outlet 112-1 A B C D
113 5 Quad Outlet 113-1 A B C D, 113-2 A B C D, 113-3 A B C D, 113-4 A B C D, 113-5 A B C D
114 1 Quad Outlet 114-1 A B C D
114A 1 Quad Outlet 114A-1 A B C D
115 1 Quad Outlet 115-1 A B C D

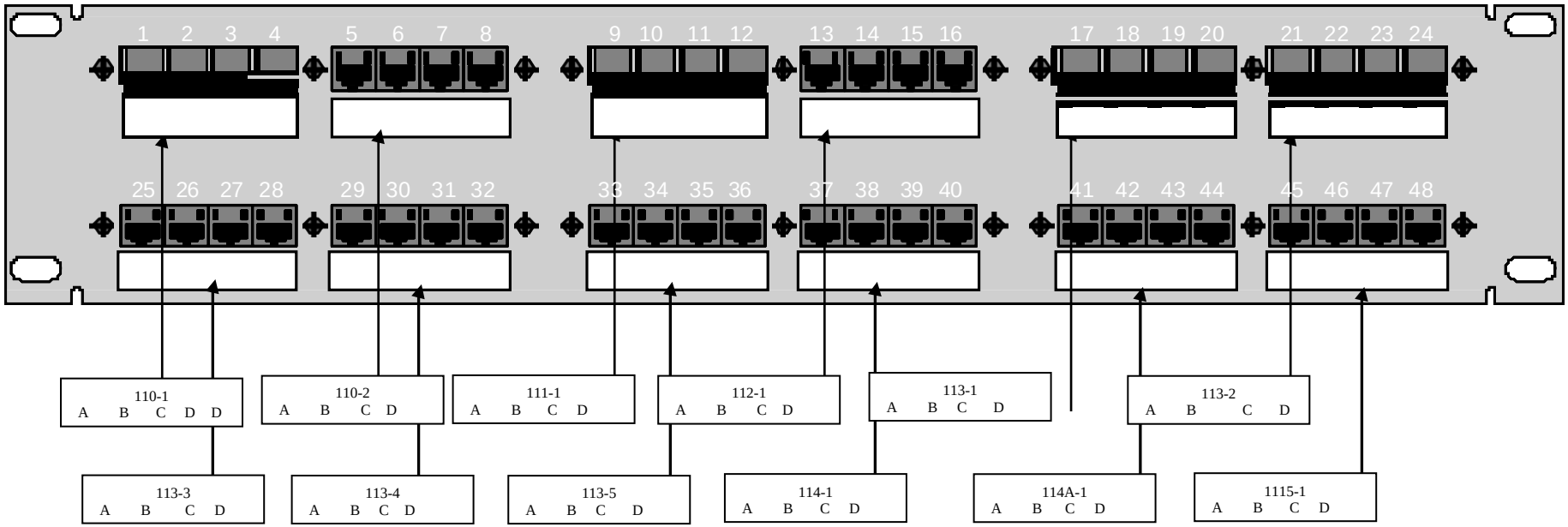


Figure 13 Example Patch Panel Numbering Scheme

42 Fiber Optic Cable Patch Panel Markings and Numbering

Fiber Optic Patch Panels shall be marked IAW the site cable plan. Labels shall be used to identify the patch panel information and labels shall be used to identify the respective jacks and their related wall plates or other Fiber Optic Patch Panels.

- All references should be to cable destination
- Mechanically printed labels shall be affixed on the front left hand side of the Fiber Optic Patch Panel Door.
- All Fiber Optic jacks shall be marked following the site cable plan. The Fiber Optic Patch Panel manufactures label card shall be filed out and installed in the Fiber Optic Patch Panel in a location that is easily readable or reachable when the door is opened. The preferred location is attached to the door with the data readable.
- Labels shall be placed under clear plastic label protectors on the patch panels if available.
- Fiber Optic enclosures shall be marked within their respected room number, rack numbers and patch panel number starting with the number 1. Each sub-panel in the enclosure shall be marked starting with the letter "A", going left to right and ports shall be numbered starting with the # 1 going top to bottom in each sub-panel.

***	-	***	-	***	-	**
Building No.		Room No		Enclosure		Port No. Designation

EXAMPLE: If a cable is marked: **204-313-02A-12**

This represents the destination of the cable, Building 204, Room 313, Enclosure 02A and port 12

5 Network Equipment

See BICSI Telecommunication Distributions Method Manual, Ch 14 PG 8-11 "Telecommunications Equipment Identification".

(Luke Supplement Begins)

568 B Wiring configuration will be used for voice and data.

PIN NO.	COLOR	PIN NO.	COLOR
1	ORANGE WHITE	5	BLUE-WHITE
2	ORANGE	6	GREEN
3	GREEN-WHITE E	7	BROWN-WHITE
4	BLUE	8	BROWN

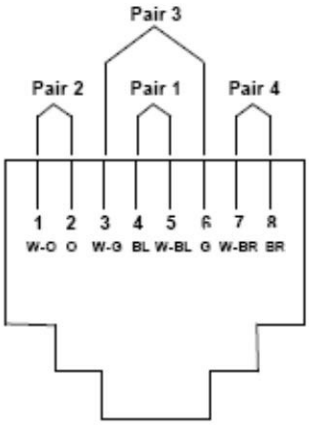


Figure 6-2 Optional eight-position jack pin/pair assignment (T568B)

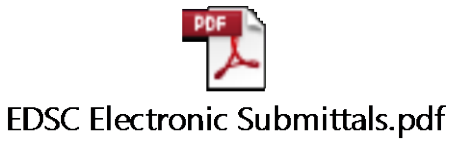
(Luke Supplement Ends)

Appendix D
Drawing Records

1 Drawings

Drawing packages shall include drawings that accurately depict the network configuration, rack/cabinet elevations, cable plant and telecommunication rooms. Architectural quality CAD drawings with polylines shall be used for physical layout drawings.

The Engineering Data Service Center (EDSC) at the 38 EIG is responsible for maintaining Drawings. A policy letter was published May 03 to all CISR monitors. In accordance with AFI 21-404, this policy details drawing formats and is inserted below with its relevant attachments;



(Luke Supplement Begins)
Paper drawings are not required. All final construction outside plant as-build deliverables shall comply with GPS Cable template document shall be provided to Base Comm; see AETC First 400 Feet Standard Guidance with Luke Supplement attachment for requirements.

Manhole/hand hole butterfly drawings are required accurately depicting cable entry and exit points.

Rack/cabinet elevations shall be provided in Visio format (.vsd) depicting true placement of copper/fiber optic cable patch panels/LIUs, cable managers, and any other items installed inside respective rack(s)/cabinet(s).
(Luke Supplement Ends)