DESIGN GUIDELINES

Local Area Network

The total oversight and management responsibilities for information assurance (IA) and protection of DoDEA’s critical infrastructure fall under the purview of the DoDEA Chief Information Officer (CIO) and DoDEA IA Chief. All requests for use of wireless technologies within DoDEA are to be routed to the DoDEA CIO and DoDEA IA Chief for approval.

It is the responsibility of the contractor or reader to be familiar with and to comply with the federal and industry Local Area Network (LAN) standards as referenced documents in Reference A for design, installation, and testing of all components. Contractors must also comply with federal and DOD LAN guidelines and standards (See Reference B).

Due to emerging network technologies, the LAN Standards shall be reviewed on an annual basis. Check with your Area Information Technology (IT) Director or DoDEA IT to ensure that this is the most current LAN standard.

Planning Requirements

Typical Features:
- Telecommunication and LAN Room(s) 70-110 sf per room (6.5 m2-10 m2) - subject to actual equipment and required clearances.

Built-In Furnishings
- LAN equipment racks (option-based on chosen model)

Finishes
- **Floor:** an antistatic surface such as tiled or sealed concrete, carpet is prohibited.
- **Base:** as appropriate for flooring material.
- **Ceiling:** no finish, waterproof, no suspended ceilings. The height of the ceiling from the floor level must be no less than 8’-6” (260cm) high.
- **Walls:** concrete block, reinforced concrete, plaster, drywall or other locally available, durable material.

Equipment
- LAN equipment (as required)
- LAN component racks
- Punch boards (as required) – minimum 4’ x 8’ x ¾” (122cm x 244cm x 19mm) plywood
- Rack mounted servers (as required)

Electrical
- Fluorescent lighting (500 lux minimum at desk height)
- General purpose outlets as required for equipment (110V and 208V in USA, utilize comparable standards for facilities outside USA)
- Rack mounted servers
- Concentrator
- Fire Protection
- Fire protection system as required by NFPA

Telecommunications

Telecommunications Rooms
Telecommunications Rooms (TR) are special-purpose rooms that house telecommunications equipment. These rooms have stringent requirements due to the nature, size, expense and complexity of the equipment housed in them. TR sizes vary according to the size of the building, number of floors, occupancy characteristics and telecommunications services required. Consideration to the future needs of the facility and the end users is a necessity.

TR Nomenclature/Designation
TR numbers will be designated as follows. The cable entrance point of the building will be designated as TR1. Additional TR rooms will be designated as TR2, TR3, etc. starting in the basement or first floor, then additional floors as required. If more than one TR exists on each floor, then the TRs will be numbered in order of installation.

Room Dimensions
TRs must be at least 10 ft x 10 ft (3m x 3m) to accommodate the telecommunications cabinets. They must be located in such a way as to provide the most advantageous cable routing and positioning of cabinets. In other words, the location of the TRs must take into account the size of the building, the required length of cable runs, the types of electronic equipment required to service the entire building. In addition, TRs may not be located or co-located with steam, electrical power, or environmental control rooms nor may they be in areas that may suffer flood damage or where flood damage occurred and has not been repaired.

Cabinet Types
Server Cabinets shall have specific dimensions to accommodate various size servers. In reference to the Dell 4210 Cabinets currently in use, dimensions of this model cabinet are 39” (100cm) tall, 24” (61cm) wide, and 39” (100cm) deep—39” (1-meter) depth is mandatory. The rack must have 42 Rack Units (RU). Figure 1 depicts server cabinets.
For network equipment and local area copper cabling, the Local Area Network (LAN) cabinets should be utilized. A common model is the 42RU Rittal Cabinet as shown in Figure 2. These cabinets provide sufficient space for the horizontal cabling patch panels and patch cords that connect into Access Layer Switches as shown in Figure 2. The dimensions are 45” (115cm) high, 32” (82cm) wide, and 35” (90cm) deep. The rack must have 42 RUs.

LAN Cabinets will be equipped with a 19” (48 cm) telescoping convenience shelf to accommodate administrative requirements.

All cabinets will be equipped with a 5 ft (1.5 m) grounding bar, installed vertically against a rear leg of frame. If the RJ-45 patch panels have the ground lug positioned on the left side the ground bar will be mounted on the left leg. If the RJ-45 patch panels have the ground lug positioned on the right side the ground bar will be mounted on the right leg.

Cabinets will be positioned in room in such a way as to provide front and rear access. If cabinet is a standalone cabinet, then the cabinet must have three- (3) sided access (front, rear and one side).

Cabinet cable entry will be on sides, top and bottom of the cabinets.

Cabinets may be bolted to the floor but is not necessary. The server racks have stabilizing platforms that must be installed. Figure 1 shows an example of front and back rack stabilizers.

**Placement of TRs**
A TR will be located on each floor at a minimum. Additional cabinets per floor may be necessary if the distances to the wall outlets exceed the maximum length of 295 ft (90m). Copper LAN cables will not be installed between floors.

**Physical Room Security**
Security locks will be provided for the TR and keys will be issued only to IT Division, Facility, and Security personnel authorized access by the IT Division Chief or required for access by fire personnel (per the NFPA). All LAN cabinet locks shall be identically keyed for management ease. The TR will be secured with a traditional lock and key system that will be keyed different than the LAN cabinet key.

**Cable Tray**
4” (10cm) deep cable trays will loop the entire perimeter inside a TR at no less than 8 ft (244cm) above the floor. Maintain a 4” (10cm) clearance from each wall. Universal 12” (30cm) cable tray (see figure 3) will be installed at the top of the communications racks spanning the width of the room. (The use of a cable tray is ideal for installing all low voltage cables; telephone, television, security, data cables etc. at the time of installation, saving time and money. Installing a cable tray with space for future cabling also

Figure 1-server cabinets

Figure 2-LAN cabinet
provides an easy way to add data cables in the future without extensively disturbing the existing ceiling.

Drainage
Telecommunications rooms will not have floor drains in order to avoid the threat of back flooding. Telecommunication rooms shall not be located in any area that presents a high risk of water damage to the network equipment.

Electrical Requirements
Conditioned power will be delivered to each cabinet via an overhead cable tray. An online power backup source will support the following requirements.

In all LAN and Main Distribution Frame (MDF) TRs, for each cabinet there must be installed three (3) 16 amp circuit breakers above a new server cabinet or LAN cabinet. Each circuit shall be on a different electrical phase. For the server cabinets, splice a Power Distribution Unit (PDU) power cable into each circuit with enough length to enter the cabinet in the front hole, shown in Figure 4, and reach the floor of the cabinet. Figure 4 shows three different phased 220V AC power in a splice box with the black PDU power cables splicing into the circuits.

Figure 5, shows where the three PDU are located in the server cabinet. These PDUs are mounted on the right side facing the back of the server cabinet. Each PDU is mounted directly below each other. All cables need to reach the floor to ensure there is sufficient length. This distance may vary depending on how these circuits are mounted.
Design Guidelines

Rating of A/C units should be based on the heat generation and power consumption ratings of the installed equipment to maintain this ambient level. Fluorescent lighting shall be installed to provide 500-lux minimum at desk height. The area must be clean, temperature controlled and large enough to allow full and unimpeded access to the cabinet for installation and maintenance requirements.

Grounding
A communications ground (#6 AWG minimum) shall be installed from the main service entrance ground bus to each LAN and TR LAN cabinet and terminate on a copper ground plate located in the bottom rear of the cabinet.

No Additional Utilities
No plumbing, HVAC, or electrical conduit shall pass through, or be directly above, the Telecommunications room. In renovation projects where new Telecommunications rooms are established, all overhead utilities will be relocated out of the room.

Telecommunication Room Requirements
Main Distribution Frame (MDF) TR
The MDF TR is a physical room located in a centralized area of the school complex used to aggregate vertical fiber optic cabling from TRs and accommodate enterprise servers, routers, and phone systems. Input power for the entire room will be provided from an online backup system. A minimum of 2-4 LAN cabinets are required to support the majority of all LAN connectivity and IT resource requirements. The Server Cabinets suitable for mounting servers while the LAN Cabinets are suitable for LAN Equipment. Additional LAN cabinets (maximum of 6) may be

From the 16 amp junction boxes, LAN cabinets will have two (2), seven-receptacle power strips, without switches. These power strips will be installed at the rear, lower half of the inner frame of the cabinet, one on the left and one on the right, and will have the receptacles facing towards the middle (not towards the front of the cabinet).

Power cable will be installed in one continuous length without splicing. This rule may be waved in certain situations, but not if power cables run under a raised floor along with the facility air conditioning.

Power will enter the cabinet and terminate to junction boxes mounted on the lower right side horizontal support and centered.

The junction boxes will be labeled (on the box if possible) showing the distribution panel number and its fuse number.

Each cabinet will be separately grounded (from the cabinet busbar) to the Telecommunications Main Ground Busbar (TMGB) or to the Telecommunications Ground Busbar (TGB) installed in the TR and connected to main building ground. Ground wires will be terminated on the TMGB or the TGB. Ground wires must be continuous with no splices.

Environmental
A dedicated air conditioning (A/C) unit shall be installed in each LAN, communications, and online backup system room to maintain temperature and humidity to a maximum of 68 degrees Fahrenheit (20 degrees Celsius) and 40 - 50 percent relative humidity.
required to support site-specific requirements and future technologies. A minimum of 39” (1m) clearance around the entire LAN cabinet and unrestricted access to all cabinet doors and side panels is necessitated. In situations that present space limitations, a maximum of two cabinets may be bolted together with three sides of each cabinet still accessible as seen in Figure 6.

Local Area Network (LAN) TR
Physical rooms located throughout a building that contain LAN cabinets required to connect horizontal copper cabling between patch panels and room wall outlets. Each TR will connect to the MDF via fiber optic cabling. At minimum, one TR shall be allocated per building per floor. In multi-level buildings, it is feasible to configure TRs on top of each other for ease of maintenance and future upgrades. Adequate clearance around the entire LAN cabinets and unrestricted access to all cabinet doors and side panels is necessitated.

Vertical Cable Infrastructure - Fiber Optics
Renovation projects or additions to existing LAN infrastructure
At a minimum, backbone network cabling shall consist of one (1) 4-strand, 62.5/125-micron multimode fiber (MMF) optic cable terminated in a fiber optic distribution panel with ST connectors and one (1) 8-strand 9/125-micron single-mode fiber (SMF) optic cable terminated in a fiber optic distribution panel with SC connectors. The installation of MMF in renovation projects allows for backward compatibility with existing legacy networks already using this technology. SMF optic cabling provides more efficient...
data throughput, increased bandwidth capacity, and greater distance support in comparison to MMF optic cable. Fiber optic cabling shall meet all applicable EIA/TIA 568 B.3 standards capable of supporting 1000Base-T and 10GBASE-T deployments conforming to IEEE 802.3ae and 802.3an.

New Construction MILCON Projects
At a minimum, backbone network cabling shall consist of one (1) 12-strand, 9/125-micron single-mode fiber (SMF) optic cable terminated in a fiber optic distribution panel with SC connectors. Fiber optic cabling shall meet all applicable EIA/TIA 568 B.3 standards capable of supporting 1000Base-T and 10GBASE-T deployments conforming to IEEE 802.3ae and 802.3an.

Installation Guidelines:
- Install plenum-rated cabling where applicable.
- Fiber optic patch panels shall be located in the upper portion of the LAN cabinet.
- Single-mode fiber will be terminated with SC connectors.
- Multi-mode fiber will be terminated with SC connectors.
- Provide 48” (122cm) service loop for fiber optic cables in each LAN cabinet. Excess cable shall be located neatly in cable tray.
- Machine printed labels will be provided for fiber optic patch panel identification. Fiber optic patch panel labeling will include type, cable number, count, and cable size at the terminal points. See Table 1 for an example of labeling fiber cabling.
- All fiber optic cabling will be certified to EIA/TIA 568 B.3 standards. Test report data must be presented, unaltered, in a common electronic format prior to acceptance of horizontal cabling infrastructure.

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<th>Type</th>
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<td>Maximum cable distance 90m, minimum of 100Mhz of bandwidth</td>
</tr>
<tr>
<td>Cat. 6 (Class E)</td>
<td>10/100/1000 MbE/10GbE</td>
<td>Maximum cable distance 90m, minimum of 100Mhz of bandwidth</td>
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Horizontal Network Cabling
The category of cabling used must be determined by the purpose and project requirements. For renovation projects or addition of LAN drops in existing facilities, the same type of copper cabling should be used. In all new constructions, Cat 6 Class E cabling is the standard horizontal cable. The cabling shall be installed in continuous, un-spliced, lengths between the LAN cabinet patch panel and the classroom or office wall outlet. It cannot exceed 295 ft (90m). All cabling installations shall conform to applicable Electrical Code, local regulations, and EIA/TIA 568 B.2 standards.

Installation Guidelines
- Each LAN cabinet has a maximum capacity of 216 drops. Note that this includes all data, telephone, and wireless AP drops.
- Install plenum-rated cabling where applicable.
- Copper patch panels will be located in the upper portion of the LAN cabinet and will be separated by 1 RU of space.
- In this 1 RU of space, Cable guides should be installed to keep acceptable cable management standards.
- Cables shall run parallel or at right angles to the building structure and shall not be installed diagonally across ceiling spaces.
- Cables shall be supported by J-Hooks or equivalent, installed at intervals not exceeding 5 ft (152cm) between supports, and be permanently anchored to building structure or building surfaces.
- Cabling shall not be supported from ductwork, water or waste piping, electrical conduits, suspended ceiling supports, or be supported from the ceiling suspension system.
- Provide 24” (61cm) service loop for cables at each LAN cabinet. Excess cable shall be located neatly in cable tray.
- Provide 12” (30cm) service loop at each LAN wall outlet. Excess cable shall be located in wall, conduit, or ceiling.
- Machine printed labels will be provided for copper patch panel, media, and the wall outlet identification. Copper patch panel labeling will include TR number or room number, patch panel number, and port number.
Wireless Network
Wireless technology requires additional LAN drops at ceiling level to support Wireless Access Points (APs). These APs provide network connectivity for approximately 10-12 computers over a limited range of distance. Based on physical area, building structure properties, and number of users, DoDDS-E network administrators determine the placement of wireless access points throughout the school.

4.1 Wireless Installation

Power
Power to these APs is provided by the network equipment through Power over Ethernet (POE) switches. No additional power requirement is needed.

Indoor Installation
The best practice is to install a minimum of one drop in the center of the room above the ceiling. Rooms where these drops will be located will be coordinated with AE firms during design and clearly annotated on as-built construction drawings. This will allow the network installers to easily locate the drop and give them the flexibility to install the AP anywhere on the ceiling to provide maximum effectiveness and signal quality to the users. The installation team is required to mark the location of ceiling LAN drops on the LAN box and drop ceiling (if applicable).

Outdoor Installation
Mounting outdoor wireless equipment needs to be weatherproof but does not require the LAN drop to be located outside the building. The antenna cables are typically long enough to connect from the AP to the external antenna. The antenna must either be able to withstand the outdoor elements or be enclosed in such a manner to withstand the elements.

Protective Covering
In gymnasiums and multipurpose rooms, a protective enclosure suitable to protect the wireless network equipment. The protective enclosure shall be designed to protect the access point from stray objects while still allowing adequate signal levels to the clients.

Cable Termination
Wireless access point cabling shall be terminated in a patch panel separate from normal wired connections and should not exceed more than 24 ports per LAN cabinet. It is the Department of Defense (DoD) standard to keep the wireless network physically and logically separated from the data network due to security risks associated with wireless. This is the most effective and robust design along with the ability to add future security equipment to protect network.

DoD Wireless Policies
Wireless technologies that are integrated or connected to DoDEA networks must comply with DoD Directive 8500.1 and DoD Instruction 8500.2. Wireless technologies under consideration for access to DoDEA networks and information are required to undergo vulnerability testing, complete the Interim DoD IA Certification and Accreditation Process Guidance.

DoD Information Assurance Certification and Accreditation Process (DIACAP), previously known as the Department of Defense Information Technology Security Certification and Accreditation Process (DITSCAP), must meet DoD standards and security requirements, and be approved by the DoDEA Chief Information Officer (CIO).

Activities considering wireless technologies for use in a test or educational setting must ensure that there is physical and logical separation from any DoDEA network, in addition to, physical and logical separation from any associated DoD networks, and that those technologies do not process unclassified, sensitive, or privacy information.

DoD has provided guidance for wireless technology in DoD Directive 8100.2.

Voice Over Internet Protocol (VoIP) System
The majority of current school LANs will support VoIP technologies without a major upgrade in cable infrastructure. The VoIP phones implemented throughout DoDDS-E, for example, have an additional port to allow a computer access to the network. The phone power is supported by Power Over Ethernet (POE) technology that originates from the network equipment in the telecommunication rooms. It is always recommended to survey a building considering VoIP implementation to best determine additional infrastructure requirements. Such additional requirements may include infrastructure upgrades for wireless networks, IP based overhead paging speakers, and phone trunk connections. Please consult the DoDEA IT Division for further guidance on VoIP requirements.
SMART Board Installation
The school principal will validate requirements for installation of wall-mounted SMART Boards and ceiling mounted LCD projectors with the educational technologist assigned to their school. Once validated, the principal is responsible for the submission of a work request with their local facilities office for action.

Installation standards:
- One SMART Board 680
- One electrical outlet located within 6.5 ft (2m) from center of the SMART Board (not required if an existing outlet is located within the recommended distance allocation)
- One universal projector ceiling mount
- One electrical outlet located within 1 ft (30cm) of projector ceiling mount
- One wall mounted combination USB/VGA terminal
- One USB cable (provided with SMART Board) connected to the SMART Board and hardwired into the wall mounted USB/VGA terminal
- One VGA cable connected to the LCD projector (to be provided by DoDDS) and hardwired into the wall mounted USB/VGA terminal

Recommended mounting heights from floor to bottom of SMART Board are as follows:
Grades K-2 at 26” (66cm), grades 3-5 at 30” (76cm), grades 6-12 at 36” (91cm)

Mounting of SMART Boards will require coordination with existing wall mounted equipment/furnishings, such as LAN raceways, whiteboards/chalkboards/bulletin boards, cabinets and may require relocation/removal of some equipment/furnishings.

Reference C lists rooms that are authorized installation of wall mounted SMART Boards and ceiling mounted LCD projectors:

Online Backup System
To protect network resources and LAN equipment from damage or data loss resulting from electrical surges or power outages, online backup systems are needed. An online backup system shall be the recommended system installed to provide conditioned power to network resources and LAN equipment installed in communication and LAN rooms.

The online backup system shall be hard wired into the building main power and will provide a minimum of 120 minutes back up power when a power outage has incurred. The online backup system should also provide standby power for approximately three days. Accurate wattage consumption for all planned equipment will be provided to allow for selection of an online backup system that can support the existing power requirements. Placement of the online backup system battery room should be on the ground floor and will be climate controlled to 68 degrees Fahrenheit (20 degrees Celsius).