RJ-45:

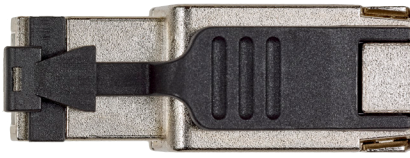
Trusted, Cost-Effective Connections for Future Data Center Networks

Twisted-pair copper cabling is a cornerstone of data center infrastructure, and the RJ-45 connection is the highest-volume port type in servers today, with close to a billion ports of RJ-45 connectors sold every year. The features in RJ-45 that made it appealing in the past are still true today, as future Category 8 systems for 25G and 40G networks will continue to use the popular connector design.

There is no one-size-fits-all solution for cabling infrastructure in a data center. It breaks down to what best fits the layout, scope, bandwidth needs, scalability, manageability, and budget of a specific facility. But as emerging data center architectures create a need for more flexibility and scalability using high-speed copper links, the demand for faster gigabit performance in a smaller footprint will continue to grow. With BASE-T providing the most cost-effective access layer networking option, copper structured cabling solutions will continue to be fundamental throughout the data center infrastructure.

40GBASE-T (and 25GBASE-T) will rely on Category 8 connectivity. The current draft of the Category 8 specification from TIA — likely to be published in mid 2016 — defines channels and connecting hardware up to 2000 MHz and 30 meters, using the standard 8P8C/RJ-45 interface. This interface allows the cabling system to be backwards compatible with existing Category cabling systems. For data center managers, backwards compatibility and auto-negotiation between active equipment provides huge benefits.

Backwards Compatibility Makes Migration Easier



Data center managers who are planning for upgrades in the near future should consider the expected life of the cabling system to maximize their return on infrastructure investment. Category 8 cabling with RJ-45 connections can support 10G today, while providing a seamless migration for 25G or 40G tech refreshes in the future. This prevents the need to re-cable during upgrades, avoiding possible network disruption and additional costs.

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Twisted-Pair Migration Roadmap - RJ-45 Simplifies the Upgrade Path

	1G	2.5G	5G	10G	25G	40G
	1G to 2.5G	2.5G to 5G	5G to 10G	10G to 25G or 40G		
Category	5e / 6	5e / 6	6	6A	8	8
Max. Bandwidth	100 / 250MHz	~100 / ~250MHz	~250MHz	500MHz	1250MHz	2000MHz
Max. Application Data Rate	1000BASE-T	2.5GBASE--T	5GBASE--T	10GBASE--T	25GBASE--T	40GBASE--T
Max. Reach	100m	100m	At Least 100m	100m	30m	30m
# of Connectors in Channel	4	4	4	4	2	2
Cable Construction	Unshielded or Shielded	Unshielded or Shielded	Unshielded or Shielded	Unshielded or Shielded	Shielded	Shielded
Date Created	1999	2016 EST	2016 EST	2006	2016 EST	2016 EST

Auto-Negotiation for Mixed Server Speeds

Data center managers can also leverage the auto-negotiation requirements in IEEE 25/40GBASE-T standards. Auto-negotiation allows for two Ethernet devices to connect to each other and select a common transmission speed that both devices support. For example, 40G switches can communicate with 10G servers, whether over Category 8 or Category 6A connectivity. This also allows for network migration to 40GBASE-T to be done in phases, allowing for more flexibility in terms of timing, disruption, and cost. With staggered active gear upgrades, BASE-T solutions can allow for mixed server speeds in each rack or cabinet supporting any combination of 1G, 2.5G, 5G, or 10G servers, creating better port utilization of the switches.

Other Copper Connections for 25G / 40G

Twisted-pair cabling using RJ-45 connections isn't the only copper option for 40G networks. Quad small form-factor pluggable (QSFP+) direct attach copper (DAC) passive assemblies were standardized in 2010 through IEEE 802.3ba. They are low-power solutions and have a similar form-factor to SFP+ 10G (and future 25G) assemblies. However, from a structured cabling viewpoint, they have a limited distance of up to 7 meters. With such limited reach, they can not supprot a wider range of topologies, such as End-of-Row or Middle-of-Row options. QSFP+ DAC assemblies are also not backwards compatible, and can be used for 40G networks only.

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Unlike the TIA Category 8 standard in development, the draft ISO standard currently specifies two types of connector interfaces. Class I will be similar to the TIA version, using the RJ-45 interface for backwards compatibility with existing Category cabling. The Class II specification is designed to support various types of connector interfaces that are not compatible with RJ-45 and not fully backwards compatible. The ISO 11801-1 standard is expected to include requirements for both Class I and Class II up to 2000 MHz, matching the frequency range of the TIA standard.

The connections specified in Class II, such as the ARJ and GG45 interfaces, will likely see limited adoption. These solutions are not fully backwards compatible and require hybrid cables that can be more expensive than BASE-T solutions. In addition, because active equipment will use an RJ-45 connection, Class II solutions will not include an option for DAC connections.

RJ-45 is here to stay

Copper solutions have been around a long time, solving data connectivity needs from residential applications to complex data center installations. There is room for continuous growth in this medium, and Leviton plays an active role in driving the latest standards through considerable collaboration with industry participants and competitors, and by developing next generation high-speed copper technology with the greatest benefit to customers and the industry.

The Leviton Atlas-X1™ Category 8 cabling system is the industry's first system to support shielded applications from Category 5e to 8 and UTP applications from Category 5e to 6A, all from one unified RJ-45 connectivity platform. This comprehensive system delivers high levels of performance across all categories to seamlessly support network migration to 40GBASE-T.

With the imminent adoption of 25/40GBASE-T and Category 8 standards, the RJ-45 design will continue to give network managers more flexibility throughout deployment and operation in terms of timing, disruption, and cost for upgrading their networks.