11801 and Use of 4P Cable for 1P Applications

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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.

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This restriction breaks the IEEE 802.3 ‘plug-and-play’ interoperability model, as well as the plug and play tradition of 11801. As such, the 802.3 WG feels the need to make a direct 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 0.75 A

- 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.

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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.

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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
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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
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Backup

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

- CURRENT CARRYING CAPACITY ~~SHOULD~~ ~~MATCH~~ SHALL BE 2.0 A MIN FROM BEGINNING TO END
  - W~~ire 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

Alternatives and risks

- CURRENT CARRYING CAPACITY SHOULD BE 2.0 A MIN FROM BEGINNING TO END
  - Disallow use of 0.75 components in systems that appear to support 2 A at the user interface
    - Otherwise users might apply 2 A to them and then what will happen????
- CLEARLY IDENTIFY ANY RESTRICTED CURRENT CHANNELS
  - Examples might be different color connectors or mandatory labelling
    - Otherwise users will not know which channels can support 2 A and which cannot, leading to potential damage
- PREVENT ACCIDENTAL MISCONFIGURATION
  - Different or keyed connectors to disallow interconnection of the disparate channels
    - Need to make sure the keyed connector is always used when required, the key cannot be removed or defeated, and the 0.75 components are never used with the 2 A user interface.
- DISCOURAGE USE OF 4P CABLE FOR 1P APPLICATIONS FOR NEW INSTALLATIONS
  - Not sure why new installations would not use new, modern technology
    - Mixed 4-pr and 1-pr systems using 0.75 A might be later utilized with 2 A devices, why take this risk????

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

- CURRENT CARRYING CAPACITY ~~SHOULD~~ ~~MATCH~~ SHALL BE 2.0 A MIN FROM BEGINNING TO END
  - If wire gauge (cross sectional area) is not uniform throughout the link length and does not support 2-amp current flow users encounter performance problems with the link.
- CLEARLY IDENTIFY ANY RESTRICTED CURRENT CHANNELS
  - PSEs and PDs cannot determine the current carrying capacity of the link. Therefore, links must be clearly identified using color and/or labels as “current restricted” to avoid problems with the link.
- PREVENT ACCIDENTAL MISCONFIGURATION
  - Connector keying or other mechanical means of preventing misconnection must be implemented on restricted current channels to avoid problems with the link.
- CONCLUSION: USE OF 4P CABLE FOR 1P APPLICATIONS CREATES UNNEEDED RISK AND COMPLEXITY.

suggested editorial changes - CJ

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

- CURRENT CARRYING CAPACITY MAY NOT MATCH FROM BEGINNING TO END
  - Current capacity shall match end-to-end and be no smaller than that presented at the user interfaces (disallow hiding lower capacity behind a larger capacity at the user interface)
  - Disallow mixing of 0.75 A and 2.0 A components
- USER WON'T KNOW THE CURRENT CAPACITY OF THE CHANNEL
  - Clearly identify any restricted current channels, examples might be different color connectors or mandatory labelling
  - PSEs and PDs cannot determine the current carrying capacity of the link. Therefore, links must be clearly identified using color and/or labeled as "current restricted" to avoid problems with the link.
  - Prevent accidental misconfiguration, perhaps 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 channel 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.
- NEW INSTALLATIONS USING 0.75 A COMPONENTS WILL NOT BE FUTURE PROOF
  - Future upgrade of a PSE could exceed the channel current capacity leading to potential damage
  - Discourage Use of 4P Cable for 1P Applications for new installations
- CONCLUSION: USE OF 4P CABLE FOR 1P APPLICATIONS CREATES UNNEEDED RISK AND COMPLEXITY.

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

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Draft of Maintenance Request

Warning to system designers:

Not all cabling supports 2.0 A 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. For example, the ISO/IEC 11801-1 Amd1 standard states "A channel made from a combination of single pair and multi-pair cabling components may have a current capacity limited to 0.75 A".

IEEE 802.3 Clause 104 (Power over Data Lines for SPE) 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 complaint IEEE 802.3 Power over Data Lines 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.

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In particular, the ISO/IEC 11801-1 Amd1 specification contains an exemption for Single Pair Ethernet (SPE) with power supporting a channel made from a combination of single pair and multi-pair cabling components that may have a current capacity limited 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.).

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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

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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.**