ANSI/TIA-942 Telecommunications Infrastructure Standards for Data Centers

Jonathan Jew – jew@j-and-m.com
J&M Consultants, Inc
Co-chair TIA TR-42.1.1 data center committee
Co-chair BICSI data centers standards committee

Purpose of the Standard

- Encourage early participation of telecom designers and information technology professionals in the data center design process
- A data center that is intelligently designed to accommodate the needs of the equipment and technologies it is meant to house need not be more expensive than one that is not, but it will certainly be more usable.

Purpose of the Standard

- Fill a void by providing nationally recognized standards for the planning of data centers.
- Provide information for a data center owners to understand data center design tradeoffs and to communicate design requirements to engineers and architects

Purpose of the Standard

- 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 known future protocols (10 Gigabit Ethernet & 10 Gigabit Fibre Channel)
  - Replaces unstructured point-to-point cabling that uses different cabling for different applications

Purpose of the Standard

- Specify data center telecommunications pathways and spaces
- 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

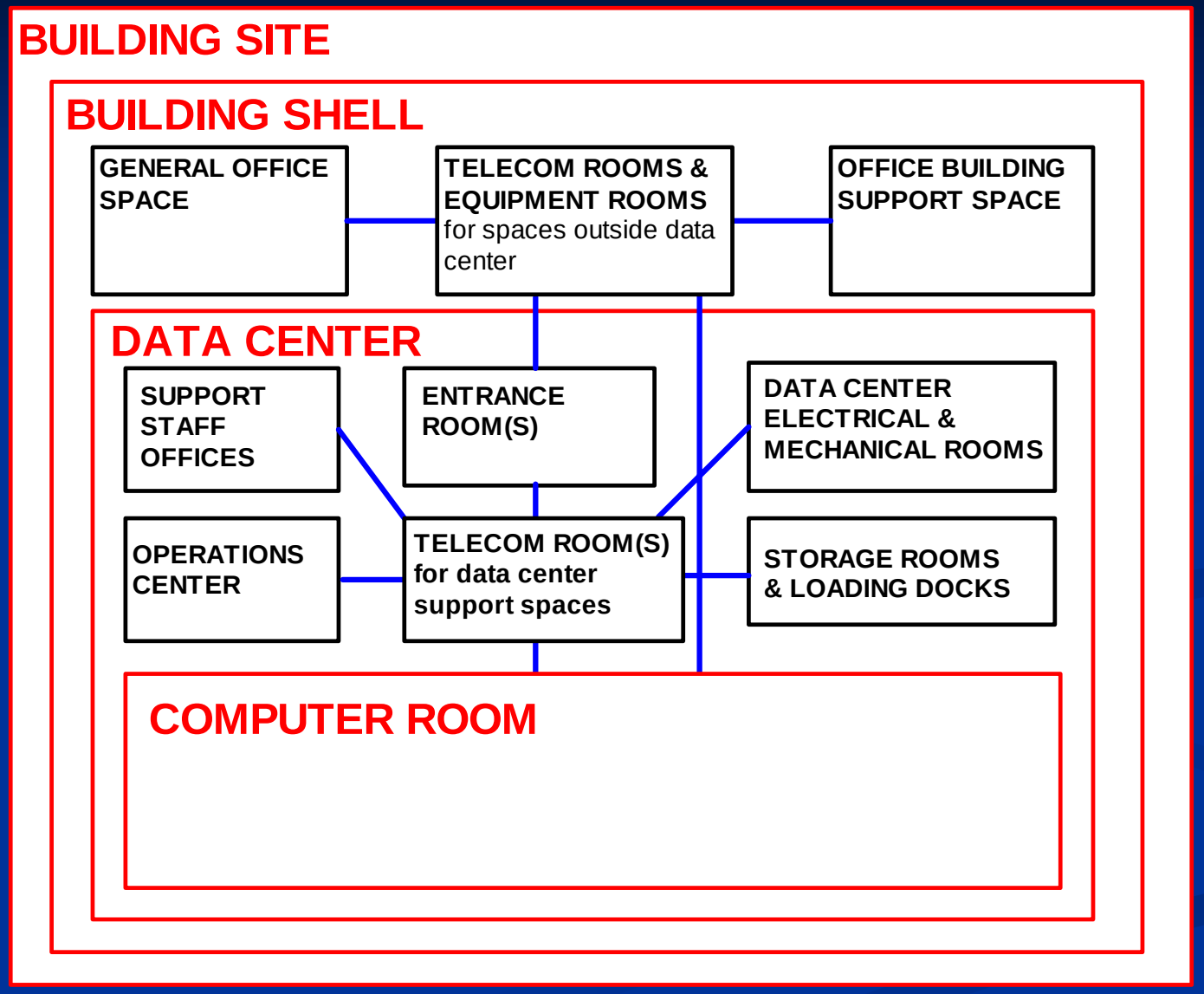
Who Developed the Standard

- The standard was developed by the TIA TR-42.1.1 Network Distribution Nodes subcommittee as Project No. 3-0092 (co-chairs Jonathan Jew & Chris DiMinico)
- Participants included:
  - Architecture & Engineering Firms
  - Consultants
  - End Users
  - Cabling and Equipment Manufacturers
- Was approved for publication on Feb 3, 2005
- Available now – www.tiaonline.org

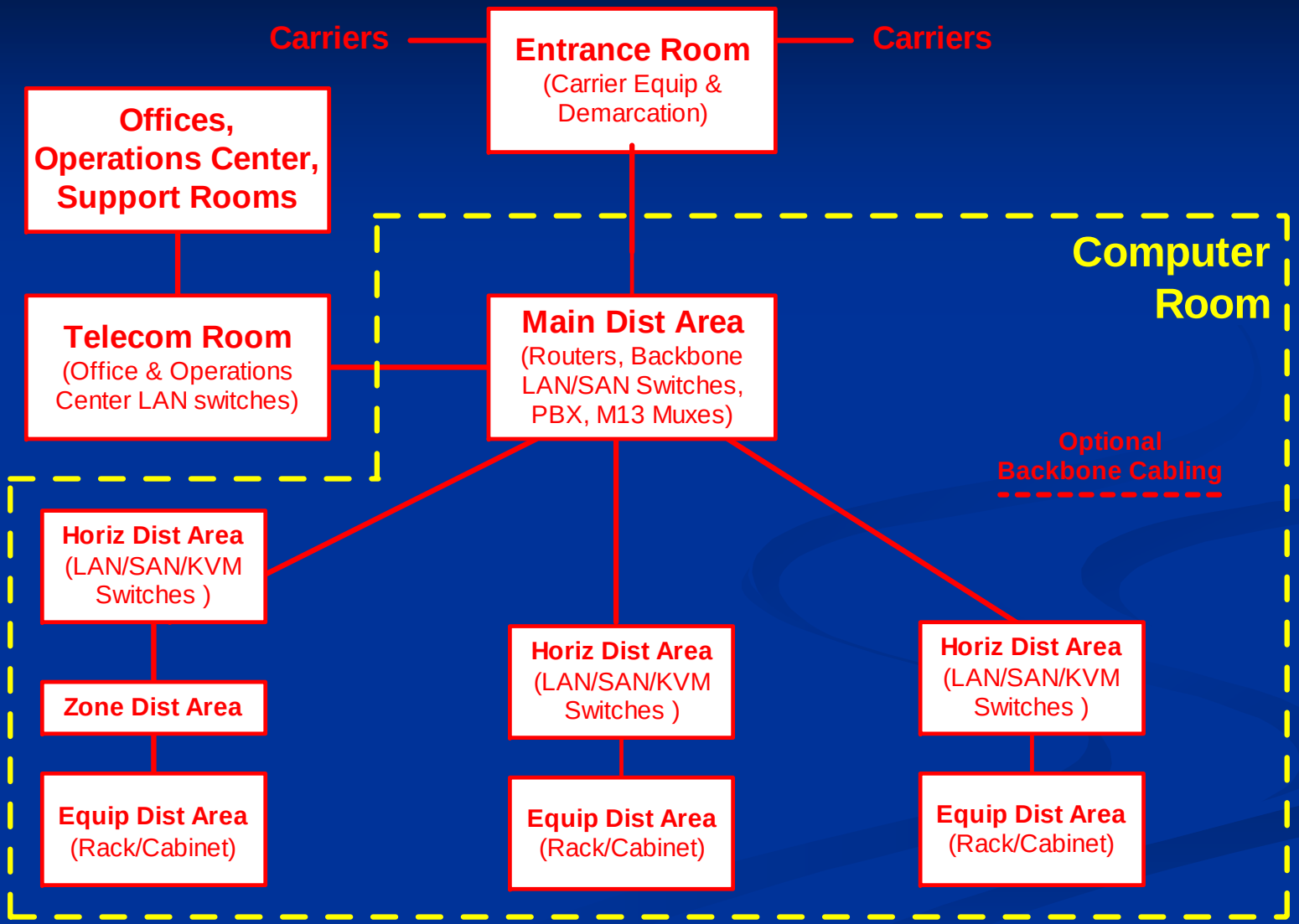
Coordination with Other Data Center Standards

- Review and Liaison with data center industry organizations – The Uptime Institute and 7x24 Exchange
- ASHRAE Thermal Guidelines for Data Processing Environments (2004)
- IEEE 1100 Revision 2 Recommended Practice for Powering and Grounding Electronic Equipment (2005)
- CENELEC EN 50173-5 Information Technology – Generic Cabling Systems Part 5: Data Centres (2006)
- ISO/IEC – new project (2007?)
- BICSI Data Center Design and Implementation Best Practices (2006) – Jonathan Jew & John Kacperski – co-chairs

Relationship of Spaces



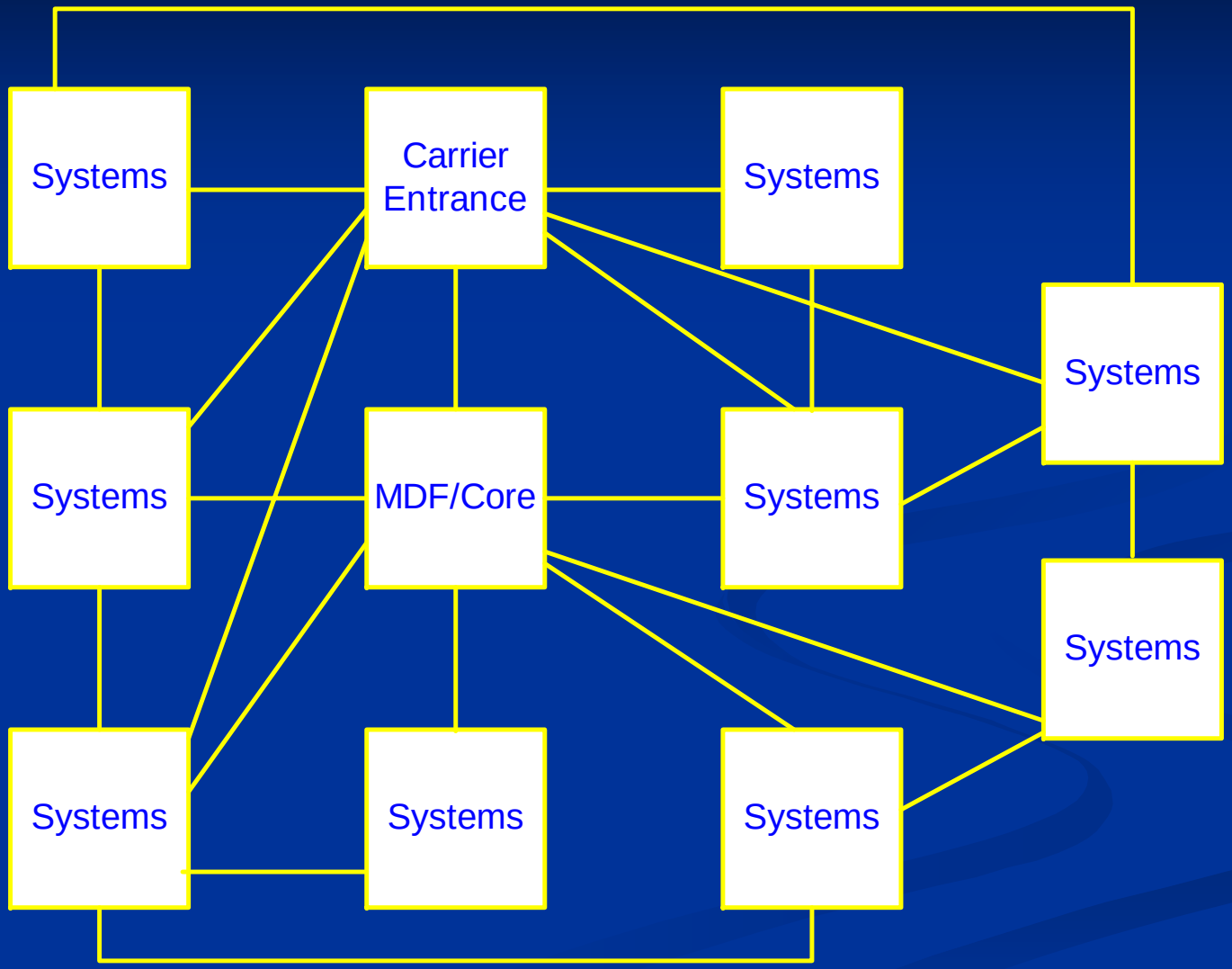
Data Center Telecommunications Spaces



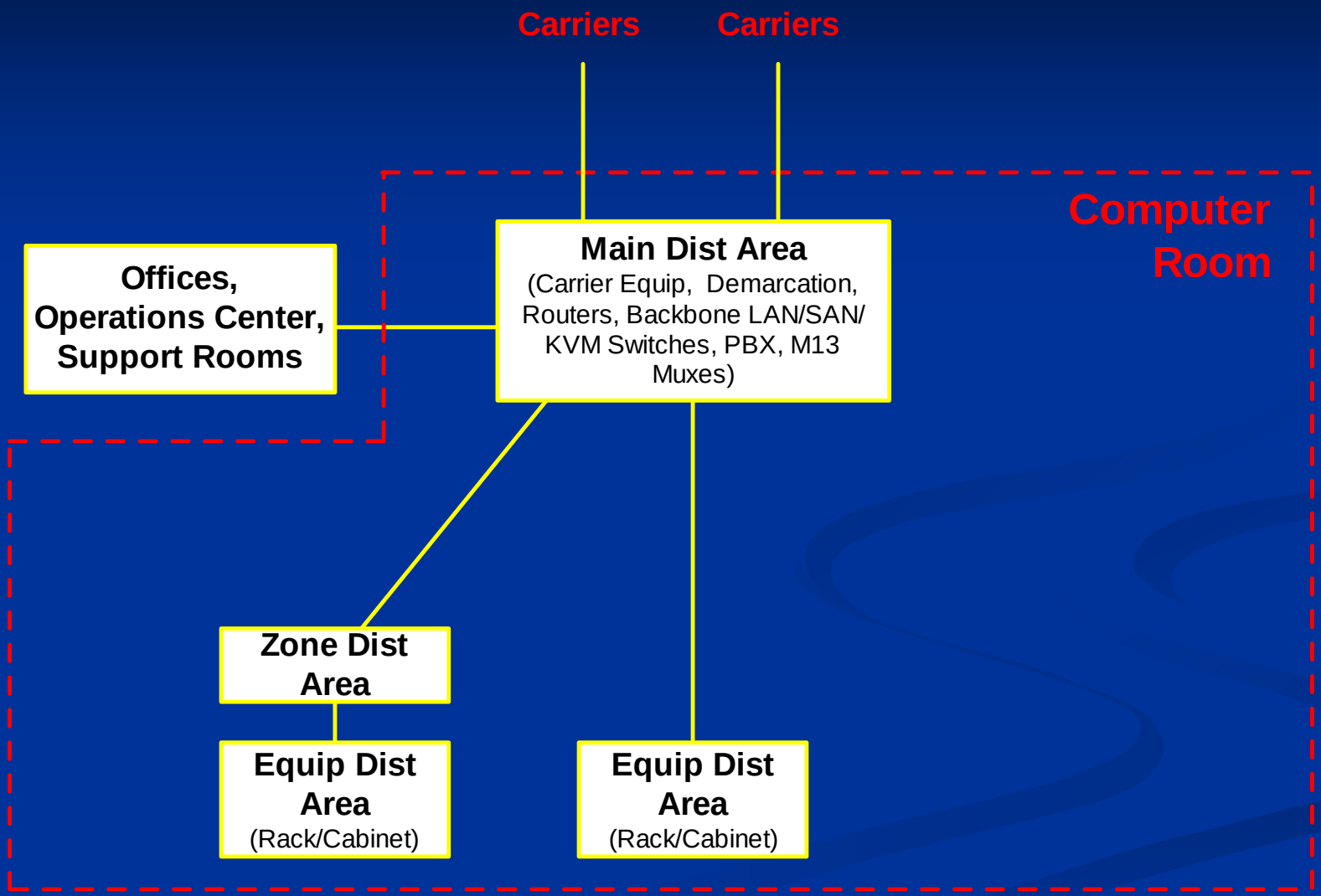
TIA-942 Spaces

- 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

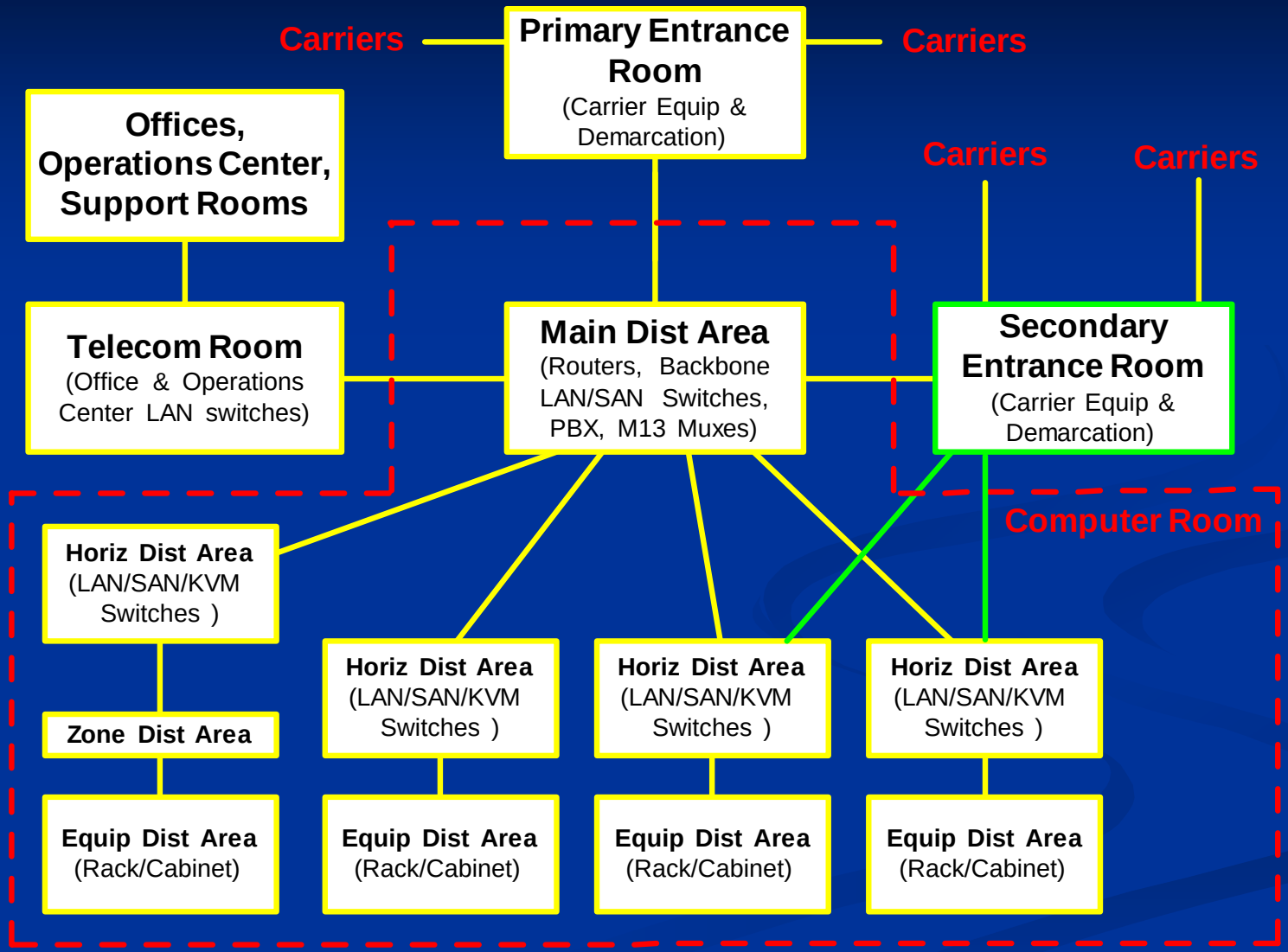
Unstructured Cabling



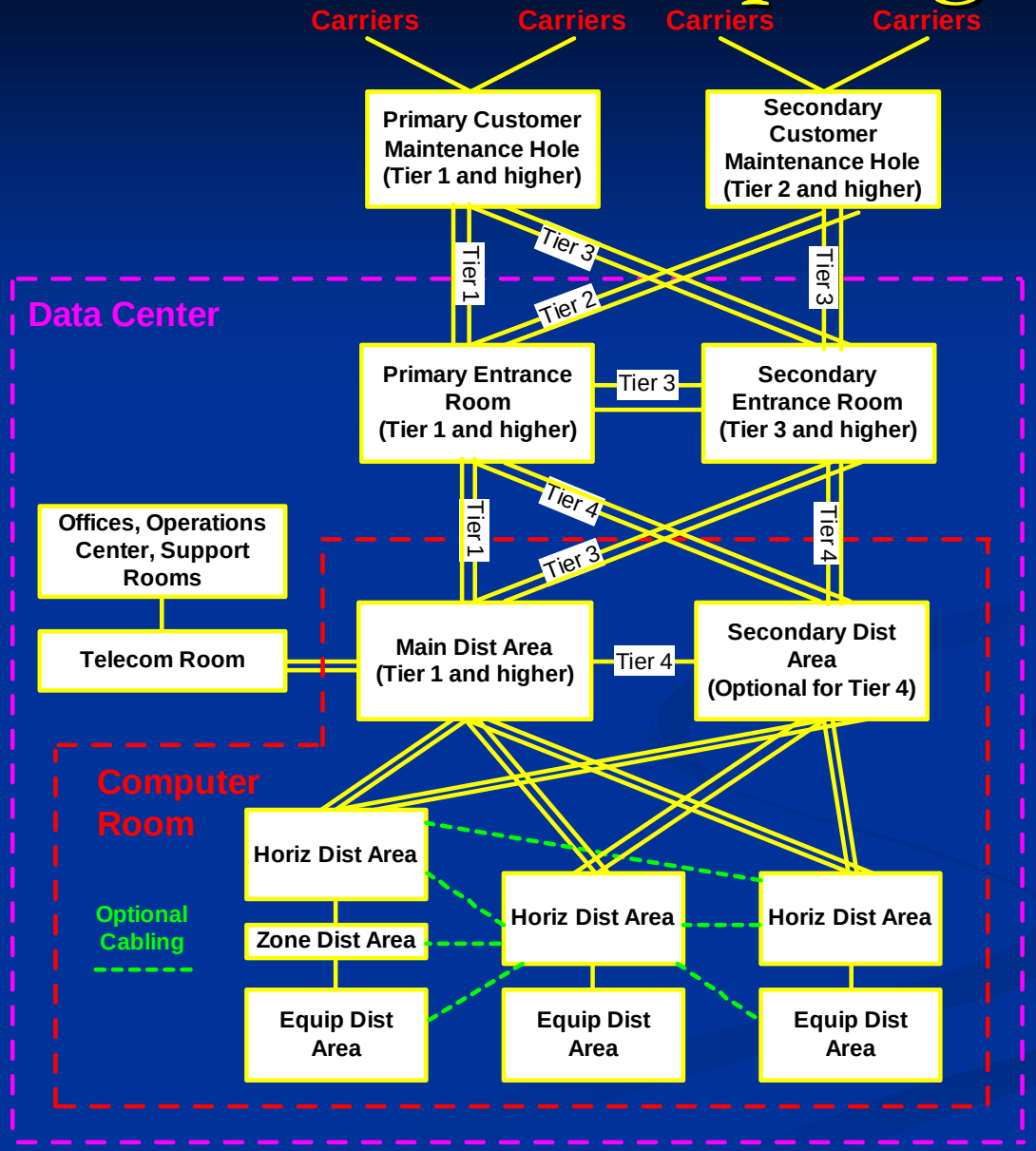
Collapsed Topology



Distributed Topology with Multiple ERs



Redundant Topologies



Data Center Cable Types

- Single-mode fiber (SONET/SDH, MAN, LAN)
- Multimode fiber (MAN, LAN, SAN) 850-nm laser optimized 50/125 recommended
- 734-type coax (E-1/E-3/DS-3) two per circuit
  - 20 AWG solid conductor, 75-ohms
  - Use 75-ohm BNC connectors and panels.

Data Center Cable Types

- Category 6 or Augmented Category 6 UTP - E-1, T1 & lower speed circuits, voice, MAN, LAN, KVM, console
- Category 3 UTP – low speed circuits
- Proprietary – IBM Parallel Channel & other (outside scope of TIA-942)
- Mainframe terminals, consoles, ESCON & FICON can be accommodated by structured cabling system but are outside scope of standard
- TIA 232, V.35, SCSI, other (outside scope of TIA-942)

Carrier Circuit Lengths in Data Centers

- Cat 3 instead of Cat 5e or Cat 6 reduces circuit lengths for T-1s and E-1s significantly
- 735 coax (mini-coax) instead of 734 coax reduces circuit lengths for T-3s, E-1s, and E-3s significantly
- Circuit length restrictions may :
  - require additional entrance rooms,
  - limit the location of telecom equipment,
  - limit the size of the computer room

Carrier Circuit Lengths in Data Centers

Maximum cable lengths for common circuits:

- E-1's over 24 AWG Cat 5/5e/6 UTP:

  517 ft (158 m) - 6.4 ft (2 m) per patch panel

- T-1's over 24 AWG Cat 5/5e/6 UTP:

  677 ft (206 m) - 6.4 ft (2 m) per patch panel

- E-3's over 734 coax:

  574 ft (175m) – 17.5 ft (5.3 m) per patch panel

- T-3's over 734 coax:

  524 ft (160m) – 15.3 ft (4.7 m) per patch panel

Distances are from carrier demarcation point to end equipment and assume no customer DSX.

Computer 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/ft^2, recommended min 12 kPA/250 lbf/ft^2
- 20°C to 25°C
- 40% to 55% relative humidity (reduces ESD)
- Any sprinkler systems must be pre-action system
- Common bonding network (CBN) – equipotential ground reference
- Bond all cabinets and racks individually to CBN
- Bond cable trays, conduits, HVAC units, building columns, PDUs, panel boards, raised floor (every 6^{th} pedestal) to CBN

Entrance Room

- Demarcation to carriers
- Telecom Entrance & Campus Conduits
- Carrier Racks
  - Coordinate power and space requirements with each carrier
  - Provide either AC or DC power to carriers.
  - If ER only has AC power, carriers install DC power from rectifiers to their racks & cabinets
- Plywood for protectors
  - Not required if no copper entrance cables or if carrier will install protectors on frames or racks

Entrance Room

- ER may be inside data center but, location outside data center provides best security
- ER may be consolidated with MDA
- ER requires the same redundancy for power and cooling as the computer room space
- Locate ER to avoid exceeding maximum cable lengths for circuits
- Cabling distances for carrier circuits may dictate multiple ERs in large data centers

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

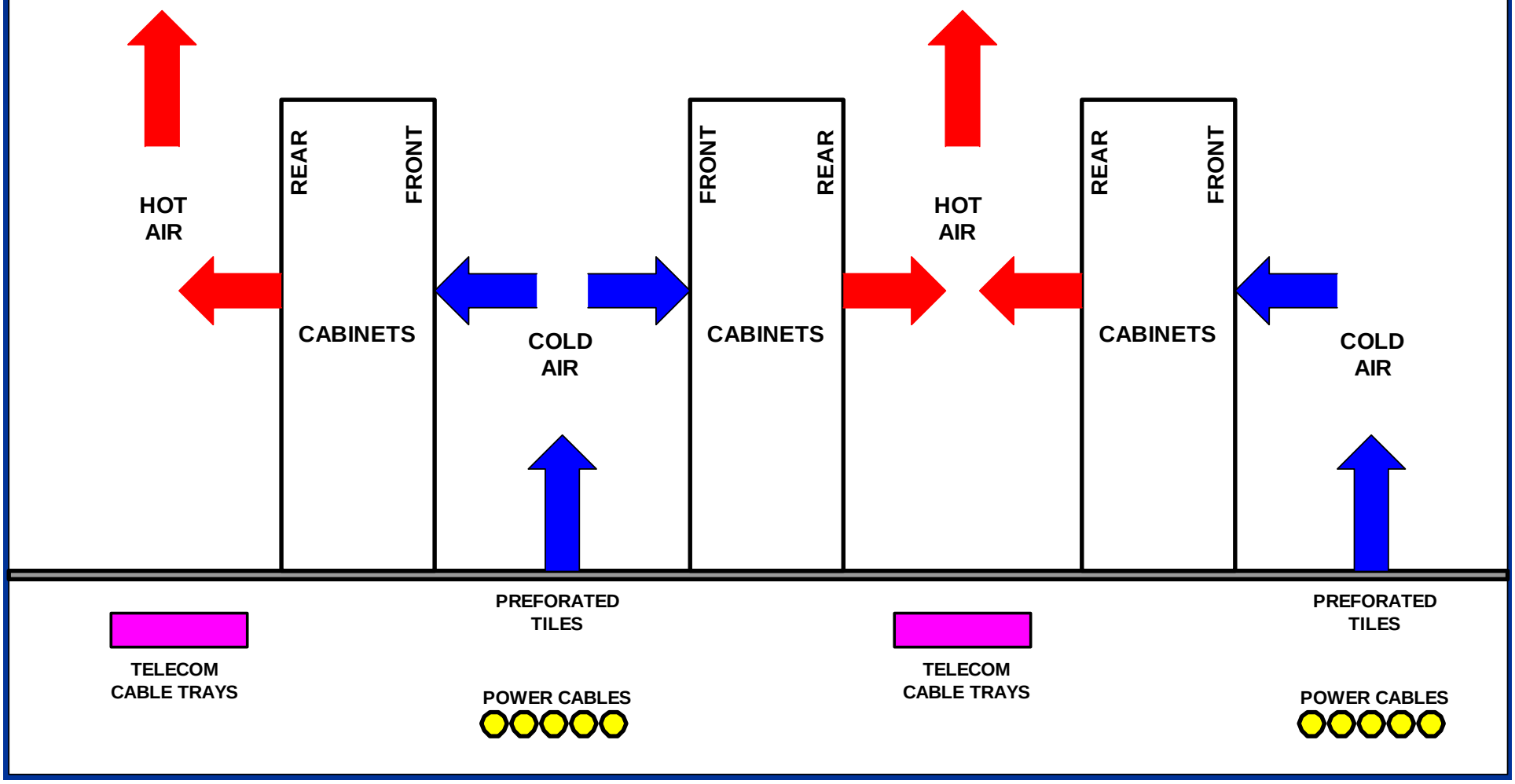
Horizontal Distribution Area

- 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
- The capacity of the cable tray system and the size of the cross-connect limit the size of the HC

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 active equipment shall be located in the ZDA
- Maximum of 288 connections in a ZDA
- Maximum of one ZDA within a horizontal cable run

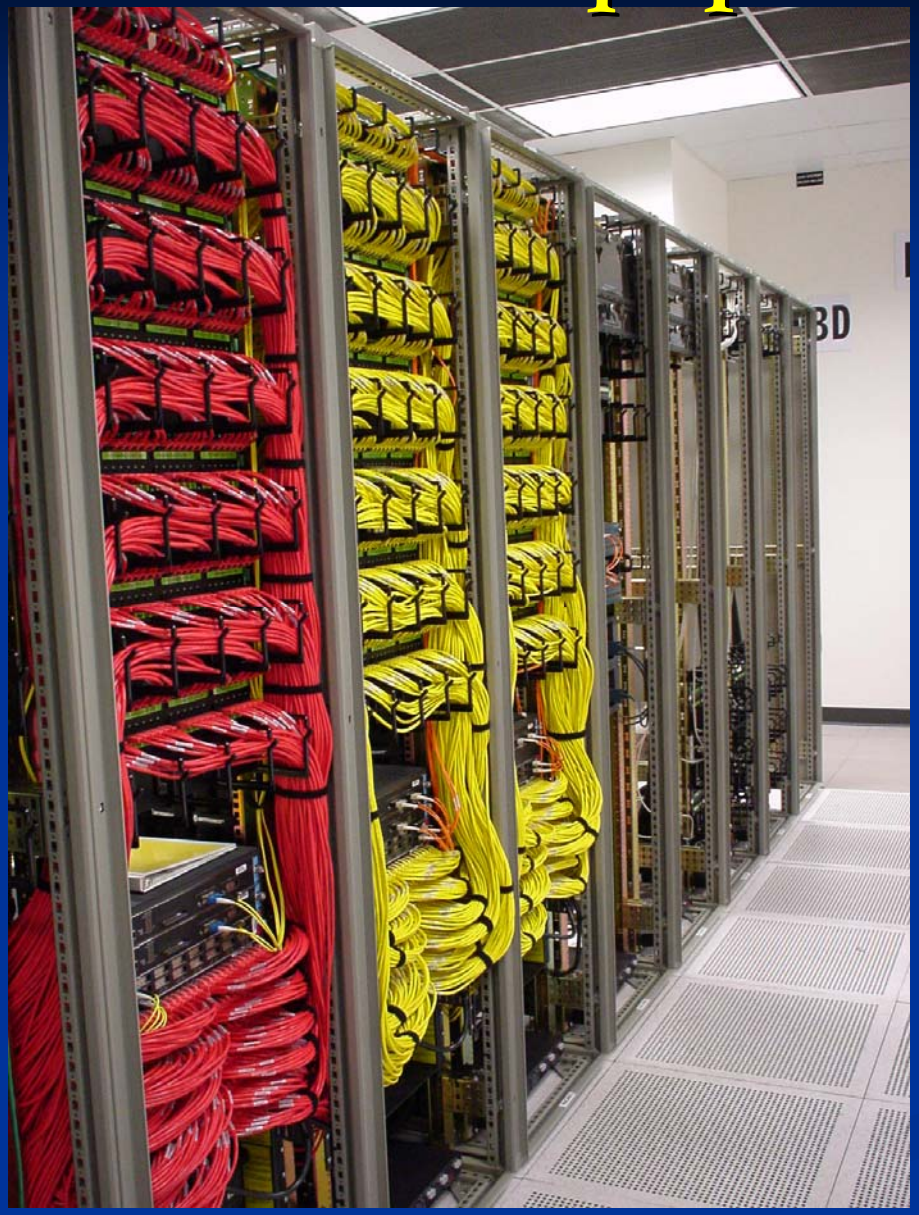
HOT AND COLD EQUIPMENT AISLES



Equipment Racks & Cabinets

- Equipment is mounted in racks & cabinets from the front – provide adequate clearance for installation of equipment (minimum of 3 feet, 4 feet is recommended).
- Cabinets and racks should be aligned with one edge along the edge of the floor tile.
- Arrange cabinets and racks on raised floor to permit tiles along the front and rear of the cabinets and racks to be lifted
- Floor tile cuts should be no larger than necessary to minimize air pressure loss.

Equipment Cabinets

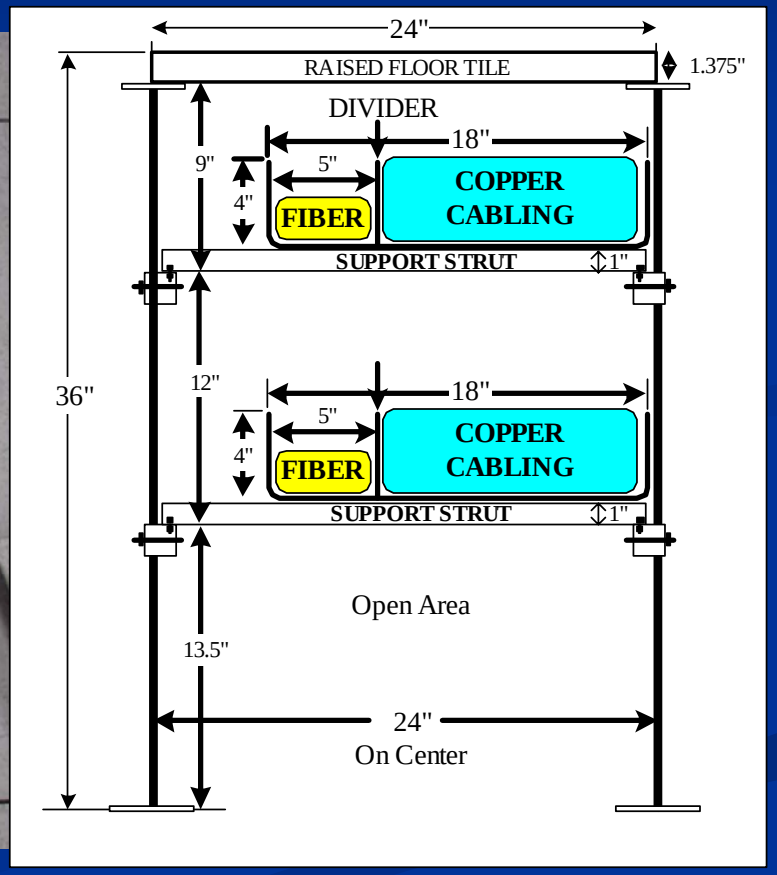


- Front rails of cabinets must be recessed to provide adequate room for patch cables and wire managers
- Adequate space for cable management
- Arrange switches and patch panels to minimize patching between cabinets & racks
- Perforated tiles at front of cabinets
- One edge of cabinets placed at edge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

Raised Floor

- More flexible cooling with raised floor than ducted air
- 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



Under Floor Example

- Color-coded PDU cables in hot aisles each cabinet fed from 2 PDUs
- Locking electrical receptacles NEMA L5-20R
- Signal Reference Grid (SRG) using bare copper conductor
- Each cabinet bonded to SRG

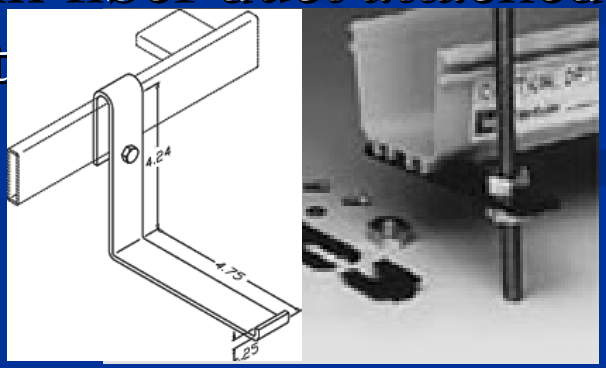
Overhead Cable Trays

- 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 provide 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 – copper
- Middle layer – fiber
- Top layer – power
- Signal Reference Grid in brackets attached to lower layer of trays
- Fiber patch cables may be in fiber duct attached to t



Facilities Specifications & Tiers

- Informative annex with general architectural, structural, electrical, mechanical, and telecommunications recommendations
- Annex includes detailed architectural, security, electrical, mechanical, and telecommunications recommendations for each Tier (expands on The Uptime Institute Tiers)
- 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.

Future Work

- Additional revisions to electrical sections for harmonization with IEEE 1100 draft 2
- High heat density issues
- Augmented Category 6 UTP – 10 Gigabit Ethernet over UTP (10GBase-T)
- 10GBase-T over standard Cat 6 (up to 55 meters) with mitigation:
  - Unbundle and randomize cables in the first 5 to 20 meters
  - Unbundle and randomize patch cords
  - Eliminate intermediate patch panels between horizontal cable patch panels and switches
  - Use non-adjacent Cat 6 UTP ports for 10GBase-T
  - Use Aug Cat 6 or shielded patch cords
  - Longer patch cords
  - Separate long and short cable runs

Conclusion

- TIA-942 is the first standard that 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.
- Guidelines on a wide range of subjects useful to someone designing or managing a data center.
- An official tiering standard for evaluating data centers. A way to objectively compare one center with another.
- Standard is available at www.tiaonline.org