ANSI/TIA-942 Telecommunications Infrastructure Standard for Data Centers

Jonathan Jew – jew@j-and-m.com
J&M Consultants, Inc
Co-chair TIA TR-42.1.1 data center working group
Co-chair BICSI data centers standards subcommittee
US Project Lead ISO/IEC data center standard

© 2006 J&M Consultants, Inc

Data Center Telecom 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

Purpose of TIA-942

- Fill a void by providing nationally recognized standards for the design of data center telecommunications infrastructure.
- Provide information for a data center owners to understand data center design tradeoffs and to communicate design requirements to engineers and architects
- Establish a standard for data center tiers to replace several proprietary standards.

Purpose of TIA-942

- Encourage early participation of telecom designers and information technology professionals in the data center design process
- Ensure that data centers can accommodate the needs of the equipment and technologies:
  - Adequately sized cabling pathways
  - Adequately sized and properly located telecom spaces
  - Adhere to cabling distance restrictions for planned applications

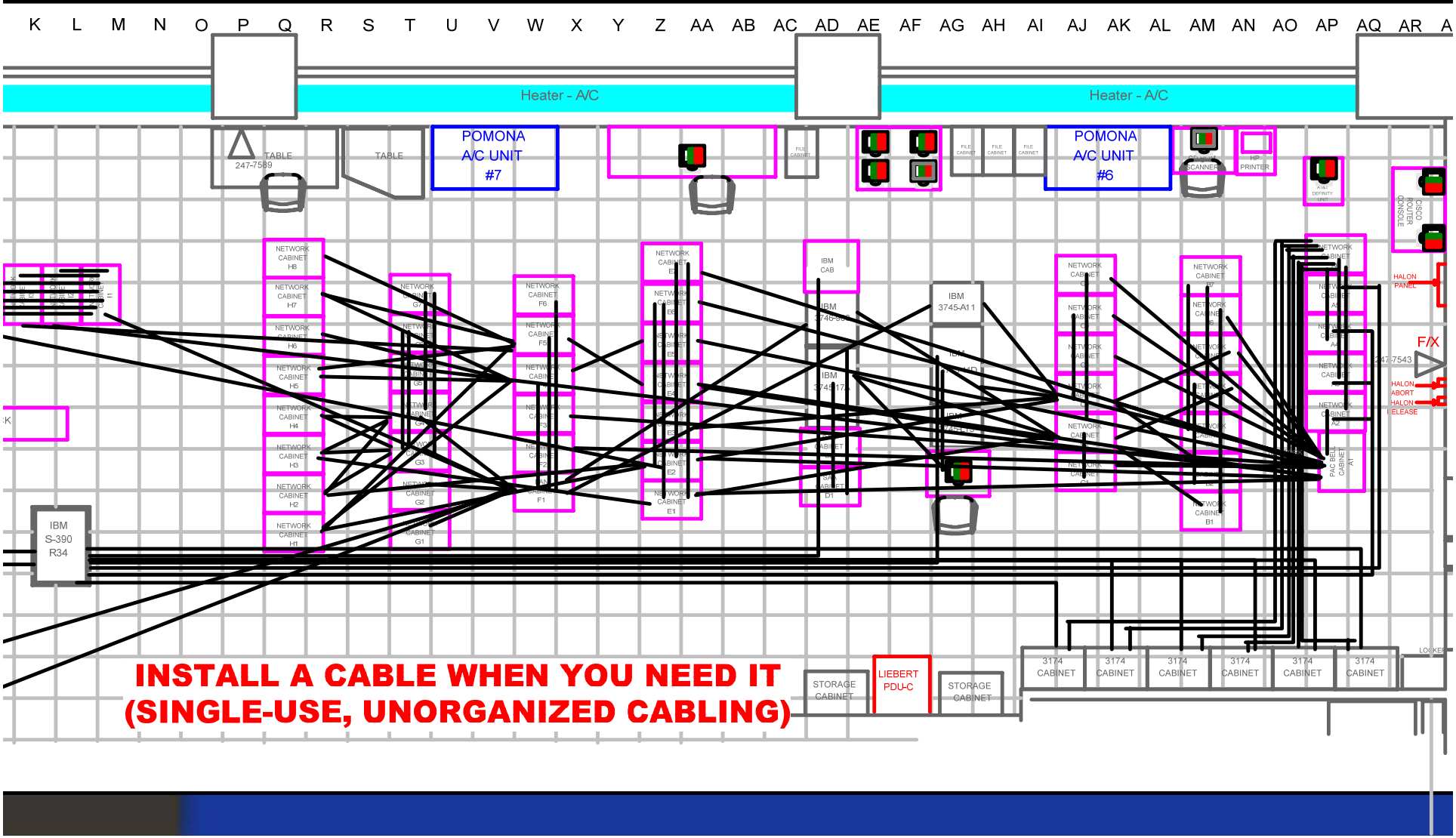
Purpose of TIA-942

- Define a standard telecommunications infrastructure for data centers
  - Structured cabling system for data centers using standardized architecture and media
  - Accommodate a wide range of applications (LAN, WAN, SAN, channels, consoles, building automation systems)
  - Accommodate current and known future protocols (10 Gigabit Ethernet & 10 Gigabit Fibre Channel)
  - Replace unstructured point-to-point cabling that uses different cabling for different applications
  - Standards for data center telecom spaces and pathways
  - Labeling scheme recommendations

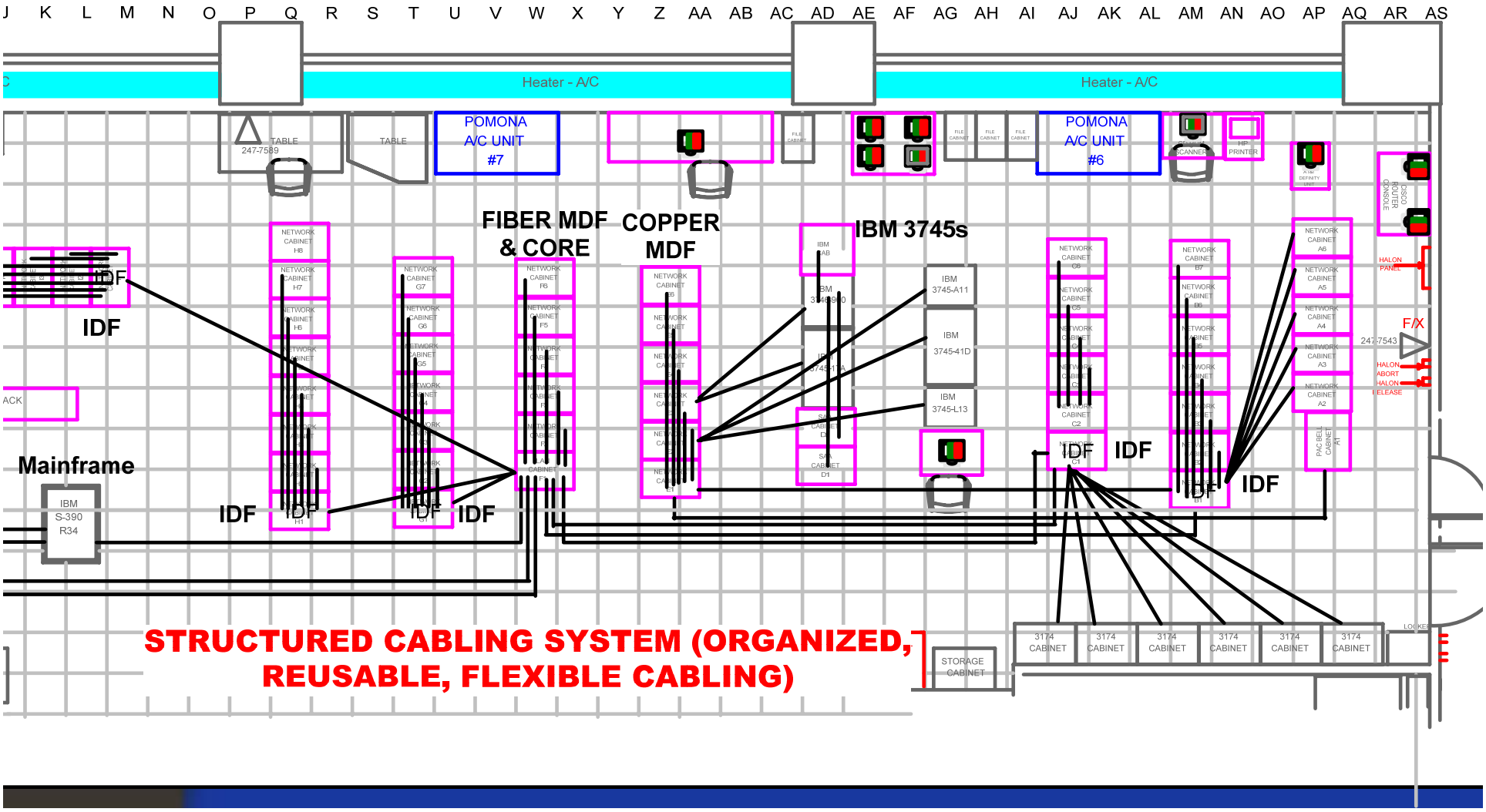
Standard/Structured vs. Proprietary/Pt-to-Pt Cabling

- Cabling can be used for multiple applications rather than installed for one application and then removed (or probably just left under the floor)
  - Saves money
  - Flexibility to deploy connections quickly
  - Helps minimize under floor mess
- Multiple sources vs. single source
- Support for future high speed protocols
- Simpler troubleshooting & administration (improves uptime)

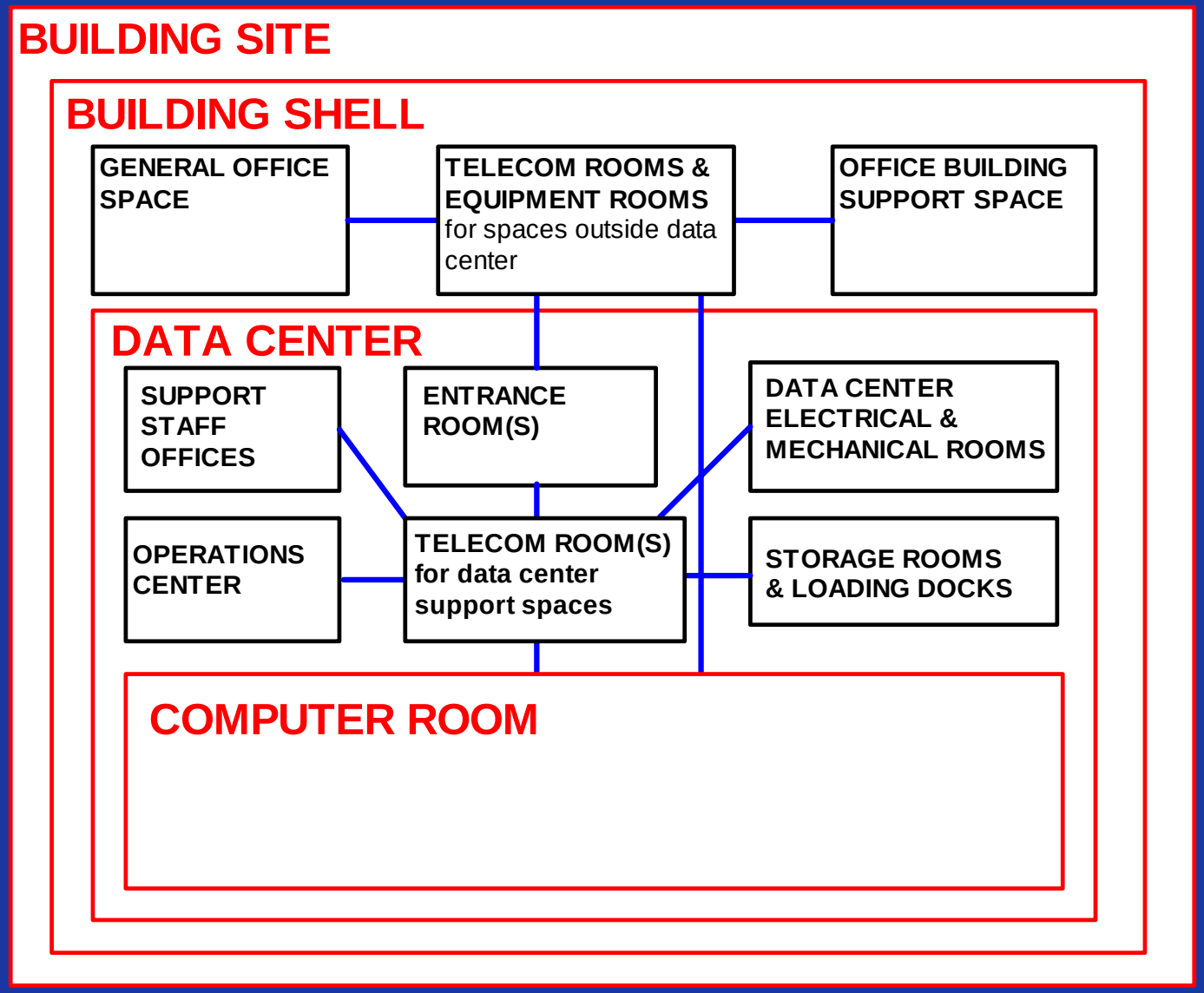
Why Structured Cabling is Important (Unstructured Example)



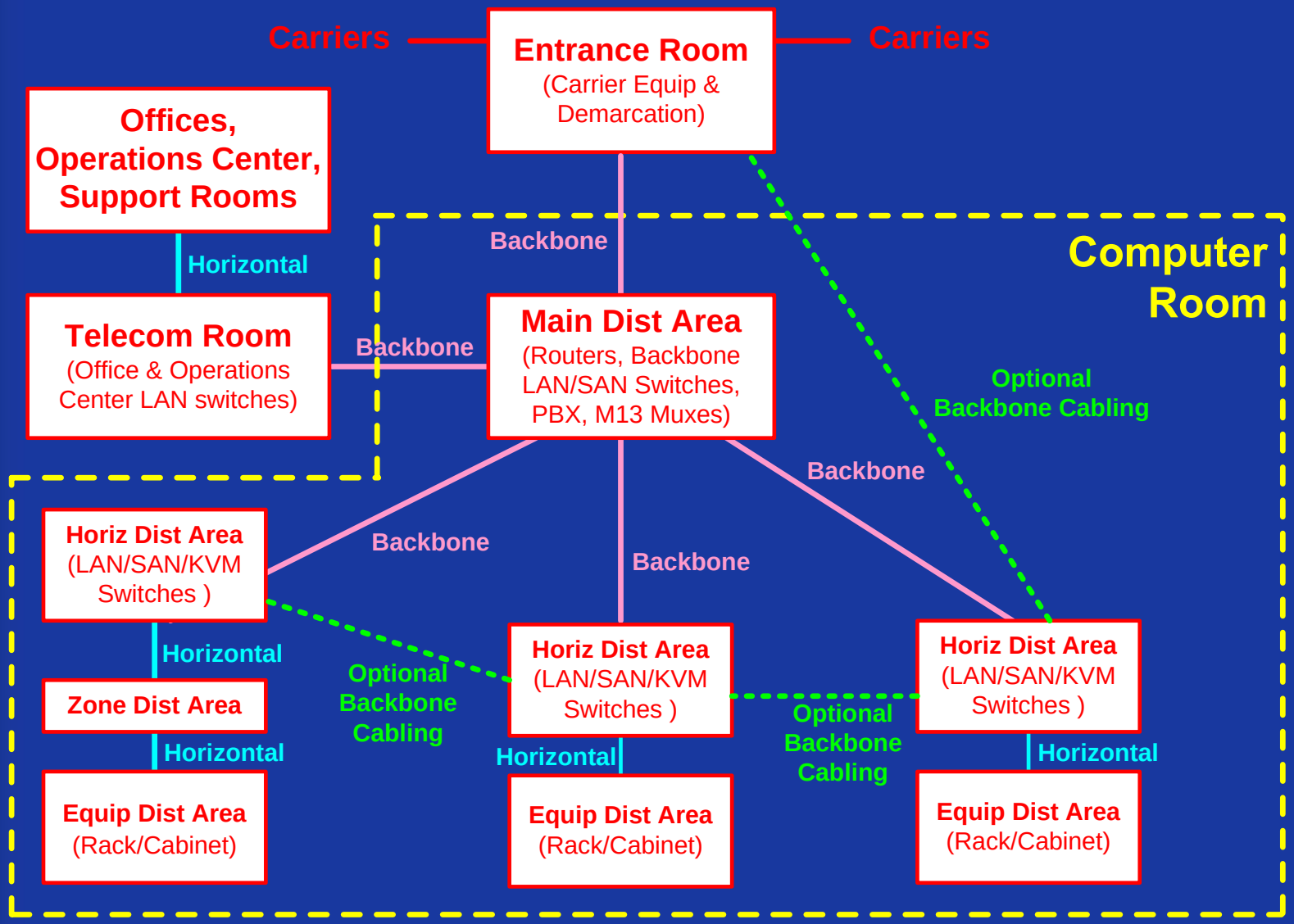
Why Structured Cabling is Important (Structured Example)



Relationship of Spaces



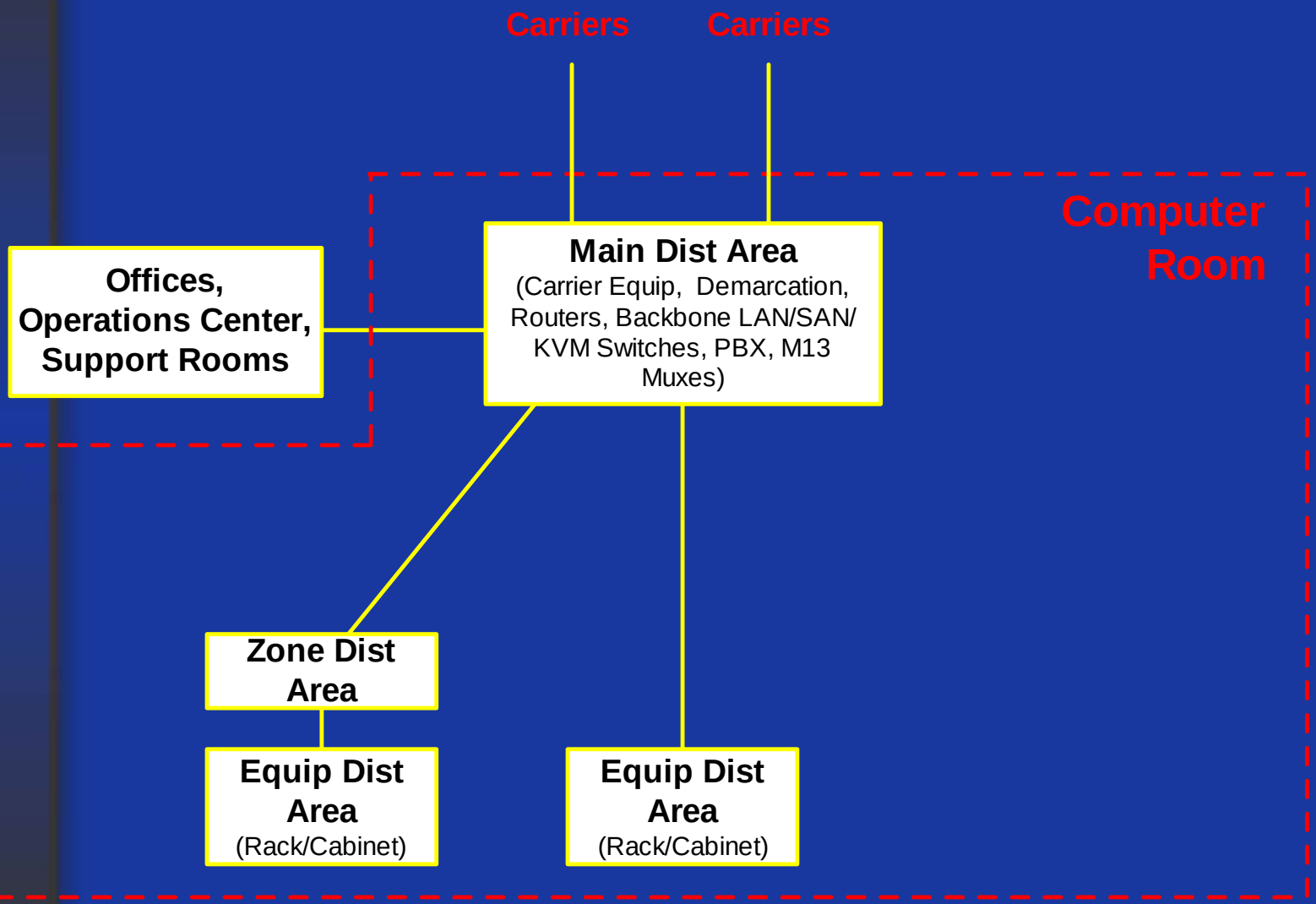
Data Center Telecomm Spaces & Topology



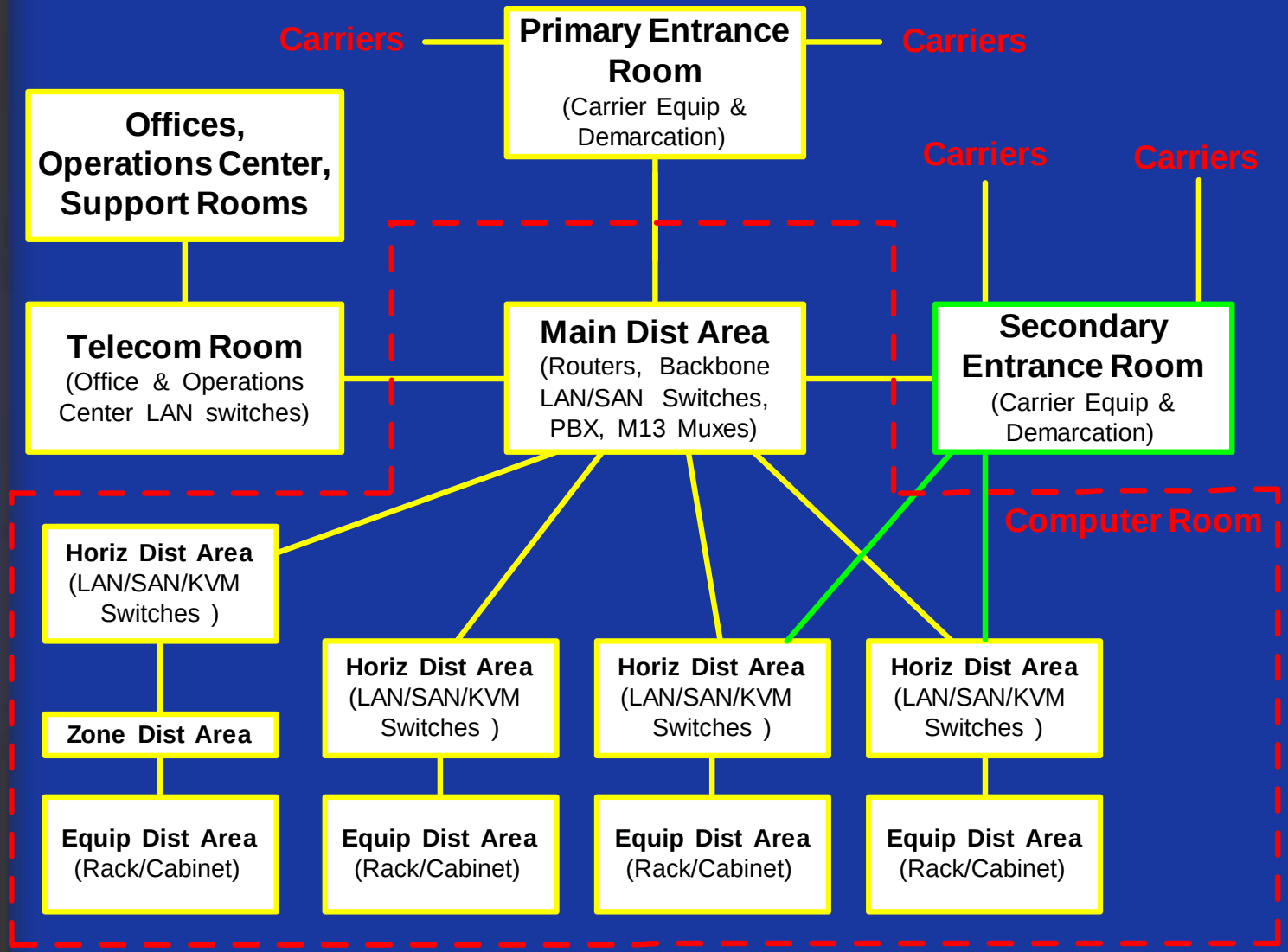
TIA-942 Spaces

- 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 horizontal cable outlet/patch panel – server/equipment cabinets and racks

Collapsed Topology

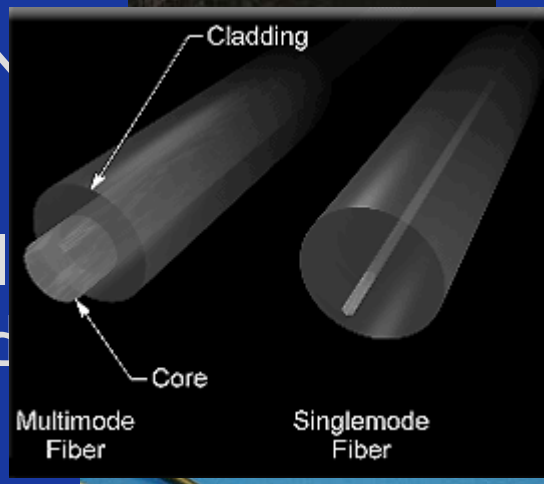


Distributed Topology with Multiple ERs



Data Center Cable Types

- Local codes may require use of plenum-rated cable or limited combustible cable, but Article 645 of NEC doesn't require it
- Single-mode fiber (WAN, MAN, LAN SAN, proprietary channel)
- Multimode fiber (LAN, SAN, channel video) 850-nm 50/125 recommended
- 734- or 735- type coaxial cable (E1, E3, T3) two per circuit (75 ohm cable & connectors)



Data Center Cable Types

- Unshielded twisted pair (UTP) - T1 & lower speed circuits, voice, BAS, video, LAN, KVM, console – typically Category 6 or Augmented Category 6 in data centers

- Mainframe channels (ESCON & FICON) can be accommodated by structured cabling system but are outside scope of TIA-942

- Computer clustering & peripheral cabling (e.g. SCSI, Infiniband, RS-232) are 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
- Optical fiber distances can drop off significantly with intermediate connections or splices
- Circuit length restrictions may :
  - require additional entrance rooms,
  - limit the location of telecom equipment,
  - limit the size of the computer room
  - Require demarcation of carrier circuits in MDA instead of entrance rooms

Circuit with Intermediate Panels

Maximum cable lengths from demarcation point:

- T-1's over 24 AWG Cat 3 UTP: 520 ft – 13.0 ft / panel
- T-1's over 24 AWG Cat 5/5e/6/6a UTP: 632 ft - 6.4 ft / panel
- T-3's over 735 mini coax: 246 ft– 1.6 ft / patch panel
- T-3's over 734 coax: 480 ft– 3.1 ft / patch panel

1G & 10G Ethernet Distances over MM Fiber (ft)

Protocol	Fiber Type	2 pnls	3 pnls	4 pnls	5 pnls	6 pnls	7 pnls	8 pnls
1GB-SX	62.5/125	984	951	852	721	590	426	131
1GB-SX	50/125	1968	1738	1508	1246	918	524	32
1GB-SX	50/125 LO	3280	2624	2230	1771	1312	721	98
10GB-SX	62.5/125	108	108	108	98	82	62	26
10GB-SX	50/125	268	268	259	229	180	127	16
10GB-SX	50/125 LO	984	984	885	754	623	426	82

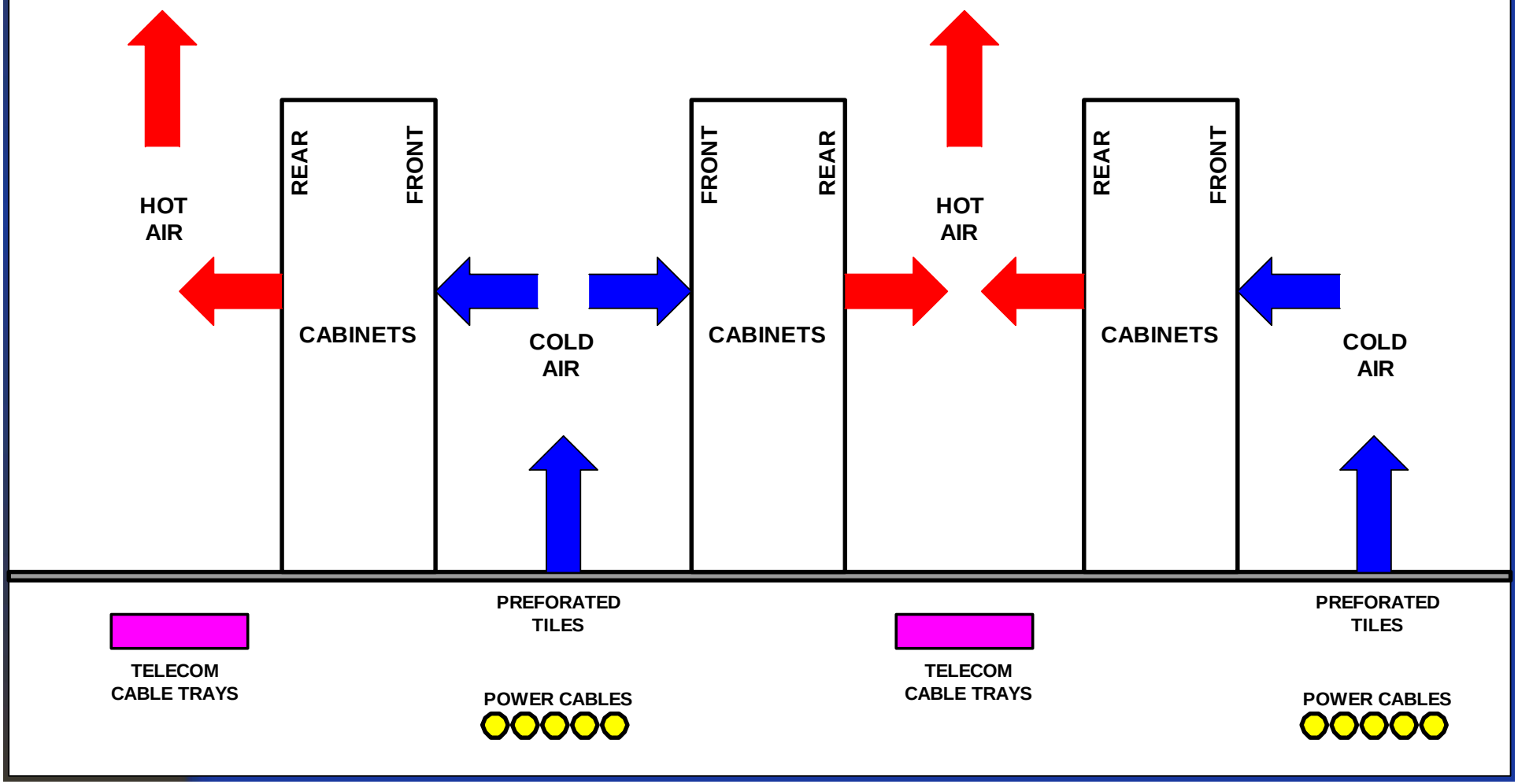
Computer Room & Entrance Room Requirements

- 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/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 6th pedestal) to CBN

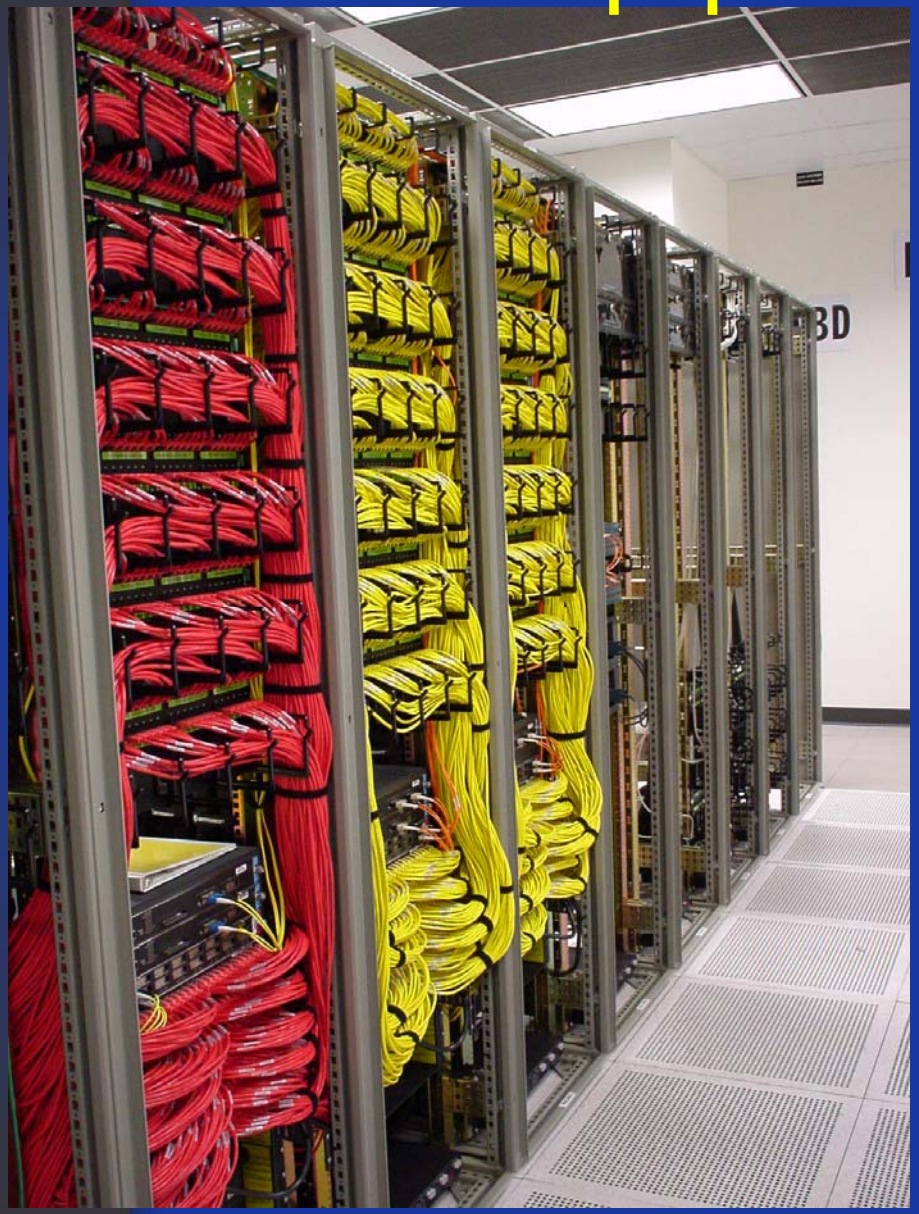
Equipment Racks & Cabinets

- 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.

HOT AND COLD EQUIPMENT AISLES



Equipment Cabinets

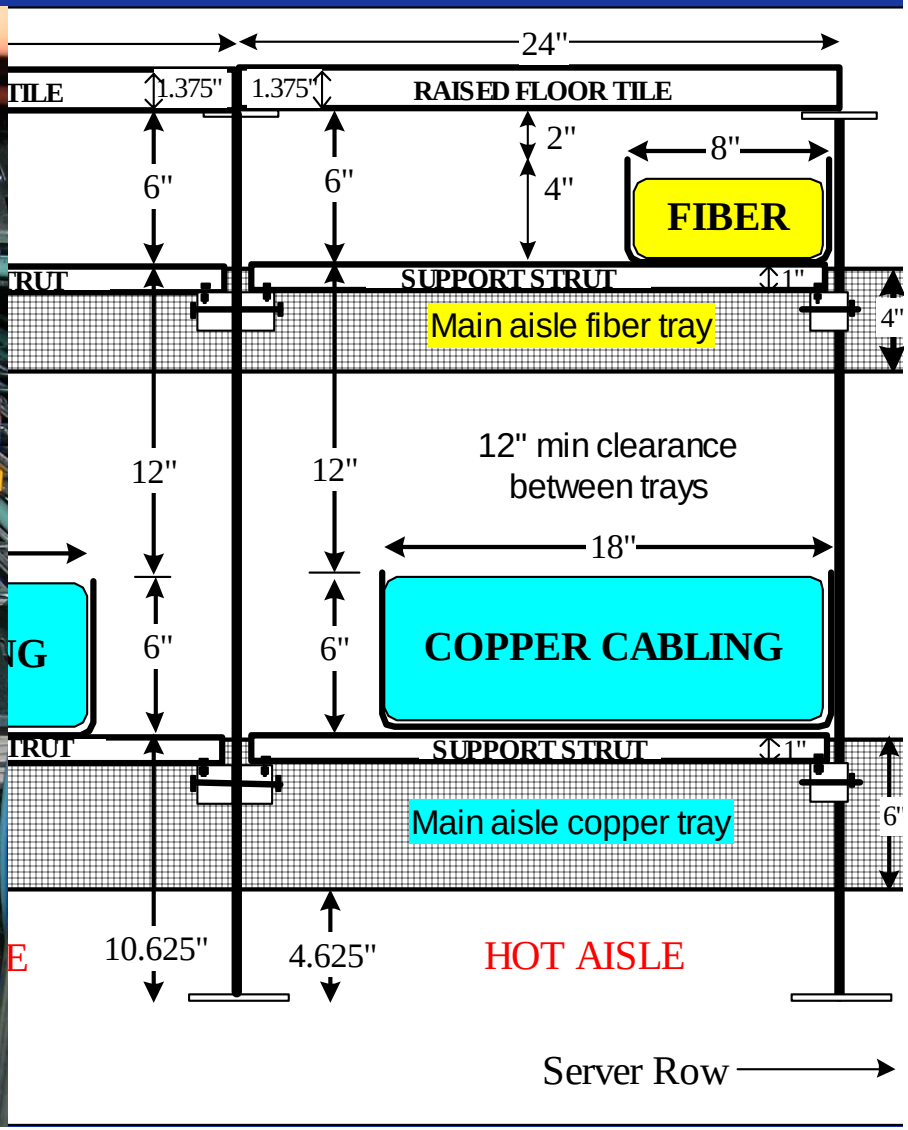


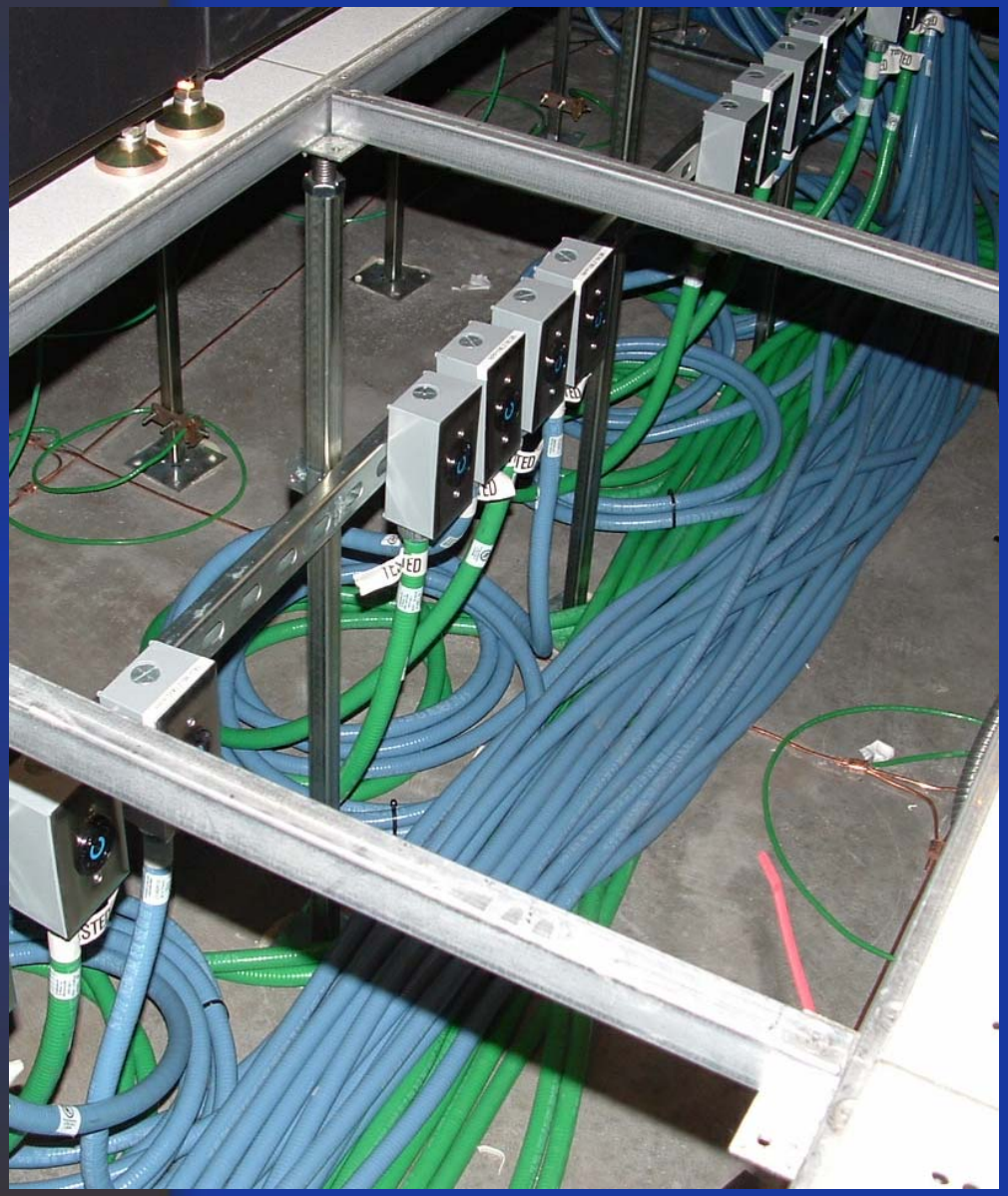
- Front rails of cabinets must be recessed to provide adequate room for patch cables and wire managers
- Adequate space for cable management
- Arrange switches and patch panels to minimize patching between cabinets & racks
- Perforated tiles at front of cabinets
- One edge of cabinets placed at edge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

Under Floor Cabling

- Less cost than overhead if there is a raised floor
- Easier installation and better appearance than overhead cable tray
- Cables should be in cable trays - preferably wire basket or other trays that minimize blockage of airflow
- Provide adequate capacity for growth
- Separate fiber patch cords from copper cabling
- Separate twisted pair cable from power
- Full cable trays could potentially block airflow if not properly planned & coordinated (place in hot aisles)
- Confirm load of cable tray & cable on pedestals

Examples 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
- Common Bonding Network/ Signal Ref Grid using bare copper conductor
- Each cabinet bonded to SRG
- Receptacles need to be labeled with PDU/panel ID & breaker #

Overhead Cabling

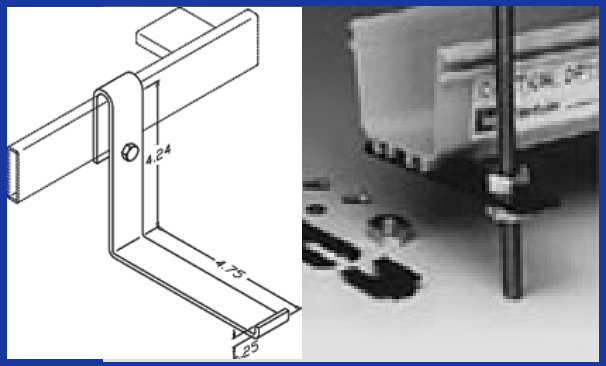
- Even in raised floors cable ladders typically installed over racks in telecom spaces for patching between racks (MDA/MDF, HDA/IDF, Entrance Room, Telecom Room/Closet) – they are typically attached to the racks
- In server areas cable ladders/trays should be suspended from ceiling with multiple layers to provide adequate capacity
- Coordinate with other trades
- Requires adequate ceiling height for 12” clearance above each ladder
- Provide room for growth
- Separation from fluorescent lights (5”) & power
- Protect fiber patch cords from copper

Overhead Cable Tray in HDA/IDF

Suspended Overhead Cable Tray

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 threaded rods



Patch Panels & Cable Management

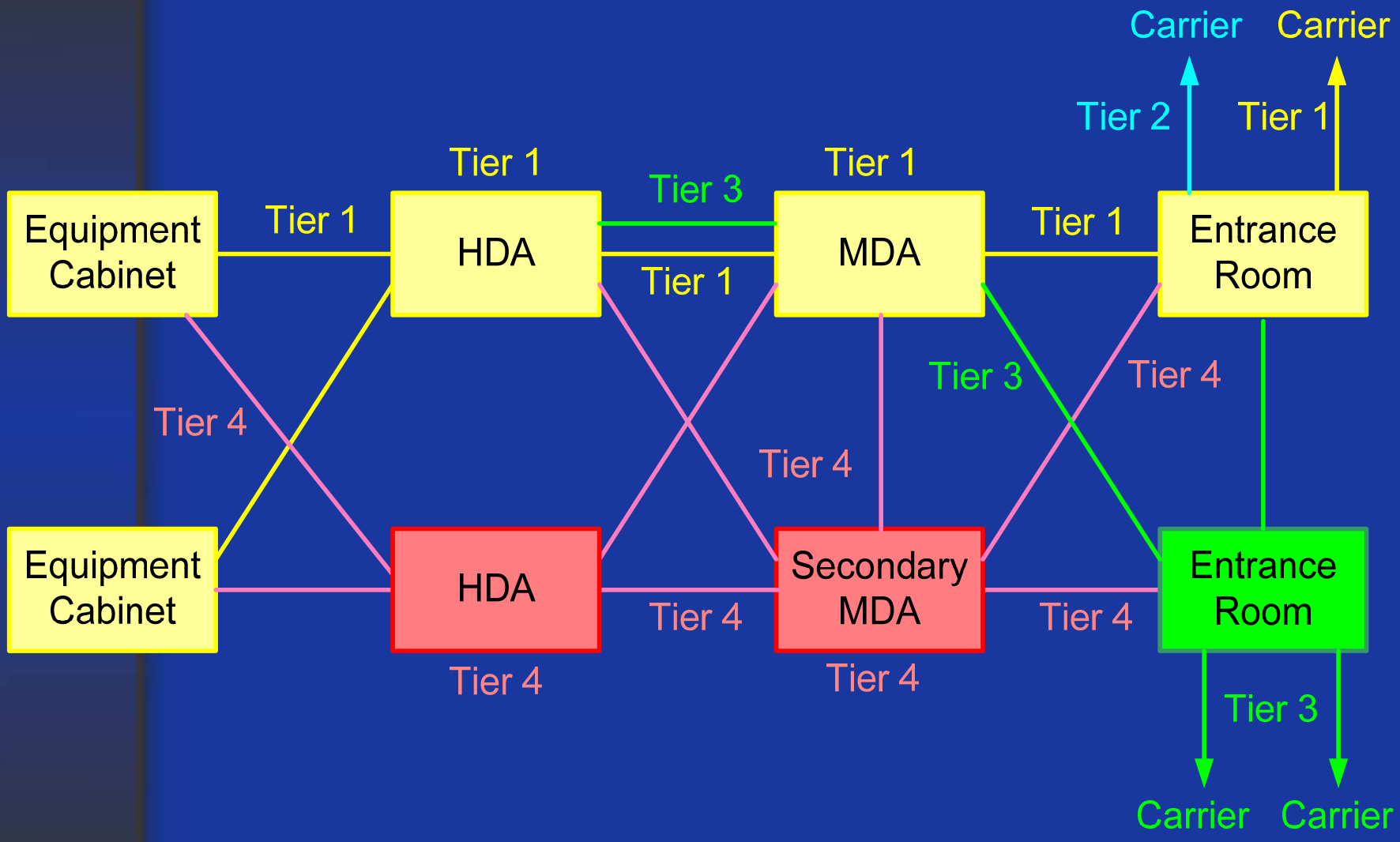
Good labeling speeds troubleshooting and reduces patching errors

- High density patch panels usually don't provide adequate space for labeling
- For non-angled patch panels, provide one-to-one ratio of patch panels to horizontal wire management
- Provide blank panels in empty spaces in cabinets
- Patch panels and cables should not block airflow from equipment
- Don't install patch panels on at both the front and back of a rack or cabinet to save space unless the patch panels can be serviced from the front

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.

Reliability Tiers and Cabling



Future Work

- Additional revisions to electrical sections for harmonization with IEEE 1100 draft 2
- Coaxial cabling addendum – testing & additional specifications for connectors
- More detailed labeling standard for data centers
- Augmented Category 6 UTP – 10 Gigabit Ethernet over UTP (10GBase-T)
- 10GBase-T over standard Cat 6 (up to 37 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 telecommunications 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.
- TIA-942 is available now
- BICSI data center design best practices standard that complements TIA-942 is in development

QUESTIONS?

- Jonathan Jew

- Co-chair TIA TR-42.1.1 data center working group – ANSI/TIA-942
- Co-chair BICSI data center subcommittee – ANSI/NECA/BICSI 002
- Vice-Chair TIA TR-42.6 telecom administration subcommittee
- US National Committee Project Manager ISO/IEC 24764 data center standard

- President J&M Consultants, Inc.
- Website: www.j-and-m.com
- Email: jew@j-and-m.com