

11801 and Use of 4P Cable for 1P Applications

Chad Jones

Chair, 802.3 PDCC Ad Hoc

Supporters

- Wayne Larsen, Commscope
- George Zimmerman, CME Consulting
- Ron Tellas, Belden
- Dave Hess, Cord Data
- Bob Voss, Panduit
- Peter Jones, Cisco
- Jim Weaver, Arista

Issue at hand

The IEEE 802.3 Working Group (WG) is aware that SC25/WG3 is drafting standards and technical reports (e.g., ISO/IEC 11801-1 Amd1 and ISO/IEC TR 11801-9911) that support use and reuse of 4P/multipair Category cabling classes to be used in 1P applications with the restriction of 0.75 A per pair.

This restriction breaks the IEEE 802.3 'plug-and-play' interoperability model. As such, the **802.3** WG feels the need to make a presentation to ISO/IEC JTC 1/SC 25, something that hasn't happened before as the work between the two groups has always had common goals.

The problem with 0.75A

- Using 4P cabling in 1P applications disallows the full current capabilities of Single Pair Ethernet (SPE)
- Cabling would limit PSEs to 0.75 A
 - IEEE 802.3 PSEs or PDs do not know what kind of cabling is connected. Allowing a 0.75 A option constrains ALL options to 0.75 A – which is well below the current needed to deliver the power levels desired, for both current classes and future planned classes.
 - Note that this is a problem with having any two levels of maximum current.
- Installation guidance becomes overly complicated
 - A lot of work has gone into appropriate bundle sizing for 4P cabling, designed around the worst case 90 W PoE current of 0.433 A (particularly in the United States' National Electrical Code). A 'second tier' of 0.75 A limit complicates this carefully crafted guidance.
 - The possibility of 1, 2, or 3 pairs being energized in shared-sheath cabling as well as grounding issues further complicate the guidance.

Future Single Pair PoE (SPoE) Plans

- Limiting SPoE to 0.75 A will keep 11801-1 cabling and perhaps SPoE from addressing the full market
 - Note that 750 mA only supports up to PoDL Class 14, which is 20 W at the PD.
- Similar to 4P PoE, there are plans to raise the power from an SPE PSE to what's allowed under LPS, i.e., 100 W max (90 W with margin)
- Of course, this power is only extended to systems that can efficiently provide the power. This implies a max allowed loop resistance which further implies reach limitations. This is a long way of saying the 1 km SPE links won't be capable.
 - PoDL Class 15 power can be delivered up to 158 meters and 400 meters with 18 AWG and 14 AWG twisted pair, respectively.
- The present requirements of Clause 104 are only a single example. Other powering schemes, outside of IEEE Std 802.3 use the full extent of NEC Class 2 limits of 2.0 A. Today, non-802.3 power sources dominate the single-pair powering landscape.

Use Cases

- Powering beyond 20 W delivered **is** required for a variety of applications
 - Media converters extending line powering to existing Class 4 PoE devices will require this (30 W PoE pass thru + power of device)
 - Line-powered PoE field switches, will require greater than 20 W even with minimal PoE capability (multiple PoE pass thru ports, likely at 15.4 W at each port + device)
 - Many sensors, such as field cameras with pan-tilt-zoom and/or heat element capability today require > 20 W delivered
 - High-transient-current actuators would require additional cost of local energy storage without the ability to provide > 0.75 A
- Class 2 power supplies today are used for a variety of non-Ethernet applications on single pairs that SPE seeks to replace
- Experience with 4-pair PoE has shown a need to deliver as much power as possible (initial release at 15.4 W, revised twice to raise power).

IEEE 802.3 Requests

- The IEEE 802.3 WG requests that reuse of 4-pair cable for SPE be abandoned. The addition of cable reuse permits sections of the cable plant to not meet the full requirements, converting this from a plug and play system to an engineered system.
- Separate 1P from 4P
 - Remove all single pair information from 11801-1 Amd 1 and placed in a new standard, avoiding confusion
 - Many other standards point to 11801 assuming 4P cabling; the inclusion of 1P will require some rewrite of those other standards

Requirements if Use of 4P Cable for 1P Applications is Maintained

- **CURRENT CARRYING CAPACITY SHOULD MATCH FROM BEGINNING TO END**
 - Wire gauge shall match end-to-end, or at least be no smaller than that presented at the user interfaces (disallow hiding smaller wire gauge behind a larger gauge at the user interface)
- **CLEARLY IDENTIFY ANY RESTRICTED CURRENT CHANNELS**
 - Examples might be different color connectors or mandatory labelling
- **PREVENT ACCIDENTAL MISCONFIGURATION**
 - Different or keyed connectors to disallow interconnection of the disparate channels
 - One might think it's ok to plug a 0.75 A cable into a 2.0 A as the 2.0 A channel can support the 0.75 A requirements, but the guidance must disallow a 2.0 A cable being the visible connection with 0.75 A cable behind the wall.
- **DISCOURAGE USE OF 4P CABLE FOR 1P APPLICATIONS FOR NEW INSTALLATIONS**

Backup

802.3 Actions

- Members of the IEEE 802.3 Working Group are discussing adding text to expressly require cabling with current capacity of at least 2.0 A for SPE applications with IEEE 802.3 defined powering

Draft of Maintenance Request

Warning to system designers:

Not all cabling supports 2A per conductor, and the current carrying capacity of both single pair cabling and multi-pair cabling used for cable sharing within the link segment may not be sufficient to support the power supplied by the PSE.

In particular, the ISO/IEC 11801-1 Amd1 specification contains two cabling options for Single Pair Ethernet (SPE) with power, one of which supports 2.0 A per conductor and another supporting only up to 0.75 A per conductor. Generally, the 0.75 A option is constructed by combining four SPE links into the typical 4P category cable (i.e., Cat5e, Cat6, etc.).

IEEE 802.3 Clause 104 compliant PSEs can supply more than 0.75 A and have no way to know what type of cable is connected to the PSE. Therefore, it is expressly disallowed that a compliant IEEE 802.3 SPE PoDL system use any cabling where the current capacity is less than the highest supported current for the PSEs attached to that link segment. As of this publication, this current is 1.58 A as defined by Clause 104, Table 104-2.

Ignoring this warning could result in premature degradation of your cabling, which could cause performance issues or yield inoperable links.

Installing cabling with a capacity less than the listed PSE output current may violate installation requirements. Please consult any local and national safety regulations.

Previous experience of IEEE 802.3

- Some have suggested that multiple current capabilities is no different than having different category cables for performance or too great of cable resistance for PoE
 - The primary effect of either of these is that the system does not perform to IEEE Std 802.3 specifications – no harm is done, and within the scope of 802.3
- Allowing reduced current carrying capacity could create a situation where the current carrying capacity of the link is exceeded by the attached application
 - Requires IEEE Std 802.3 to disallow easily misconfigured cabling or risk additional restrictions placed on the use of SPoE by other standards such as IEC 60364 Low-voltage electrical installations originating in IEC TC64

Slide added but not reviewed by Ad Hoc. Will discuss and consider in next PDCC meeting.

5. This slide to add

Title: Considering dependency of wire diameter and current carrying capacity

As wire diameter is a key parameter for current carrying capacity, smaller diameters will not allow the same amount of current per conductor. Therefore, the powering classes must be split into 2 groups:

- Maximum current carrying capacity (today 2A) for AWG18 wires to provide the maximum power to the PD. This includes a future proof current increasement from todays 1.6A to 2.0A per conductor.**
- Reduced current carrying capacity for AWG23 wires to provide reduced power of maximum 20W to the PD. All devices, sensors and actors which require more power must be wired with AWG18 wires only.**
- Keyed connectors shall be used to avoid a wrong insertion of small wire diameters into a PSE capable to deliver the maximum power.**