

A photograph of a data center. In the foreground, there are several computer workstations with white desks and black chairs. In the background, there are rows of server racks. The room is dimly lit, with a green light strip visible on the left side of the ceiling. The text is overlaid on the image.

Telecommunications Infrastructure Standard for Data Centers

ANSI/TIA-942

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Data Center Standards

- ANSI/TIA-942 Telecommunications Infrastructure Standard for Data Centers
 - ◆ Co-chairs: Chris DiMinico & Jonathan Jew
 - ◆ Published 2005 – available through TIA at www.tiaonline.org
- ANSI/NECA/BICSI-002 Data Center Design and Implementation Best Practices
 - ◆ co-chairs: Jonathan Jew & John Kacperski
 - ◆ best practices – complements TIA-942 – 2007 target

Who Developed TIA-942?

- Developed by the TIA TR-42.1.1 Network Distribution Nodes subcommittee as Project No. 3-0092
- Participants included:
 - ◆ Architecture & Engineering Firms
 - ◆ Consultants
 - ◆ End Users
 - ◆ Manufacturers

Purpose of TIA-942

- Encourage early participation of telecom designers in data center design process
- Fill a void by providing standards for planning of data centers, computer rooms, server rooms, and similar spaces.
- The standard encompasses much more than just telecommunications infrastructure.
- Close to half of the technical content deals with facility specifications.

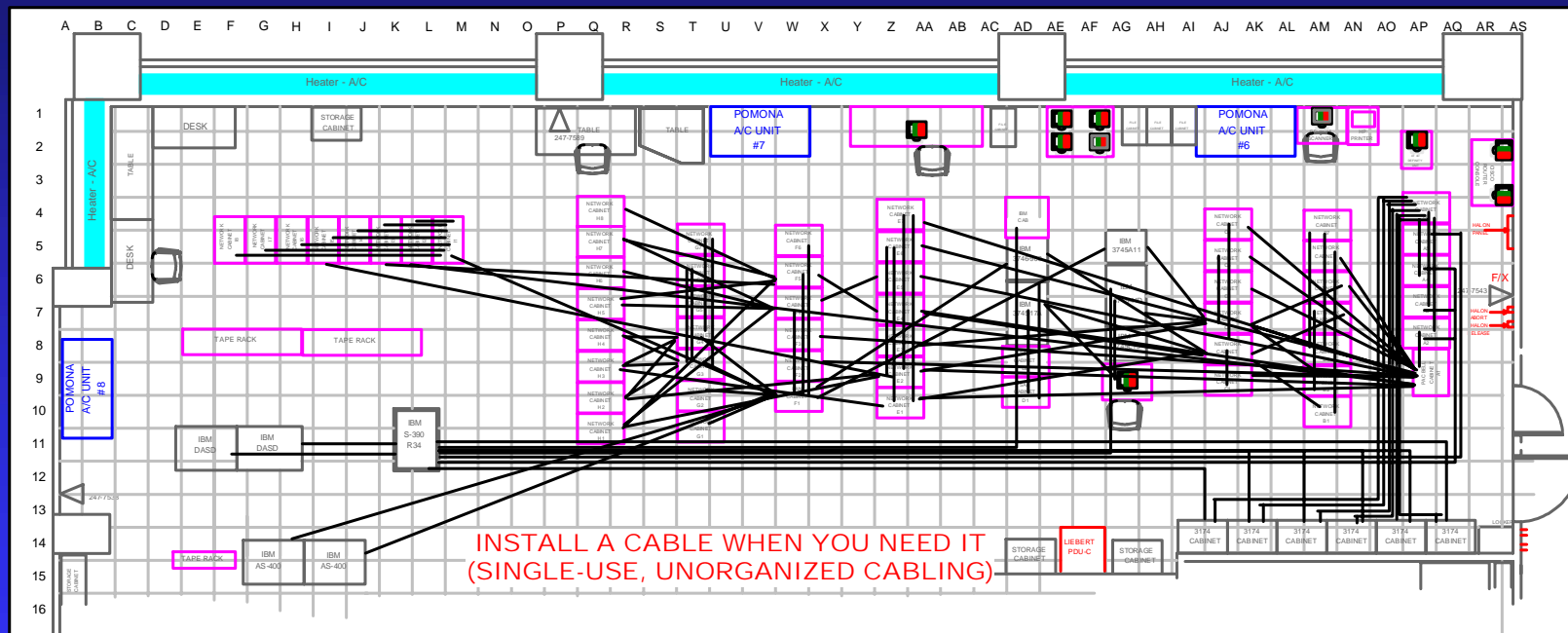
Purpose of TIA-942

- Define a standard telecommunications infrastructure for data centers
 - ◆ Structured cabling system for data centers using standardized architecture and media
 - ◆ Accommodates a wide range of applications (LAN, WAN, SAN, channels, consoles)
 - ◆ Accommodates current and future protocols (e.g., 10+ GbE)
 - ◆ Replaces unstructured point-to-point cabling that uses different cabling for different applications

Purpose of TIA-942

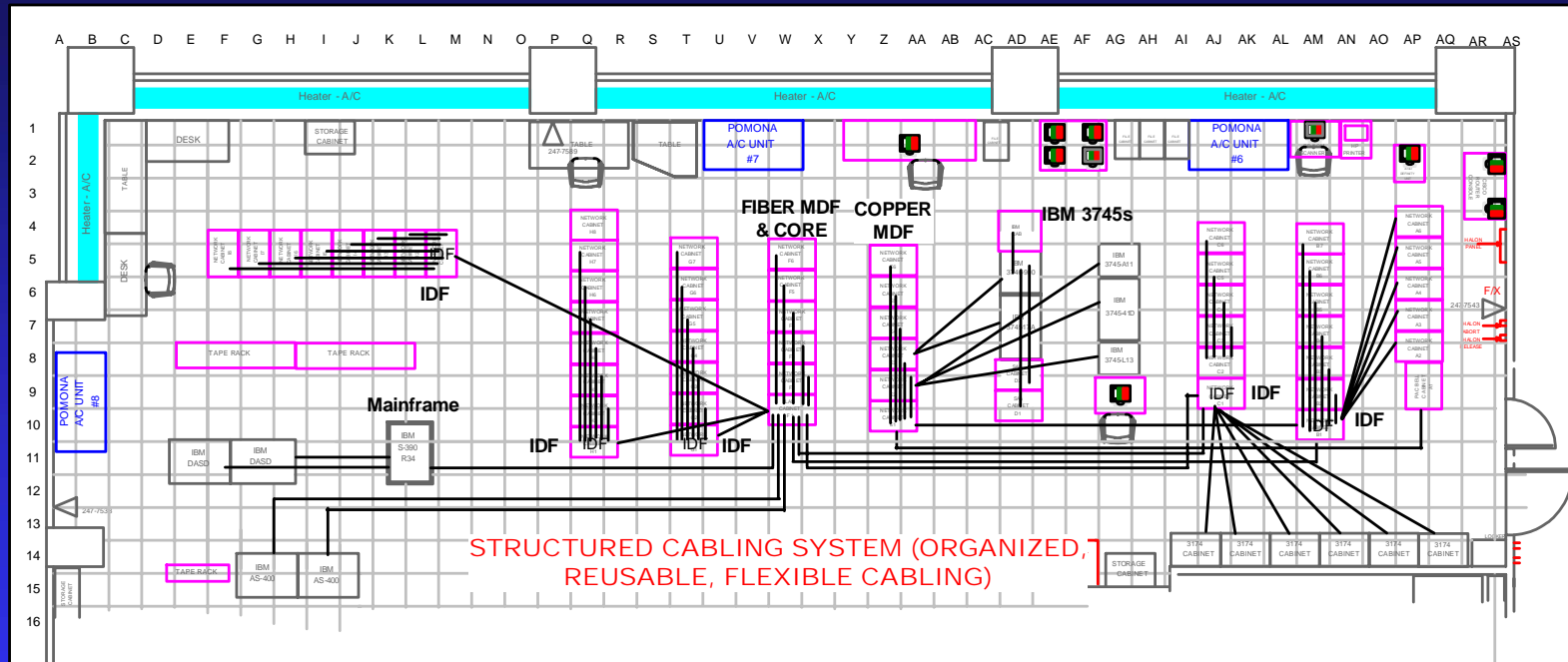
- Specifications for data center telecommunications pathways and spaces
- Recommendations on media and distance for applications over structured cabling
- Establish a standard for data center tiers to replace several proprietary standards. The TIA data center tier standard is:
 - A tool to evaluate existing data centers
 - A tool to communicate design requirements

Unstructured Cabling



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Structured Cabling



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Design Elements

- **Cabling Design**
- **Facility Design**
- **Network Design**

- **Informative annex's: Provide best practices**
 - ◆ **Annex A - Cabling Design Considerations**
 - ◆ **Annex B- Telecommunications infrastructure administration**
 - ◆ **Annex C-Access provider information**
 - ◆ **Annex D- Coordination of equipment plans with other engineers**
 - ◆ **Annex E- Data center space considerations**
 - ◆ **Annex F- Site selection**

Design Elements

- **Cabling Design:**

- ◆ **Copper and fiber cabling performance**
- ◆ **Connectors, cables, distribution hardware**
- ◆ **Cabling distances**
- ◆ **Space management**

- **Facility Design:**

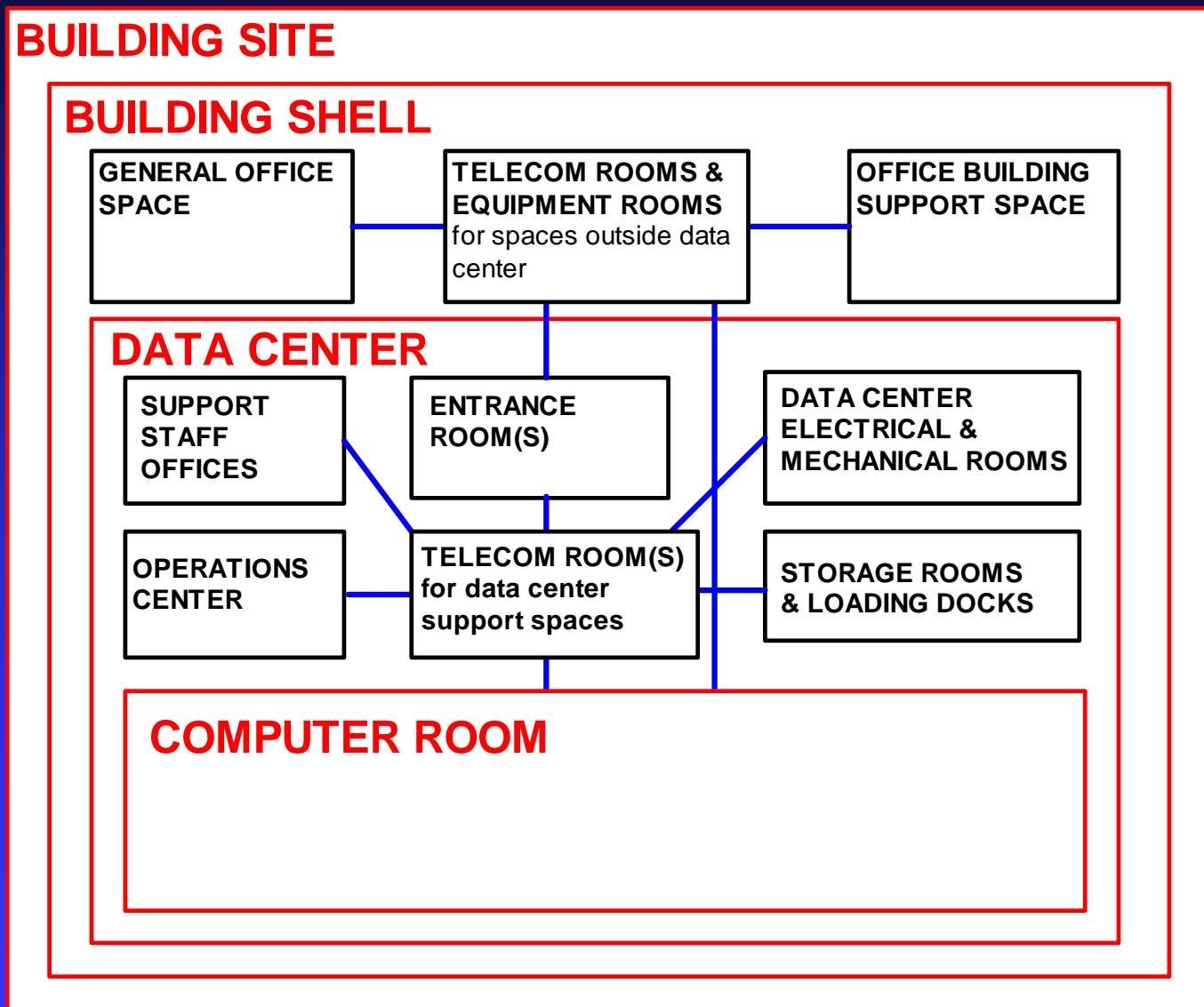
- ◆ **Data center sizing**
- ◆ **Power distribution methodologies**
- ◆ **Pathways and spaces**
- ◆ **HVAC, security, operations, and administration.**
- ◆ **Flexibility, scalability, reliability and space management**

Design Elements

■ Network Design:

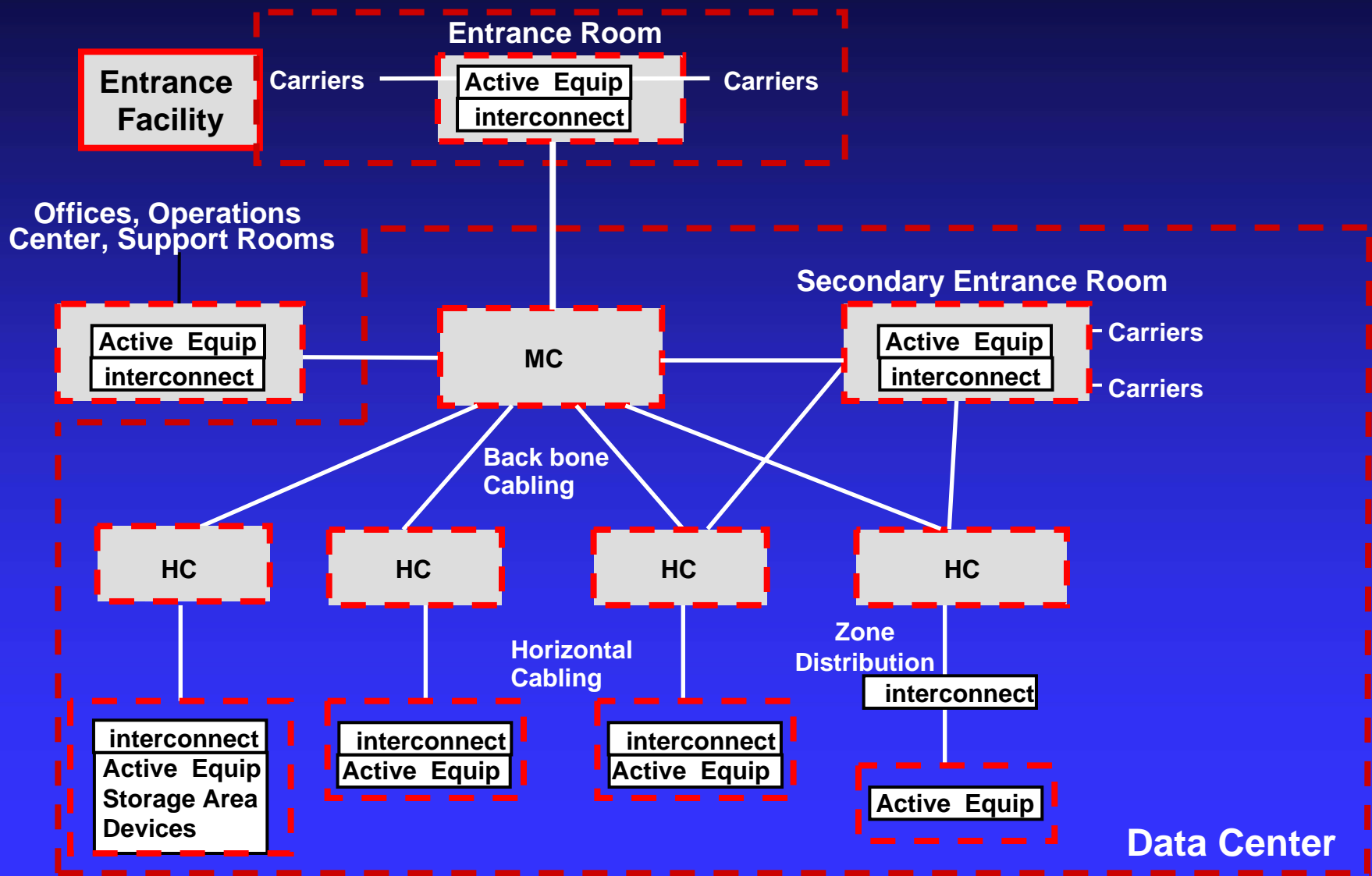
- ◆ Support of legacy systems
- ◆ Enable rapid deployment of new and emerging technologies such as 10 GbE and 10+ GbE copper and fiber applications.

Relationship of Spaces



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Data Center Topology

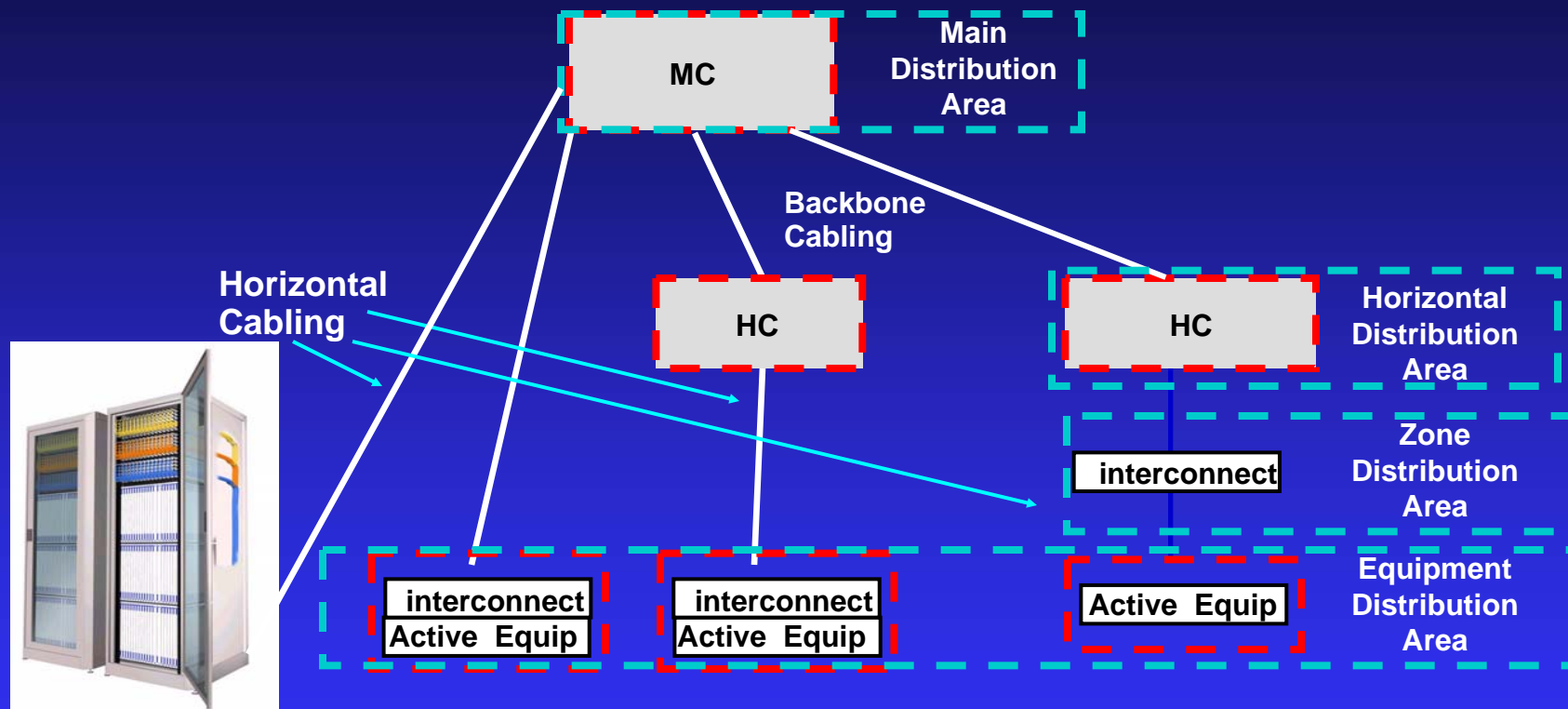


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TIA-942 Spaces

- **Entrance Room (ER)** - location of interface with campus and carrier entrance facilities
- **Main Distribution Area (MDA)** – location of main cross-connect (MC)
- **Horizontal Distribution Area (HDA)** – location of horizontal cross-connect (HC)
- **Zone Distribution Area (ZDA)** – location of zone outlet (ZO) or consolidation point (CP)
- **Equipment Distribution Area (EDA)** – location of equipment cabinets and racks

Data Center Cabling



Horizontal cabling is the cabling from the horizontal cross-connect (in the main distribution area or horizontal distribution area) to the outlet in the equipment distribution area or zone distribution area.

Horizontal and Backbone Cabling

- Recognized Cables:
 - ◆ a) 100-ohm twisted-pair cable (ANSI/TIA/EIA-568-B.2), category 6 recommended (ANSI/TIA/EIA-568-B.2-1)
 - ◆ b) multimode optical fiber cable, either 62.5/125 micron or 50/125 micron (ANSI/TIA/EIA-568-B.3), 50/125 micron 850 nm laser optimized multimode fiber is recommended (ANSI/TIA-568-3-1)
 - ◆ c) singlemode optical fiber cable (ANSI/TIA/EIA-568-B.3)
 - ◆ d) 75-ohm (734 and 735 type) coaxial cable (Telcordia Technologies GR-139-CORE)

Horizontal cabling distances

- The maximum horizontal distance is 90 m independent of media type.
- The maximum channel distance including equipment cords is 100 m.
- The maximum cabling distance in a data center not containing a horizontal distribution area is:
 - ◆ 300 m for an optical fiber channel including equipment cords.
 - ◆ 100 m for copper cabling including equipment cords.

Backbone Cabling

- Includes cabling from MDA to ER, HDA
- Optional cabling between HDAs allowed
- Maximum backbone cable lengths depend on applications to be supported
- Centralized optical fiber cabling supported with interconnect, splice, or pull-through at the HDA
- Star topology with no intermediate cross-connects
- Various topologies permit redundancy and flexibility to support various data center sizes

Computer Room & Entrance Room Requirements

- Min clear height of 2.6m/8.5 ft
- Min door size 1m/3ft wide 2.13/7ft high
- Min dist floor loading 7.2 kPA/150lbf/ft², recommended min 12 kPA/250 lbf/ft²
- 20 degrees C to 25 degrees C
- 40% to 55% relative humidity (reduces ESD)
- Any sprinkler systems must be pre-action system
- Common bonding network (CBN) – equipotential ground reference

Main Distribution Area

- Location of Main Cross-Connect (MC), the central point of distribution for data center structured cabling system
- Centrally located to avoid exceeding maximum distance restrictions (typically for E-1s, E-3s, T-1s and T-3s)
- Install separate racks for Fiber, UTP, and coaxial cable distribution

Horizontal Distribution Area

- Location of Horizontal Cross-Connect (HC), the distribution point for cabling to equipment distribution area
- Distribution LAN, SAN, KVM switches and console servers located in HDA
- MDA may also include an HC for nearby equipment distribution area
- Number of HDAs depends on the density of cabling and the size of the data center

Horizontal Distribution Area

- The capacity of the cable tray system and the size of the cross-connect creates practical limits on the size of the HC
- Guideline is maximum of 2,000 4-pair UTP or coax cable terminations per HDA
- Arrange patch bays to minimize patch cable lengths and to simplify cable management
 - ◆ Separate racks for fiber, UTP, and coax
 - ◆ Locate switches and patch panels to minimize patch cord lengths

Zone Distribution Area

- Rack, cabinet, or under floor enclosure that houses a zone outlet (ZO) or consolidation point (CP)
- ZO - structured cabling termination for floor-standing equipment that cannot accept patch panels (e.g. mainframes and large servers).
- CP - intermediate termination point (e.g. cabling to areas where floor plan is uncertain or dynamic)
- No cross-connects within the ZDA
- No active equipment shall be located in the ZDA
- Maximum of 144 connections in a ZDA
- Maximum of one ZDA within a horizontal cable run

Equipment Cabinets

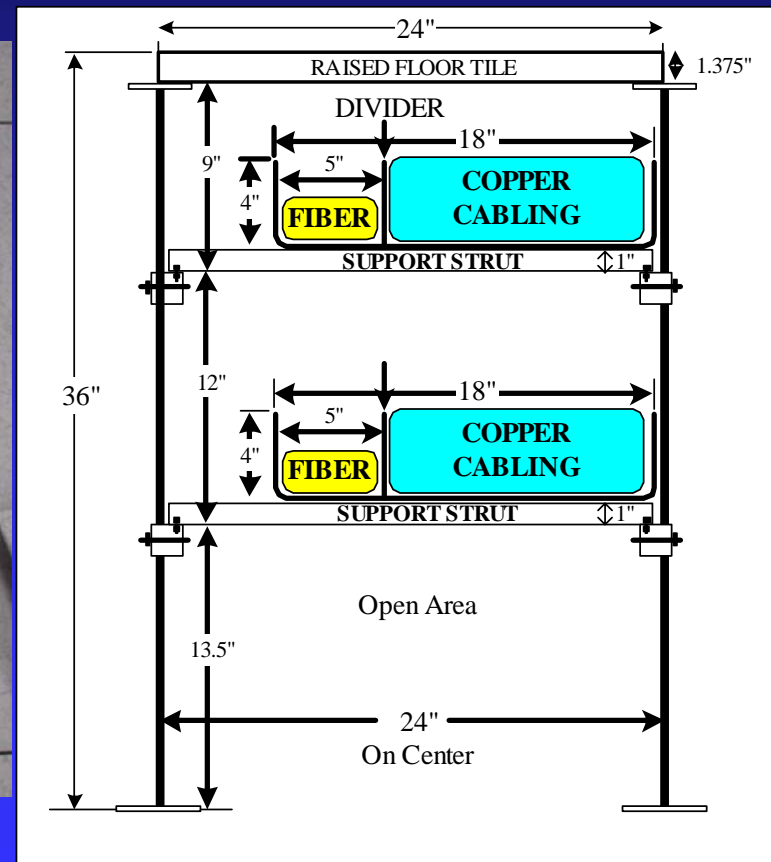


- Front rails of cabinets must be recessed to provide adequate room for patch cables and wire managers
- Recommend 1-to-1 ratio of patching to cable management
- Arrange switches and patch panels to minimize patching between cabinets & racks
- Perforated tiles at front of cabinets
- One edge of cabinets placed at edge of tile

Raised Floor

- Better appearance than overhead cabling.
- Allows higher power densities, better control of cooling, and more flexibility in location of cooling equipment
- Most stand-alone computer systems are designed for cabling from below
- Coordinate under floor cabling with mechanical & electrical engineers
- Recommend wire basket cable trays in hot aisles for telecom cabling

Example of Wire Basket Cable Trays For Cabling Under Raised Floor



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Overhead Cable Trays

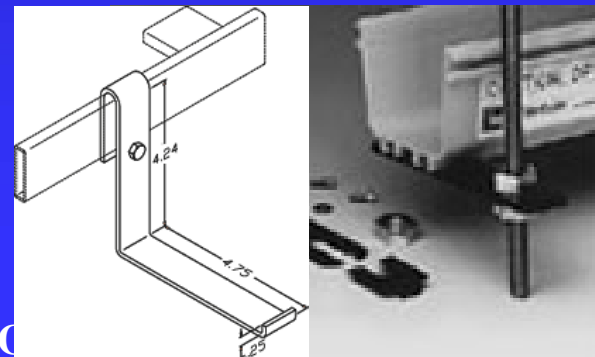
- Less expensive than raised floor systems
- Cable trays can be attached to the top of racks and cabinets (if they are uniform in height)
- Cable trays suspended from the ceiling provides more flexibility for supporting cabinets/racks of various heights and for adding and removing cabinets/racks.
- Cable trays can be installed with several layers
- Coordinate location with lighting, ducts, overhead conduits, overhead power distribution

Overhead Cable Tray Example



3 Layer cable tray system:

- Bottom layer – signal
- Middle layer – power
- Top layer – fiber
- Signal Reference Grid in brackets attached to lower layer of trays
- Fiber patch cables may be in fiber duct attached to threaded rods

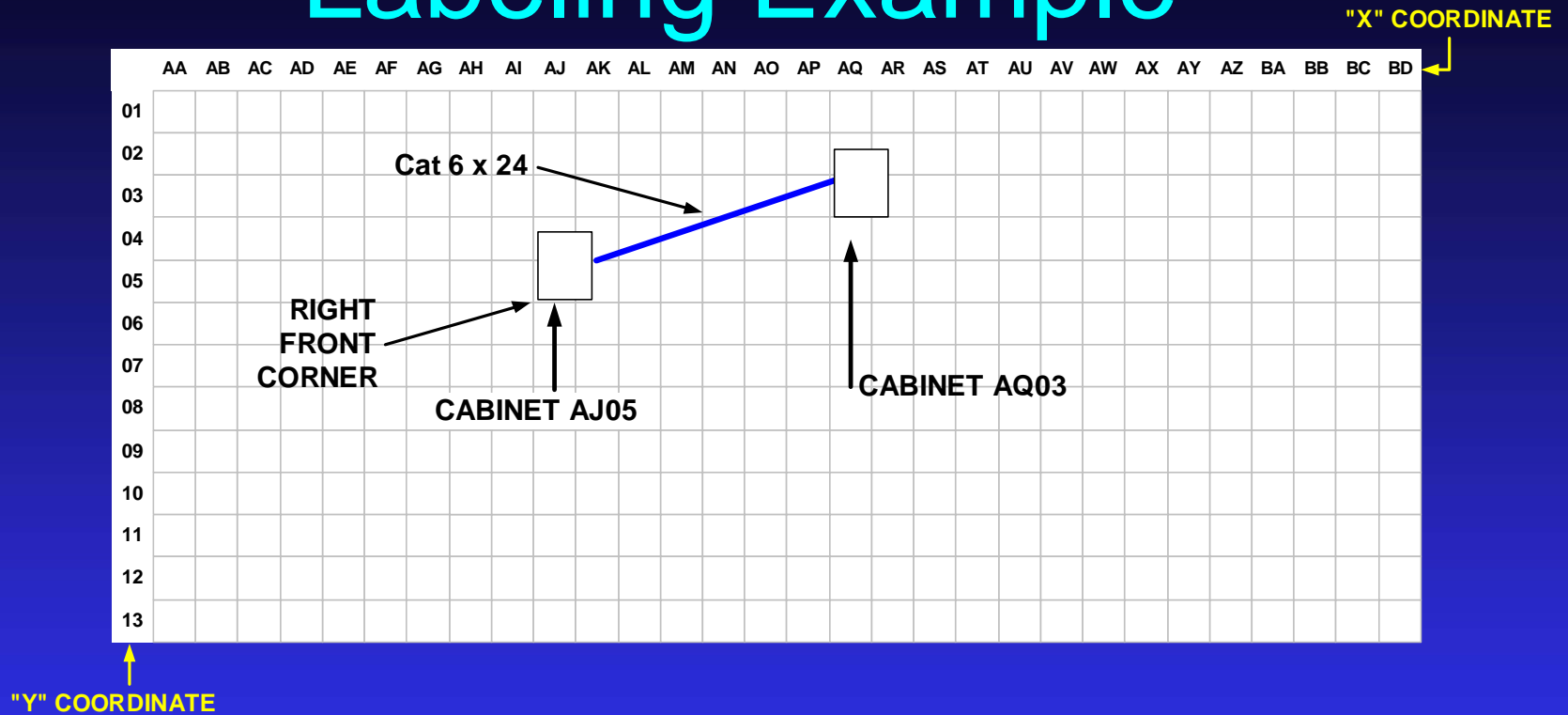


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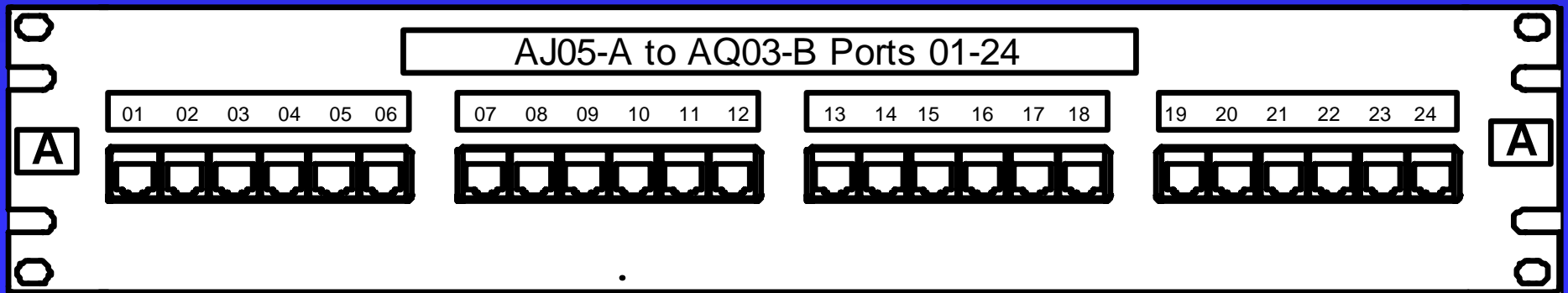
Infrastructure Administration

- Informative annex with TIA-606-A standards compliant labeling scheme for all components.
- Labeling scheme extended for use in data centers
- Cabinets and racks labeled by location using tile grid or row/position identifiers
- All cabinets, racks, patch panels, cables, and patch cords should be labeled

Labeling Example



Patch Panel for 24 Cat 6 from 1st Panel in Cab AJ05 to 2nd Panel in Cab AQ03



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Site Selection

- Informative annex with guidelines for selection of a site for a data center
 - ◆ Architectural
 - ◆ Electrical
 - ◆ Mechanical
 - ◆ Telecommunications
 - ◆ Security
 - ◆ Other

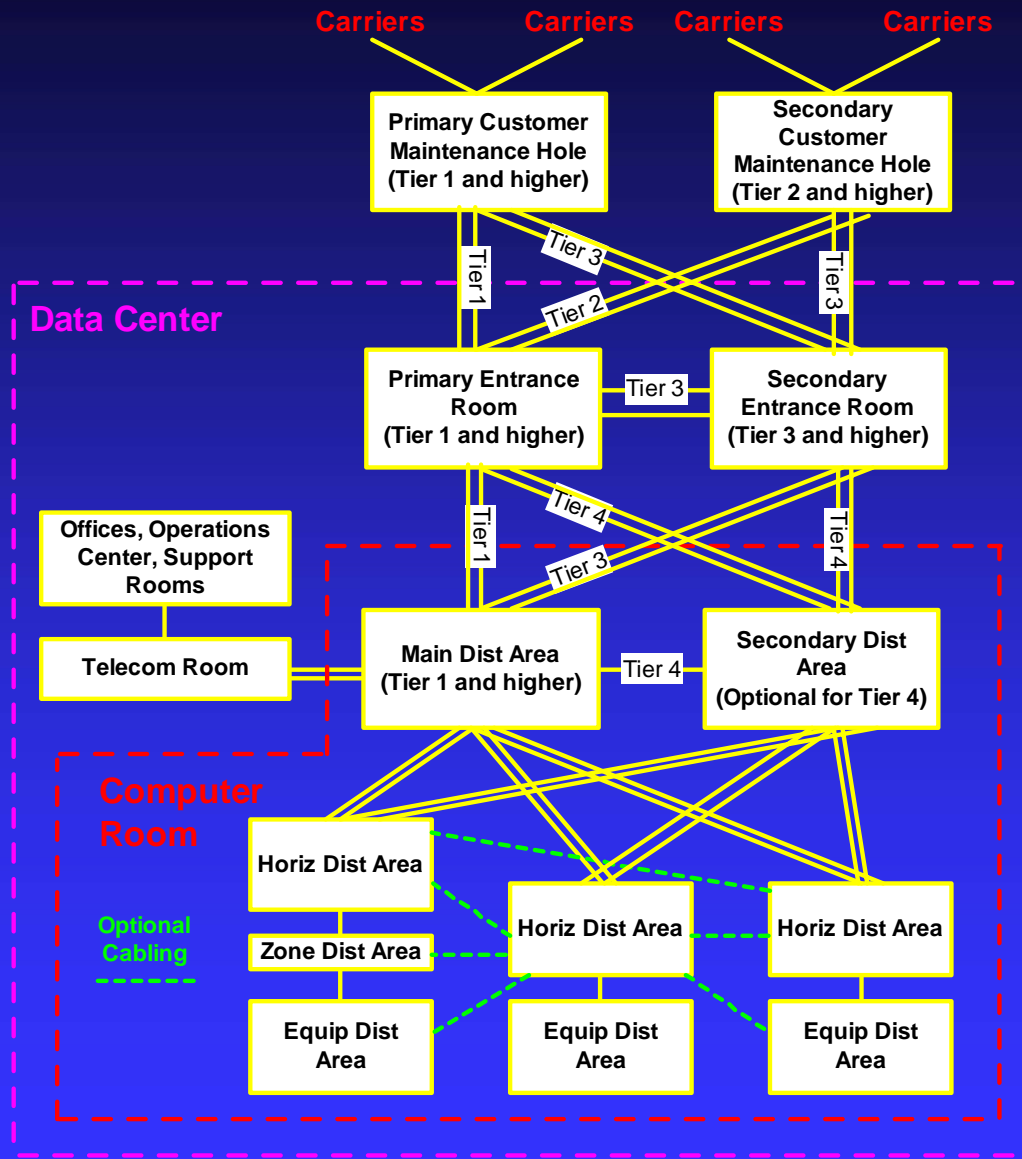
Facilities Specifications & Tiers

- Informative annex with general architectural, structural, electrical, mechanical, and telecommunications recommendations requirements
- Annex includes detailed architectural, security, electrical, mechanical, and telecommunications recommendations for each Tier
- Recommended specifications by tier are a uniform way to rate aspects of a data center design and are a starting point for initiating design requirements with qualified architects and engineers

Data Center Tiers

- Tier 1 – basic data center
 - ◆ no redundancy
- Tier 2 – redundant components
 - ◆ Single distribution path with redundant components
- Tier 3 – concurrently maintainable
 - ◆ Multiple distribution paths with only one active
- Tier 4 – fault tolerant
 - ◆ Multiple active distribution paths

Redundant Topologies



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Data Center Tiers

- Higher tiers correspond to higher availability, but also have higher construction costs
- Data Center can have different tier ratings for different portions of its infrastructure (architectural, security, mechanical, electrical, telecommunications)
- The overall rating for the data center is equal to the lowest tier rating
- Capacity of systems may need to be upgraded to maintain tier rating as data center load increases
- Human error and operating procedures have a major impact on availability

Conclusion

- TIA-942 is the first standard to specifically addresses data center infrastructure.
- Primarily a telecom infrastructure standard, but about half of the content deals with facility requirements.
- Provides a flexible and manageable structured cabling system using standard media.
- Builds on existing standards, when applicable
- Guidelines on a wide range of subjects useful to someone designing or managing a data center.
- An official tiering standard for determining the quality of a center. A way to objectively compare one center with another.