Taking the Heat with PoE

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07/30/22

Power over Ethernet (PoE) has become a critical technology in today's evolving cabling infrastructure for intelligent buildings. Once power could be delivered over the same data cabling, it opened the doors to add more previously disparate applications and provided many advantages to the evolving IP network. These advantages include reduced CAPEX and OPEX expenses, streamlined installations by eliminating electrical cables, expanded flexibility of device placement without being tethered to an AC outlet, and increased safety and scalability to add more devices. However, careful selection of category cable and RJ45 connectors have become vital elements to the reliability of delivering PoE.

Turning up the heat

One of the first network applications to employ PoE was Voice Over IP phones (VoIP). Shortly after that low-bandwidth, low power IP cameras became attached to the network. At that time, IEEE 802.3af ratified PoE (Type 1) to deliver 15.4W from the powered source equipment (PSE), such as a switch, to 13W to the powered device (PD). From there the evolution of use-cases along with IEEE's ensuing standardization of higher power upgrades fueled the growth of PoE.

In 2009 IEEE approved that twice the power could be transmitted over twisted pair cabling up to 30W at the PSE. Similar to the original PoE standard, power was transmitted over the two unused pairs. Applications extended to include pan-tilt-zoom (PTZ) cameras. By 2018, new IEEE standards (802.3bt) for Type 3 and Type 4 (also referred to as PoE Plus Plus) recognized powering at higher wattages, 60W and 90W, respectively, from the PSE to expand PoE's capability utilizing all four pairs. These PDs include PTZ cameras using heaters and blowers, video conferencing equipment, access control devices, wireless access points (WAPs) and many more.

With wattage of 60W and higher, cable and RJ45 connector issues were identified which could affect data and power transmission. The main concerns are heat build-up within cable bundles, as well as the potential for electrical arcing damage to the connector contacts supporting remote powered applications. For new installations, both TIA and BICSI provide a summary of minimum and recognized cabling performance for balanced twisted-pair media when transmitting power and data. The recommended minimum 4-pair copper cable is Cat 6A/Class EA with corresponding RJ45 connectors.

Power Play

Standards such as TIA-TSB-184-A and ANSI/TIA-568.2-D provide best practices for safety and design related to cable performance and sizing of pathways. These documents all focus on defining acceptable temperature rise as it relates the bundle size, conductor size (AWG), ambient temperature, and insulation temperature ratings. When planned properly, heat build-up and signal loss can be minimized or mitigated.

Whereas power is not "live" until the PD negotiates power needed from the PSE. Auto-negotiation takes place and power is energized through the cable and RJ45 connector. Since the power does not flow through the cable and connector until they are already attached to the device, possible electrical arcing between the keystone contacts and the contacts on the RJ45 connector can happen during the disconnection phase. Connection and disconnection of PoE-enabled devices, such as security cameras, to the network is performed manually.

The Weakest Link

Electrical arcing that can occur on the RJ45 connector degrades the gold tines of the connector contact. Over time,

corrosion of the connector can occur which lowers network stability and reliability. The international standard, IEC 60512-99-001, addresses these PoE connection concerns by providing a test performed on each of the eight connector contacts for PoE deployments in which all four pairs are used.

Since the weakest link is often the RJ45 connector, the reliability of the entire cabling link is dependent on a robust connector construction. One example of a high performing RJ45 connector, Simply45® RJ45 modular pass-through plugs were designed to deliver greater electrical conductivity than other Category 6 and 6A RJ45s resulting in optimal PoE performance. Simply45 is uniquely constructed with polycarbonate that meets all stringent commercial plenum ratings, UL94-V0, which is the highest flammability rating approved by NFPA and meets IEC 60603 connector specs. These connectors are also available shielded, which provides additional protection against signal loss.

Simply the Best

Unlike many modular plugs that employ two prong contacts for conductor alignment, Simply45's three-prong design provides the most secure option to hold conductors in place. With the two-prong design, solid conductors can slide to one side, stack on top of each other, or even pop-up which creates disconnects, intermittence, and signal loss. Simply45's three-prong contact is designed to lock in the conductors, including larger Category 6A AWG size.

One of the biggest connector performance flaws is correlated to the distance between the connector tines and the tips of the conductors as this contributes to arcing damage. While there is no immediate damage or danger to users, the integrity of the RJ45 connector can be weakened, especially over numerous mating/demating. Both the Simply45®and Simply45®Pro feature the patent pending Bar45™ and patented Cap45™ systems making installation easier and performance even better. The Bar45™ load bar precisely lines up the conductors for better signal isolation and greatly reduces near-end (NEXT) and far-end crosstalk (FEXT). The Cap45™ is an isolation cap that snaps onto the front of the pass-through RJ45 plug after termination, sealing off the exposed wire ends preventing any electrical shorts at the port and preventing any further arcing damage.

As data bandwidths continue to climb and more PoE-enabled devices, like PoE LED lighting, climb on to the network, the selection of components become critical. Although all RJ45 connectors and plugs should meet minimum ANSI/TIA-568 industry standards, minimum compliance is not good enough. When adding PoE devices to the network, make sure to consider the effects on the network's reliability. Most importantly, determine which physical infrastructure components (such as cables and RJ45 connectors) are robust enough to support the demands of the implementation.

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