802.3da Powering Voltage

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For power transmission (PoDL) up to now only the ~50V voltage has been considered.
but lower voltages should be also considered such as 12V or 24V as they are widely used in the industrial and automotive world.

Several reason are given here as examples:

- Safety of Low Voltage Distribution
- Creepage distances in harsh environment
- Compatibility with Advance Physical Layer
- Compatibility with PoDL Standard 802.3bu + 802.3cg

Safety of Low Voltage Distribution

For safety reasons (e.g. NEC 411.1 for lighting) distribution of 60Vdc voltage is not longer enough to ensure the safety of user in the event of direct contact in wet environment. In this case the maximum allowed voltage is reduced to 30Vdc.
If the 10BASE-T1M cannot be supplied with 24Vdc of 12Vdc, it cannot be used in wet (24Vdc) or immersed (12V) environment without additional protection like residual current protection device.

Title: ARTICLE 411 Low-Voltage Lighting.

411.1 Scope. *This article covers lighting systems and their associated components operating at no more than 30 volts ac or 60 volts dc. Where wet contact is likely to occur, the limits are 15 volts ac or 30 volts dc.*

Creepage distances

The creepage distances to be considered in the design of products change according to the degree of pollution.

For example, IEC60664-1 gives 1.2mm for 50V in a pollution degree 2 environment (dry) but if the product is used in a pollution degree 3 environment (wet) these 1.2mm are only acceptable for 25V.

Table F.5 – Creepage distances to avoid failure due to tracking *(1 of 2)*

Voltage RMS [a, e]	Minimum creepage distances								
	Printed wiring material								
	Pollution degree								
	1	2 [f]	1	2			3		
	All material groups	All material groups, except IIIb	All material groups	Material group I	Material group II	Material group III	Material group I	Material group II	Material group III [b]
V	mm	mm	mm	mm	mm	mm	mm	mm	mm
10	0,025	0,040	0,080	0,400	0,400	0,400	1,000	1,000	1,000
12,5	0,025	0,040	0,090	0,420	0,420	0,420	1,050	1,050	1,050
16	0,025	0,040	0,100	0,450	0,450	0,450	1,100	1,100	1,100
20	0,025	0,040	0,110	0,480	0,480	0,480	1,200	1,200	1,200
25	0,025	0,040	0,125	0,500	0,500	0,500	1,250	1,250	1,250
32	0,025	0,040	0,14	0,53	0,53	0,53	1,30	1,30	1,30
40	0,025	0,040	0,16	0,56	0,80	1,10	1,40	1,60	1,80
50	0,025	0,040	0,18	0,60	0,85	1,20	1,50	1,70	1,90

This would have huge consequences on the connectors which would be larger in a humid environment if we cannot supply them with 24V.

Advance Physical Layer

The APL (Advance Physical Layer) standard used in the industrial world, is based on 10BASE-T1L.
It recommends for zone 0 (energy limited zone for hazardous area) to limit the voltage to 15V.

There are three classes: from 0.55W up to 1.17W.

	APL Port Profile					Unit
Class	**15 V**			**50 V**		
Class#	A	B	C			
$V_{PSE(max)}$	15			50		V
$V_{PSE(min)}$	9,6	10,1	11,61	46		V
$I_{PI(max)}$	55,56	115	95	1250	2000	mA
$P_{PD(max)}$	0,54	1,17	1,1	57,5	92	W

Therefore, it will not be possible to use 10BASE-T1M in ATEX environments (explosive atmospheres) if it is not allowed to supply 15V voltage.

PoDL Standard 802.3bu + 802.3cg

The 802.3bu & 802.3cg standards introduced classes 0 to 7 and 10 to 12 with voltages of 12V or 24V.
Many products have or will be developed using these classes for 10BASE-T1L and 10BASE-T1S, it would be a pity to exclude them from 10BASE-T1M.

	IEEE 802.3bu										IEEE 802.3cg						Unit
Class	**12 V** unregulated		**12 V** regulated		**24 V** unregulated		**24 V** regulated		**48 V** regulated		**24 V**			**55 V**			
Class#	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
$V_{PSE(max)}$	18				36				60		30			58			V
$V_{PSE(min)}$	6		14,4		12		26		48		20			50			V
$I_{PI(max)}$	101	227	249	471	97	339	215	461	735	1360	92	240	632	231	600	1579	mA
$P_{PD(max)}$	0,5	1	3	5	1	3	5	10	30	50	1,23	3,2	8,3	7,7	20	52	W

Conclusion / Proposition

Some applications on 10BASE-T1M will require a lower voltage than 50~57V.
This is the responsibility of the 10BASE-T1M based system specifier to choose the correct voltage depending on the environment (it is not a constraint from the PSE or PD design).

Propositions are:

- Let the 10BASE-T1M based system specifier choose the voltage of the PSE depending on the environment and maximum power, number of Nodes and length of cable, complying with Clause 104.
- Ask for PD to operate with a larger voltage range:
  - A proposition for input voltage range could be 10.6V[1] to 58V[2] (to be discussed)
  - With a reduced amount of power: (0.5W ?)
  - Devices requiring higher power must stay in low power mode if input voltage is too low (to not exceed max current of coupling inductances of PD)

1: minimum PD voltage of class 3
2: maximum PSE voltage of class 15