“Engineered” power delivery
1000 m Link Segment

Berlin, Germany

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Purpose

- **Scope**
  - **Continuation of development of 802.3cg baseline "Optional Power Distribution annex".**

Contributors

- Ronald Nordin, Bob Voss – Panduit
- Steffen Graber, Timo Graber – Pepperl+Fuchs

Background

Motion #12

Move to create normative annex in 802.3cg baseline "Optional Power Distribution annex" to include:

- ***Power/voltage/current/DCR for link segment (point-to-point/plug-and-play) topologies* slide 12 diminico_02_0517.pdf.***
- ***"engineered" power delivery for other topologies* (trunk cables) slide 14 diminico_02_0517.pdf.***
- ***Link Segment DCR characteristics slide 19 diminico_02_0517.pdf.***

- ***M: C. Diminico S: S. Graber***
- ***Y: 18 N: 0 A: 9***
- **Motion Passes (Technical >= 75%)**

http://www.ieee802.org/3/cg/public/May2017/motions_3cg_01b_0517.pdf

Background

- Link Segment DCR characteristics slide 19 diminico_02_0517.pdf.

AWG	Resistance per meter (ohm)	Length @ IL limit (m)	Conductor resistance @ IL limit (ohm)	Loop resistance @ IL limit (ohm)	10 connector DCR	Link segment resistance @ IL limit (ohm)
14	0.0092	1589	14.67	29.33	4.00	33.33
15	0.0116	1415	16.47	32.94	4.00	36.94
16	0.0147	1261	18.50	37.00	4.00	41.00
17	0.0185	1123	20.78	41.55	4.00	45.55
18	0.0233	1000	23.33	46.66	4.00	50.66
19	0.0294	891	26.20	52.40	4.00	56.40
20	0.0371	793	29.42	58.84	4.00	62.84
21	0.0468	706	33.04	66.07	4.00	70.07
22	0.0590	629	37.10	74.19	4.00	78.19
23	0.0744	560	41.66	83.31	4.00	87.31
24	0.0938	499	46.78	93.55	4.00	97.55

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Annex – P-to-P Powered Device

- normative annex in 802.3cg baseline “Optional Power Distribution annex” to include:
  - Power/voltage/current/DCR for link segment (point-to-point/plug-and-play) topologies* slide 12 diminico_02_0517.pdf.

Point-to-Point Powered Devices

Class	Vpse, min V	Ipi, max (A)	Rloop (60C) ohm	Ppd (1000m) W
new *1	20	.102	59	1.4
new 2	20	.155	39	2.2
new 3	50	.255	59	8.9
new 4	50	.388	39	13.6

**new refers to in addition to PoDL classes*

Background

Motion #13

- ***Move to adopt in 802.3cg baseline Optional Power Distribution annex baseline power requirements for (point-to-point/plug-and-play) powered devices in Table below:***

Class	Vpse, min V	Ipi, max (A)	Rloop (60C) ohm	Ppd (1000m) W
new 1	20	.102	59	1.4
new 2	20	.155	39	2.2
new 3	50	.255	59	8.9
new 4	50	.388	39	13.6

- ***M: C. Diminico S: H. Stewart***
- ***Y: 20 N: 0 A: 9***
- **Motion Passes (Technical >= 75%)**

http://www.ieee802.org/3/cg/public/May2017/motions_3cg_01b_0517.pdf

Annex – Point-to-point

- Link Segment DCR

AWG	Resistance per meter (ohm)	Length @ IL limit (m)	Conductor resistance @ IL limit (ohm)	Loop resistance @ IL limit (ohm)	10 connector DCR	Link segment resistance @ IL limit (ohm)
14	0.0092	1589	14.67	29.33	4.00	33.33
15	0.0116	1415	16.47	32.94	4.00	36.94
16	0.0147	1261	18.50	37.00	4.00	41.00
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18	0.0233	1000	23.33	46.66	4.00	50.66
19	0.0294	891	26.20	52.40	4.00	56.40
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21	0.0468	706	33.04	66.07	4.00	70.07
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Annex – Point-to-point

- Closed form equation for other point-to-point powered devices based on power/voltage/current/DCR/Temperature (TBD)

$$P_{\text{Class-2P}} = \left\{ V_{\text{PSE}} \times \left(\frac{V_{\text{PSE}} - \sqrt{V_{\text{PSE}}^2 - 4 \times R_{\text{Chan}} \times P_{\text{Class\_PD-2P}}}}{2 \times R_{\text{Chan}}} \right) \right\}_{\text{W}} \qquad (145\text{–}3)$$

where

V_{PSE} is the voltage across the pairset at the PSE PI as defined in 145.1.3.

R_{Chan} is the link section DC loop resistance

$P_{\text{Class\_PD-2P}}$ is the maximum power at the PD PI for a pairset per the PDs assigned Class, as defined in Table 145–28

Source: IEEE_P8023bt_DRAFT_2p5.pdf

Annex – Point-to-point

$$P_{\text{Class-2P}} = \left\{ V_{\text{PSE}} \times \left(\frac{V_{\text{PSE}} - \sqrt{V_{\text{PSE}}^2 - 4 \times R_{\text{Chan}} \times P_{\text{Class\_PD-2P}}}}{2 \times R_{\text{Chan}}} \right) \right\}_{\text{W}}$$

$$I_{PSE} = \frac{V_{\text{PSE}} - \sqrt{V_{\text{PSE}}^2 - 4 \times R_{\text{Chan}} \times P_{\text{Class\_PD-2P}}}}{2 \times R_{\text{Chan}}}$$

Point-to-Point Powered Devices

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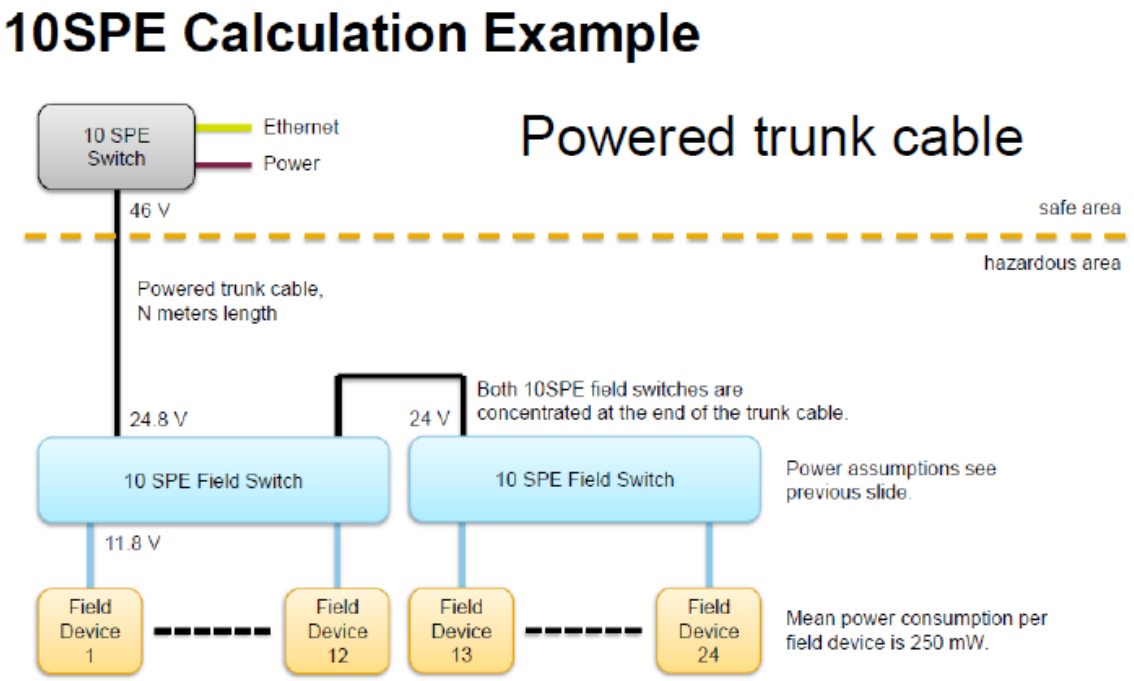
Annex – Trunk Cables

- normative annex in 802.3cg baseline “Optional Power Distribution annex” to include:
  - “engineered” power delivery for other topologies* (trunk cables) slide 14 diminico_02_0517.pdf.



http://www.ieee802.org/3/cg/public/Jan2017/Graber_10SPE_09a_0117.pdf

Annex – Trunk Cables

10SPE Calculation Example

- The following assumptions should only be seen as an example, for a specific implementation the values may change.
- 10SPE power supply
  - 48 V open circuit output voltage
  - 46 V minimum output voltage
  - 1.25 A maximum output current.
- 10SPE field device
  - 9 V minimum supply voltage
  - 250 mW power consumption (50 mW PHY, 70 mW microcontroller, 50 mW application, 80 mW protection, auxiliary circuits and power supply)
- 10SPE field switch
  - Supply voltage range 24 - 48 V
  - 250 mW power consumption (50 mW PHY, 30 mW series resistors, 10 mW cable losses, 20 mW functional current limiting, 140 mW protection, auxiliary circuits and power supply) per spur port
  - 5 W switch core losses
  - 80 % power supply efficiency
  - 1.5 W primary side losses
  - 0.5 W average losses per daisy-chain element

http://www.ieee802.org/3/cg/public/Jan2017/Graber_10SPE_09a_0117.pdf

Summary

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