

TIA-942 Data Center Networking Applications: 10 Gigabit Ethernet Over Twisted-pair Copper

Background: Significant changes in data storage applications, data storage equipment, and storage area networks (SAN), have altered the telecommunication infrastructure requirements for the data center's and computer rooms. Mainframes and their support peripherals are being supplanted by high performance servers interconnected with gigabit speed data links. The decentralization of computing resources from large mainframes to distributed server clusters has significantly impacted the infrastructure design for data center's and computer rooms.

Published in early 2005, the Telecommunications Industry Association (TIA) has delivered TIA-942 the "Telecommunications Infrastructure Standard for Data Centers". The primary purpose of the standard is to provide a comprehensive understanding of the data center design including the facility planning, the cabling system, and the network design.

In parallel and subsequent to the development of TIA-942, the IEEE 802.3 Ethernet working group published two twisted-pair copper standards, 1000 Mb/s Ethernet designated 1000BASE-T and 10 Gb/s Ethernet (10 GbE) designated 10GBASE-T, both standards are targeted at meeting the increasing bandwidth requirements for data center applications.

This white paper will discuss the TIA-942 Data Center standard with emphasis on data center cabling and 10GBASE-T twisted-pair Ethernet data center applications.

Data Center Cabling: Targeted at bridging the information gap between the design and construction phases of a data center, the TIA-942 standard takes a multidisciplinary approach to the document content and structure facilitating coordination and cooperation between the architect, building engineer, and the telecommunications engineer. A key element of the standard is embodied in the data center cabling recommendations.

The data center cabling system includes the following elements:

- Horizontal cabling
- Backbone cabling
- Entrance cross-connect (EC) in the entrance room or main distribution area (if the entrance room is consolidated into the main distribution area).
- Main cross-connect (MC) in the main distribution area
- Horizontal cross-connect (HC) in the horizontal distribution area, telecommunications room, or main distribution area.

- Zone outlet (ZO) or consolidation point (CP) in the zone distribution area
- Outlet in the equipment distribution area

Horizontal cabling is the portion of the telecommunications cabling system that extends from the outlet in the equipment distribution area or zone outlet in the zone distribution area to the horizontal cross-connect in either the horizontal distribution area or main distribution area. Horizontal cabling may include an optional consolidation point in the zone distribution area.

Backbone cabling provides connections between the main distribution area, the horizontal distribution areas, telecommunications rooms, and entrance rooms in the data center cabling system.

Cabling Topology The topology of the data center horizontal cabling and backbone cabling is a star topology (Figure 1).

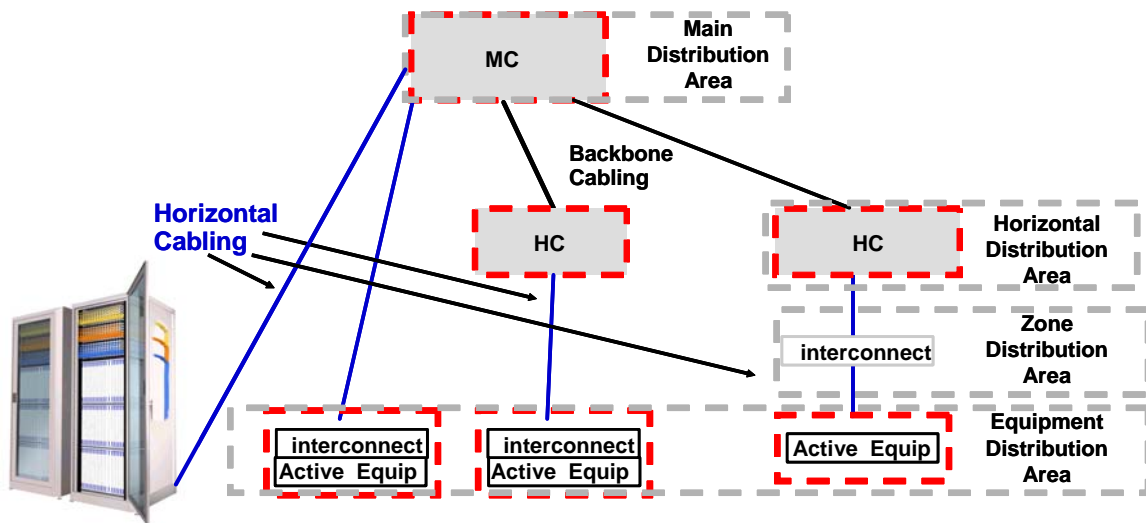


Figure 1 Cabling Topology

Horizontal cables are connected to a horizontal cross-connect in either a horizontal distribution area or main distribution area.

Backbone cabling uses a hierarchical star topology where each horizontal cross-connect in the horizontal distribution area is cabled directly to a main cross-connect in the main distribution area. Only one hierarchical level of cross-connect in the backbone cabling are allowed (there are no intermediate cross-connects within the data center cabling architecture).

Cabling Media: The standard recognizes multiple media types to support a wide variety of applications, but it recommends that the highest capacity cabling media be used for new installations to maximize the flexibility and useful life of the data center cabling infrastructure.

The recognized media are:

- 100-ohm twisted-pair cable (ANSI/TIA/EIA-568-B.2), category 6 is recommended (ANSI/TIA/EIA-568-B.2-1) or Class E/Category 6 as specified in ISO/IEC 11801;
- 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- 16 B.3-1) or as specified in ISO/IEC 11801;
- singlemode optical fiber cable (ANSI/TIA/EIA-568-B.3) or as specified in ISO/IEC 11801;
- 75-ohm (734 and 735 type) coaxial cable (Telcordia Technologies GR-139-CORE) and coaxial connectors (ANSI T1.404). These cables and connectors are recommended to support T-3, E-1, and E-3 circuits.

10GBASE-T: TIA-942 data center applications: 10 GbE can be seamlessly deployed over twisted-pair copper data center cabling offering many advantages over alternative media types. The RJ-45 connector provides a single user interface enabling plug-and-play connectivity from active equipment to the patch panels located in each distribution area. Ethernet data rates from 10 Mb/s to 10 Gb/s can be easily implemented in a variety of multi-connector topologies with one user patch cord type; providing the operational benefits of maintaining an inventory of one user patch cord type and avoiding incompatible multiple connector options and cabling media types.

Figure 2 illustrates a number of possible 10 GbE twisted-pair data center cabling configurations:

- 10 GbE twisted-pair links deployed from the horizontal distribution area to the equipment distribution area in 2 and 3 connector topologies.
- 10 GbE twisted-pair links deployed between active equipment in the equipment distribution areas; typical of cross-connected server links.

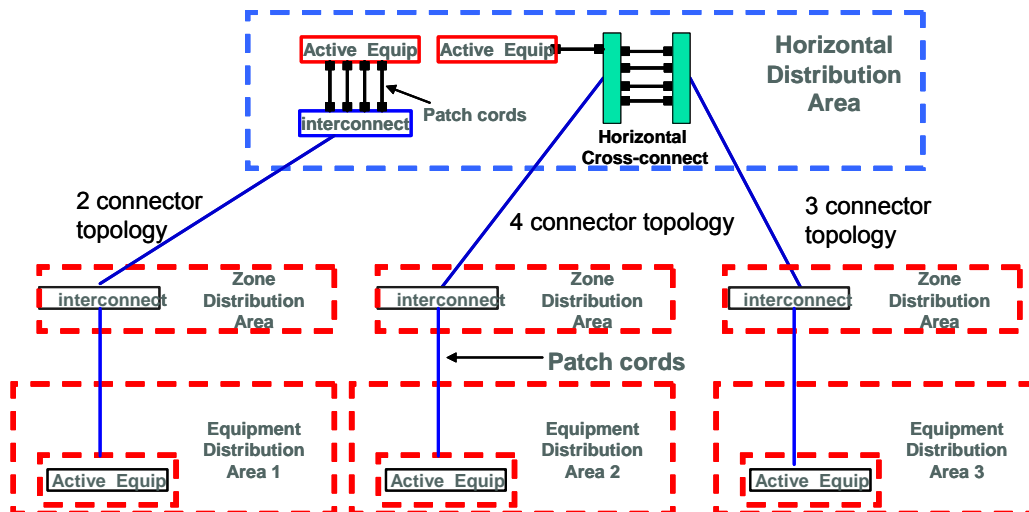


Figure 2 Active equipment deployment

10GBASE-T cabling types and distances: 10 GbE twisted-pair designs are based on simple look-up tables of link distances and cable category usage; avoiding the complexity of engineering links based on link loss budgets and bandwidth specifications required of 10 GbE alternative media types.

Category 6 UTP is supported to 55 meters in reasonable alien crosstalk environments and Category 6_A UTP is supported to 100 meters over 4 connector topologies. Category 6_A link segment distances of 100 meters with 4 connectors enables cross-connect topologies between equipment distribution areas (figure 2) typical of many data center distances.

Table 1 IEEE 10GBASE-T cabling types and distances

Cabling	Supported link segment distances	Cabling Reference
Class E / Category 6	55 to 100 meters	ISO/IEC TR-24750 ¹ / TIA/EIA TSB-155 ²
Class E / Category 6 unshielded	55 meters	ISO/IEC TR-24750 / TIA/EIA TSB-155
Class E / Category 6 Shielded	100 meters	ISO/IEC TR-24750 / TIA/EIA TSB-155
Class F	100 meters	ISO/IEC TR-24750
Class E _A / Augmented Category 6	100 meters	ISO/IEC 11801 Ed 2.1 /TIA/EIA-568-B.2-10 ³

Notes:

1. The ISO/IEC technical report for installed Class E and Class F cabling to support 10GBASE-T consistent with the ANSI/TIA/EIA-TSB-155 Guidelines.
2. Additional Cabling Guidelines for 4-Pair 100 Ω Category 6 Cabling for 10GBASE-T.
3. Transmission Performance Specifications for 4-pair 100 Ω Augmented Category 6 Cabling.

Conclusions: Dramatic changes in computing and networking have transformed the telecommunications infrastructure requirements for data center's and computer rooms. The TIA-942 data center standard addresses an industry recognized need for infrastructure requirements that can be applied to any data center independent of size or usage including small-to-large single tenant enterprise data centers and small-to-large scale multi-tenant Internet hosting data centers. A key benefit of data center structured cabling is the facilitation of the plug-and-play deployment of 10 GbE over twisted-pair Ethernet into data centers

About Solarflare:

Solarflare is delivering the next level of high-performance 10 Gigabit Ethernet. As the leading supplier of standards-based 10GbE silicon and reference designs, Solarflare's robust and power-efficient solutions are easy to deploy and cost effective for switches and NICs. The combination of Solarflare's Solarstorm™ 10GbE Controller and 10Xpress® 10GBASE-T PHY enables NIC and server OEMs to provide 10G adapters at about the same cost as quad 1Gb. As the first company to demo, sample and ship standards-based 10 Gigabit Ethernet that works to 100 meters over copper cabling, Solarflare is engaged with key industry partners and customers to ensure interoperability and build a complete 10GBASE-T ecosystem. For more information visit <http://www.solarflare.com/>.