ANSI/TIA-942 Telecommunications Infrastructure Standard for Data Centers

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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)

INSTALL A CABLE WHEN YOU NEED IT (SINGLE-USE, UNORGANIZED CABLELING)
Why Structured Cabling is Important
(Structured Example)

STRUCTURED CABELING SYSTEM (ORGANIZED, REUSABLE, FLEXIBLE CABELING)
Relationship of Spaces

BUILDING SITE

BUILDING SHELL

GENERAL OFFICE SPACE

TELECOM ROOMS & EQUIPMENT ROOMS
for spaces outside data center

OFFICE BUILDING SUPPORT SPACE

DATA CENTER

SUPPORT STAFF OFFICES

ENTRANCE ROOM(S)

TELECOM ROOM(S)
for data center support spaces

DATA CENTER ELECTRICAL & MECHANICAL ROOMS

STORAGE ROOMS & LOADING DOCKS

COMPUTER ROOM
Data Center Telecomm Spaces & Topology

- **Entrance Room** (Carrier Equip & Demarcation)
  - Carriers
  - Horiz Dist Area (LAN/SAN/KVM Switches)
  - Equip Dist Area (Rack/Cabinet)

- **Main Dist Area** (Routers, Backbone LAN/SAN Switches, PBX, M13 Muxes)
  - Backbone
  - Horiz Dist Area (LAN/SAN/KVM Switches)
  - Equip Dist Area (Rack/Cabinet)

- **Offices, Operations Center, Support Rooms**
  - Carriers
  - Horiz Dist Area (LAN/SAN/KVM Switches)

- **Telecom Room** (Office & Operations Center LAN switches)
  - Backbone
  - Horiz Dist Area (LAN/SAN/KVM Switches)

- **Zone Dist Area**
  - Horizontal

- **Equip Dist Area** (Rack/Cabinet)
  - Optional Backbone Cabling

- **Horiz Dist Area** (LAN/SAN/KVM Switches)
  - Optional Backbone Cabling

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

- **Carriers**
  - **Main Dist Area**
    - (Carrier Equip, Demarcation, Routers, Backbone LAN/SAN/KVM Switches, PBX, M13 Muxes)
  - **Equip Dist Area**
    - (Rack/Cabinet)
  - **Zone Dist Area**
  - **Equip Dist Area**
    - (Rack/Cabinet)
- **Offices, Operations Center, Support Rooms**
- **Computer Room**
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)

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<th>Fiber Type</th>
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<th>3 pnls</th>
<th>4 pnls</th>
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<th>6 pnls</th>
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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/150 lbf/ft², recommended min 12 kPA/250 lbf/ft²
- 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

- HOT AIR
- COLD AIR
- CABINETS
- REAR
- FRONT
- POWER CABLES
- TELECOM CABLE TRAYS
- PREFORATED TILES
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

- Raised Floor Tile
- Support Strut
- Copper Cabling
- Fiber

Main aisle fiber tray
12" min clearance between trays

Main aisle copper tray

10.625" 4.625" Hot Aisle

Server Row

6" 8" 4"
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.
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
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