

The bundle in that tray is where the channel loss becomes heat, and nothing in the switch reports the temperature inside it.

NLC ACADEMY · EPISODE 26

A 90 W Class 8 port guarantees 71.3 W at the PD.

PoE Power in Practice: Types, Classes, Losses & Thermal Limits. What the switch sources, what the channel takes and what the device is guaranteed.

CURRENT IEEE REFERENCE

For Type 3 and Type 4, cite Clause 145 of IEEE Std 802.3-2022

802.3af 2003
802.3at 2009
802.3bt 2018

incorporated
superseded

IEEE Std 802.3-2022
Clause 33
Types 1 and 2
Clause 145
Types 3 and 4

current base standard

The familiar amendment names remain widely used in industry. For specifications and formal references, cite the applicable clause of the current IEEE 802.3 base standard, which carries Types 1 and 2 in Clause 33 and Types 3 and 4 in Clause 145. The standard's own terms are Type and Class. [1]

ONE EQUATION, FOUR FAMILIAR NUMBERS

Port power minus channel loss

port = amps × volts | loss = amps² × ohms

	PSE		loss		PD
Type 1	15.4 W	-	2.45 W	=	12.95 W
Type 2	30.0 W	-	4.50 W	=	25.5 W
Type 3	60.0 W	-	9.00 W	=	51.0 W
Type 4	90.0 W	-	18.7 W	=	71.3 W

port minus channel loss = guaranteed at the PD

15.4, 30, 60 and 90 W are PSE-side levels in these examples. 12.95, 25.5, 51 and 71.3 W are the power available at the PD interface under the stated minimum voltage and worst-case channel resistance. [1][2]

A CITATION CAN BE STALE WITHOUT BEING WRONG

12.95 W, and the 13.0 W that replaced it

802.3af 2003	802.3at 2009	802.3-2012 2012	802.3-2022 2022
12.95 W	13.0 W	13.0 W	13.0 W

still printed in a 2022 vendor white paper

802.3-2012: “12.95” appears 0 times in 3,748 pages

the equation still gives 12.95, so it never looks wrong

The equation still lands on 12.95 W. Since 802.3at the published Class 3 figure has been 13.0 W, and "12.95" does not appear in the 2012 edition. Legacy values can stay in current technical literature long after the base standard adopts a different published number. [1]

FOR POWER LOSS, ASK FOR OHMS, NOT METRES ALONE

Distance alone does not define PoE loss. Channel resistance does.

ISO/IEC 11801
25 Ω
per pair, Class D channel

÷2

one pairset
12.5 Ω
out on one pair, back on the other

÷2

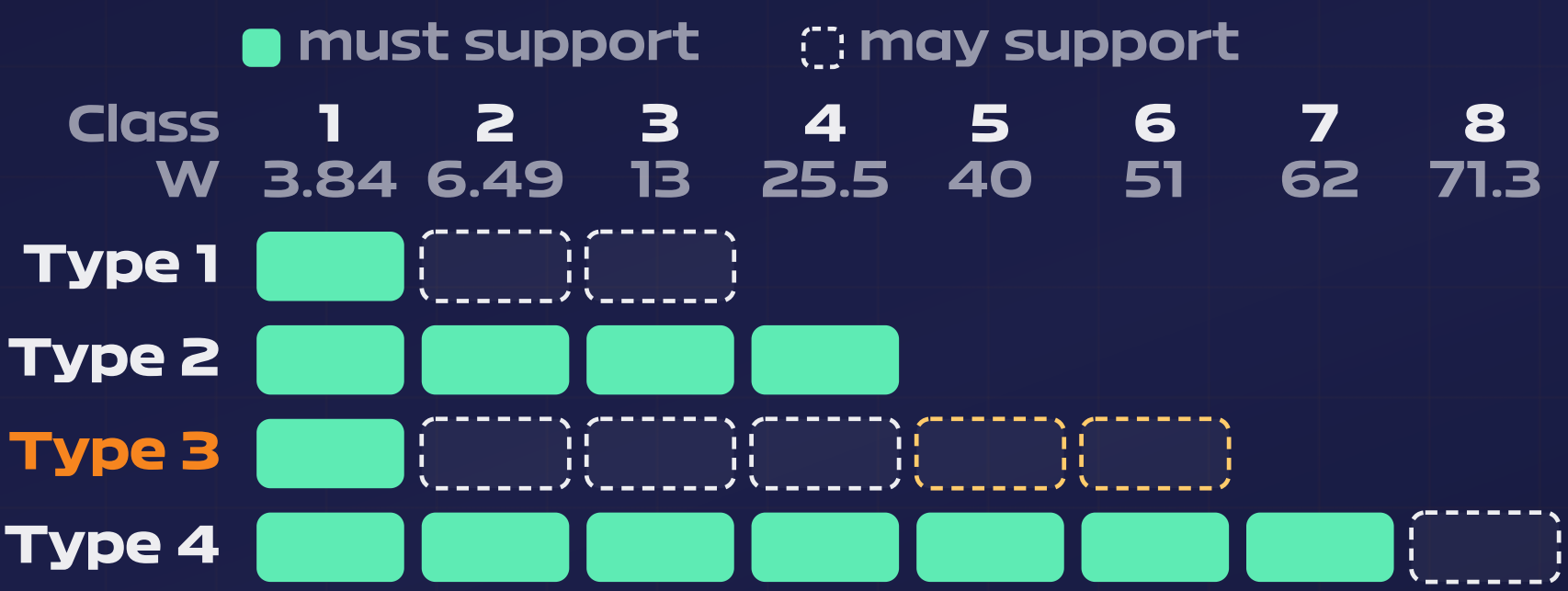
all four pairs
6.25 Ω
two pairsets in parallel

the PoE budget is the cabling spec divided by two, twice

Length affects resistance, but resistance is the quantity in the loss calculation: 12.5 Ω per pairset and 6.25 Ω on four pairs, derived from the Class D channel limit. Record the measured pairset loop resistance per channel alongside the length. [1][3]

TYPE IS NOT A POWER GUARANTEE

Type 3 can reach Class 6, but Type alone does not specify PD power



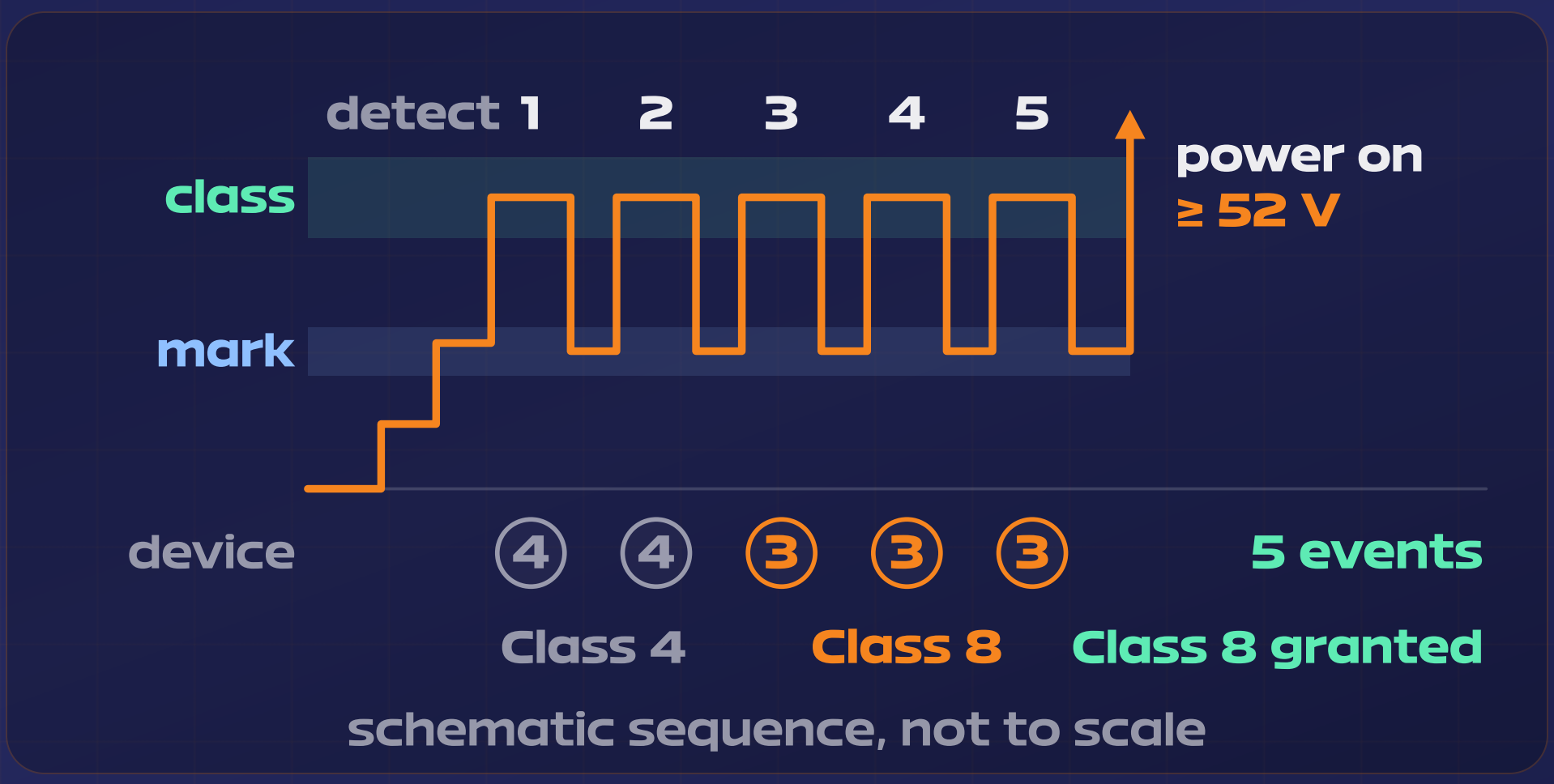
per this source, Type 3 must support at least Class 1: 3.84 W at the PD

amber outline: Classes 5 and 6 also need four pairs

Class 6 corresponds to 51 W at the PD. Type 3 capability depends on the Class supported and the pair configuration, and per the cited source a Type 3 PSE must support at least Class 1. A Type 4 PSE must support Class 7, with Class 8 as additional capability. [2]

HOW THE PORT DECIDES

Detection is a resistor. Classification is a conversation.



The 25 kΩ signature identifies a powered device. The PSE then applies 15.5 to 20.5 V and the PD answers with the current it draws, changing its class signature from the third event when it requests more than Class 4. [2]

WHEN THE POWER BUDGET RUNS SHORT

The port may be assigned a lower Class instead of failing

requests	events the switch sends				
	1	2	3	4	5
Class 5	13	25.5	25.5	40	
Class 6	13	25.5	25.5	51	
Class 7	13	25.5	25.5	51	62
Class 8	13	25.5	25.5	51	71.3

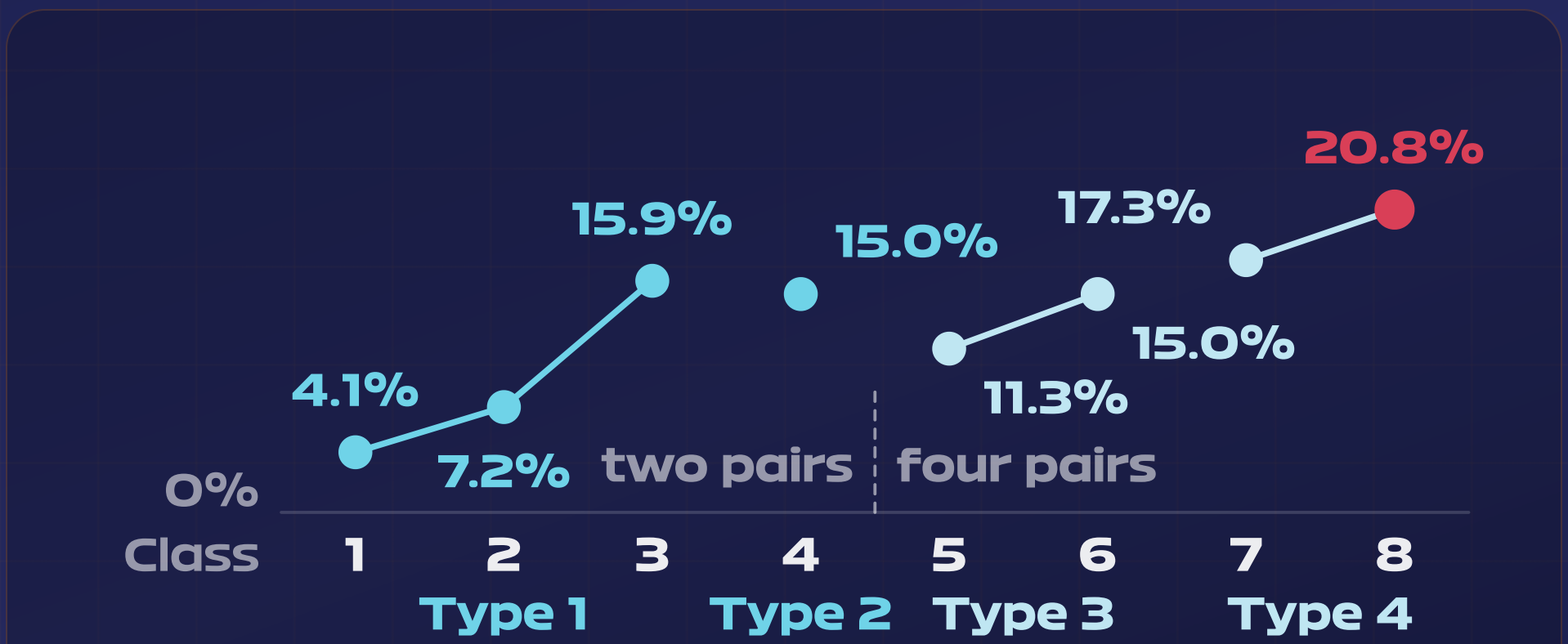
granted in full demoted

W at the PD · empty cell: not permitted

In power demotion the PSE produces fewer class events, and the PD is assigned the lower of what it requested and what the count grants. If a luminaire powers up but does not reach full output, verify the Class actually granted by the PSE before blaming the driver. [2]

MORE POWER CAN MEAN MORE CHANNEL LOSS

At Class 8, worst-case channel loss can reach 20.8%

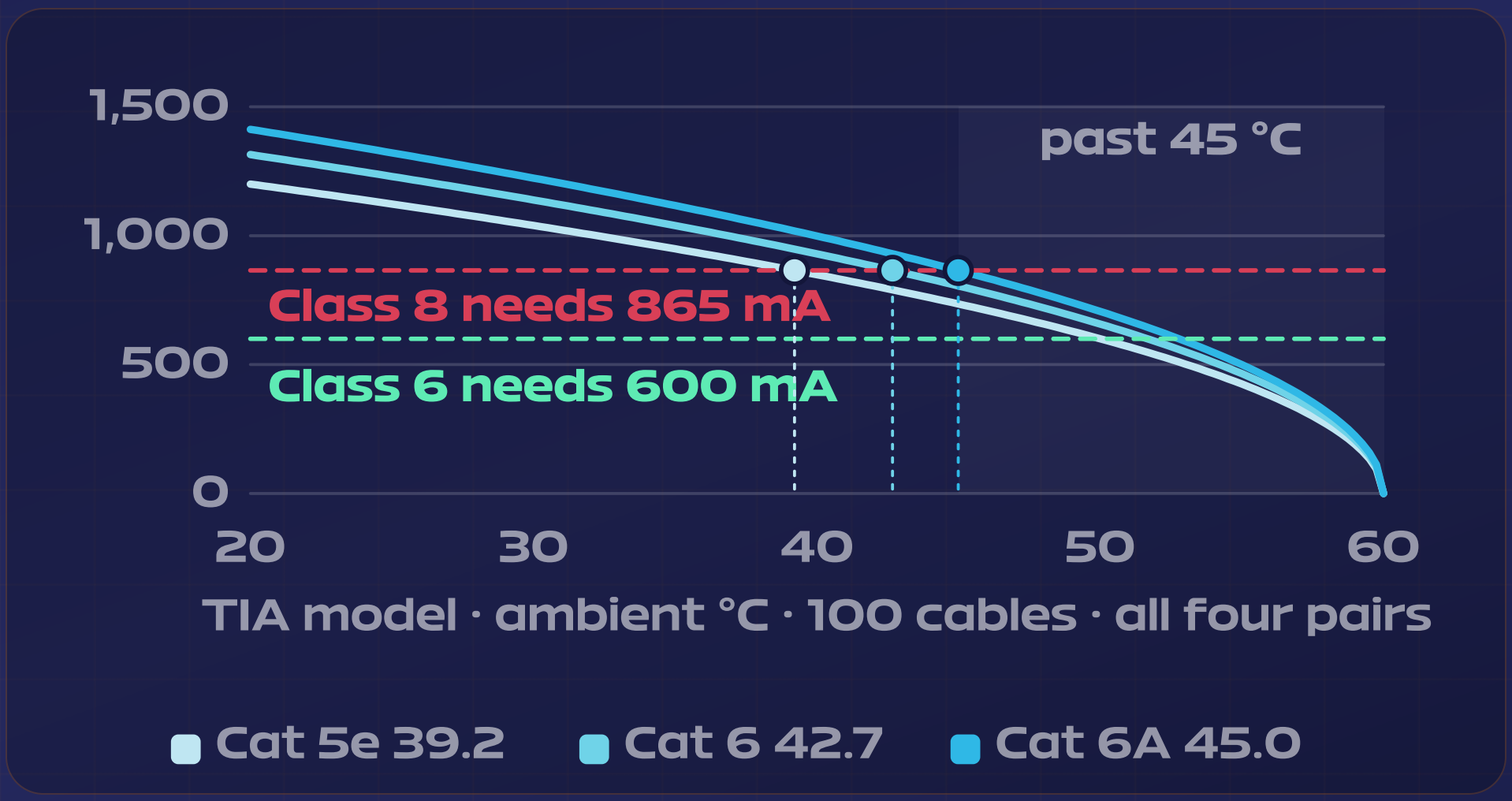


worst-case channel loss, by Class

This is channel loss, not total system efficiency. In the standard's worst-case channel a 90 W port loses 18.7 W in the copper; across 200 luminaires that is about 3.74 kW of cable heat under the same assumption, which may need to be counted in cooling calculations. [1]

THE HOT-BUNDLE LIMIT

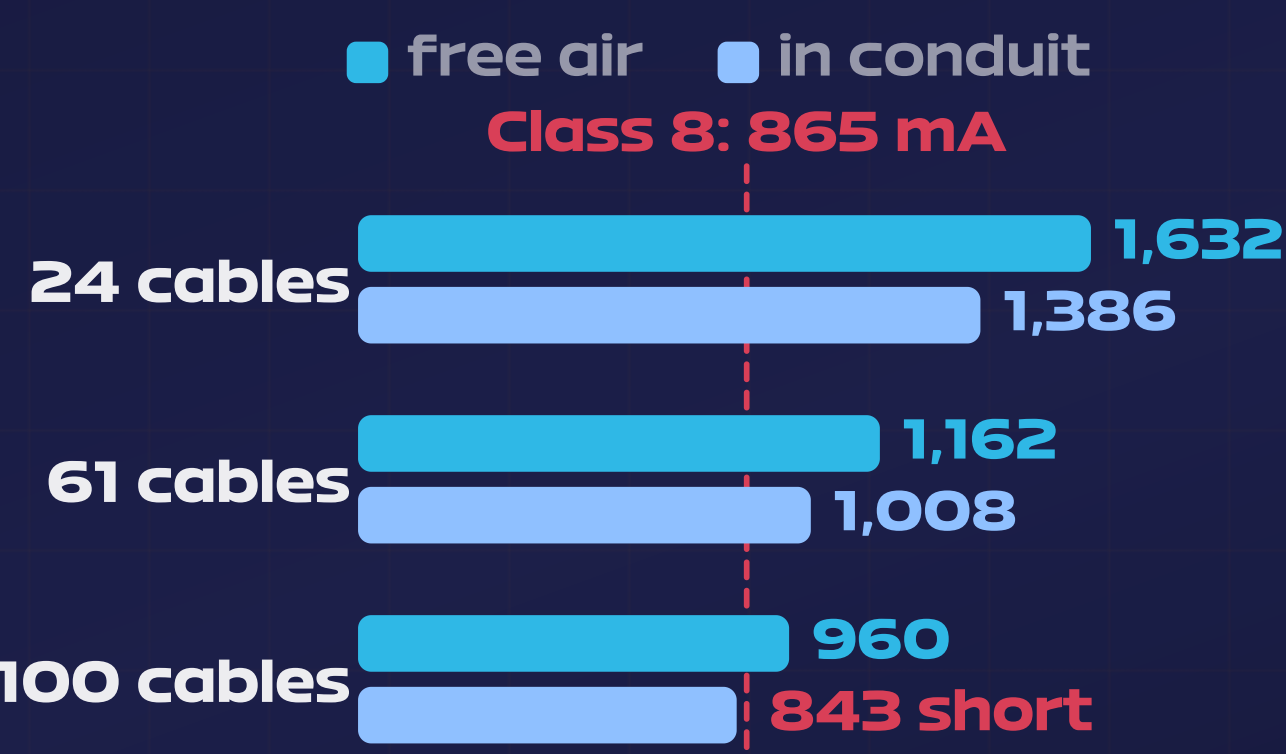
In this TIA model, Class 8 reaches the Cat 6A limit at 45 °C



TIA, the Telecommunications Industry Association, models a 100-cable bundle with all four pairs energised in its bulletin TSB-184-A. Class 8's 865 mA per pair meets the Cat 6A curve at 45 °C, Cat 6 at 42.7 °C and Cat 5e at 39.2 °C. Class 6's 600 mA stays inside every curve to 50 °C. [4]

BUNDLE SIZE AND PATHWAY MATTER

Same cable. Same ambient. Different allowable current.



one manufacturer's Cat 6A data, mA per pair at 45 °C

bundle and pathway change the limit

One manufacturer's Cat 6A data at 45 °C: 960 mA per pair in a 100-cable bundle in free air, 843 mA in conduit, and 1,632 mA at 24 cables. Thermal capability follows the cable, the bundle, the pathway and the ambient. [5]

SAUDI BUILDING CODE 2024

SBC 401-CR-2024 introduces Chapter 716 for DC power over ICT cabling



Its contents page places the chapter between 715 and 717, under the section headings of IEC 60364-7-716:2023. In this example a 90 W Type 4 port at 52 V puts 433 mA in each conductor against the 750 mA electrical limit in the IEC text, while thermal limits can become the binding constraint. Use the Saudi text for Saudi requirements. [6]

THE QUESTION EVERY PoE QUOTATION SHOULD ANSWER

How many ports can actually run at 90 W simultaneously?

EXAMPLE: 48 ports, each 90 W capable



21 at 90 W simultaneously

set by the switch budget and the installed supplies



Every green link there is a finished negotiation. Nothing on that panel says how many watts the port granted.

Example: one vendor’s 48-port switch, every port 90 W capable, 21 ports at 90 W at once with the specified supplies fitted. Aggregate PoE capacity follows the switch power budget and the installed supplies, not the port rating multiplied by the port count. [7]

A PoE LIGHTING SYSTEM, MEASURED

In one PNNL test, switch and cable overhead reached 13 to 19%



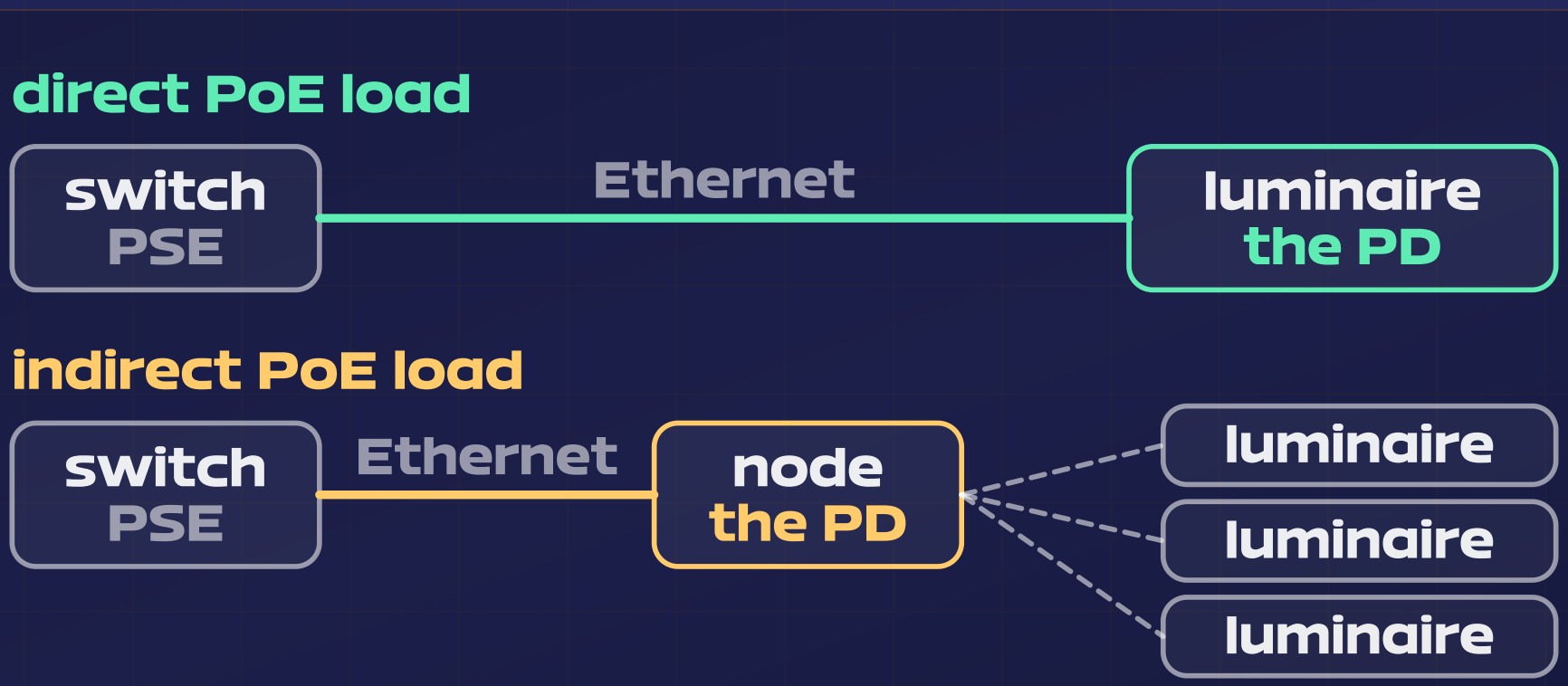
one tested system · switch supply 88 to 91% efficient
cables held under 5%, per ANSI C137.3

conversion moves into the switch; it is not removed

One tested system: specific switch hardware, 49 m cables and ANSI C137.3 conditions, with the switch supply measured 88 to 91% efficient. Moving AC-to-DC conversion into the switch does not remove conversion losses. Whole-building DC savings claims are a separate question. [8][9]

READ THE WIRING DIAGRAM

Not every "PoE luminaire" is itself the PoE device



low-voltage leads: not Ethernet, not IEEE 802.3

In some PoE lighting systems the node is the PD, and low-voltage wiring runs on to the luminaires. Everything after the PD is outside the IEEE 802.3 power link. Ask which device is the PD, and who specifies and verifies the wiring downstream. [10]

SPECIFY PoE LIKE THIS

Six requirements that make a PoE specification measurable

EACH LINE NAMES A DOCUMENT, A QUANTITY OR A CONDITION

1. PSE to IEEE Std 802.3-2022 Clause 145, Type 4, four-pair, minimum port voltage 52 V.
2. Guaranteed [X] W at the PD power interface, not at the port, calculated with the measured channel resistance.
3. Measured pairset DC loop resistance recorded per channel, not above 12.5 Ω per pairset.
4. Design ambient in the cable pathway stated by the designer, not assumed at 20 °C.
5. Bundle size and pathway stated, with the temperature rise calculated to TIA TSB-184-A at that ambient, all four pairs energised, within the cable's rating.
6. Switch PoE budget stated for the supplied power supplies at project mains voltage, with the number of ports supportable simultaneously at the specified Class.

"Ohms, not metres" is the useful reminder: specify the electrical and thermal conditions, not distance alone.

SOURCES

Where each number comes from

[1] IEEE Std 802.3-2022, Clauses 33 and 145; IEEE Std 802.3-2012
[2] Ethernet Alliance, Overview of 802.3bt v2.1 (2019), Tables 2-15
[3] ISO/IEC 11801 channel limits; TIA-568-A DCR; Panduit TX6A sheet
[4] ANSI/TIA TSB-184-A, Table A.1; TIA-568.2-E Annex H
[5] CommScope CO-112435.1-EN (2018), 45 °C bundle current table
[6] IEC 60364-7-716:2023; SBC 401-CR-2024 contents, Chapter 716
[7] Cisco Catalyst 9300 datasheet and white paper; RUCKUS ICX 7550
[8] PNNL-27079 (2017, rev. 2019) for US DOE, PoE cable energy losses
[9] Gerber et al., Applied Energy 210 (2018), a DC-microgrid model
[10] US DOE PoE load terms; Focal Point PoE brochure (2020)

Standards are cited by clause in the current base document. Every computed figure is reproduced from the published equations by poe_physics.py, which self-tests against the published tables on every build.

PRACTICAL LIGHTING ENGINEERING

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https://nlc.com.sa/academy/poe-types.html

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