Extended Power v140

P802.3bt

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Supporters

- Yair Darshan – Microsemi
- David Tremblay – HP
- Sesha Panguluri – Broadcom
- Yan Zhuangyan – Huawei

Problem & Goal

- 802.3at is designed to allow operation at maximum PD power with the lowest allowed PSE voltage and the longest, highest impedance cable.
  It always works (this is a good thing!)

- This limits the maximum PD power to a worst corner case of 3 parameters.
- Significant power is “reserved” for the cable (100m of IEEE cable). This power is not dissipated, but the PSU must be able to provide it (cost + cooling + regulation).

Goal

- Maintain interoperability, things must Just Work
- Increase power budget at PD

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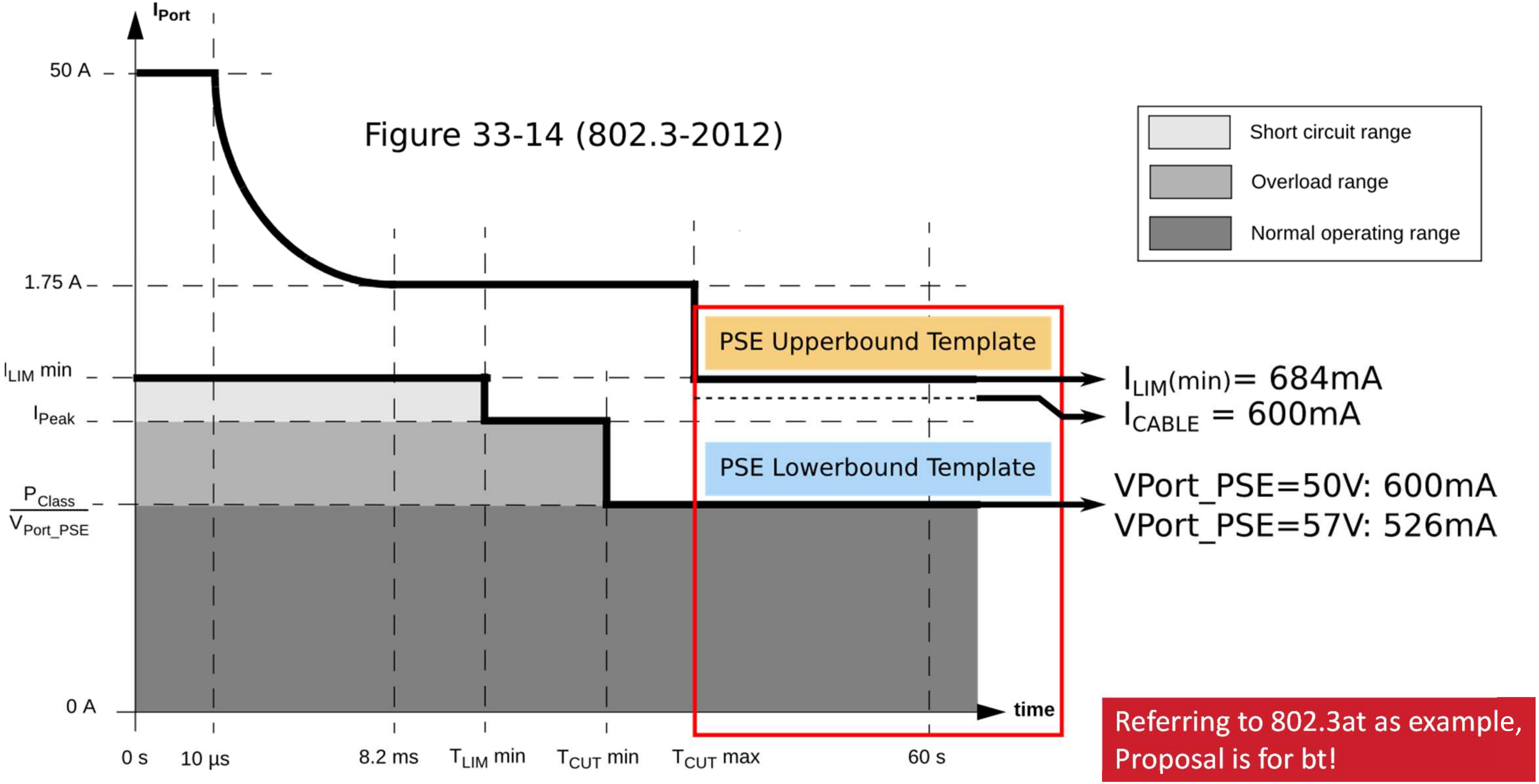
Definitions in 802.3at

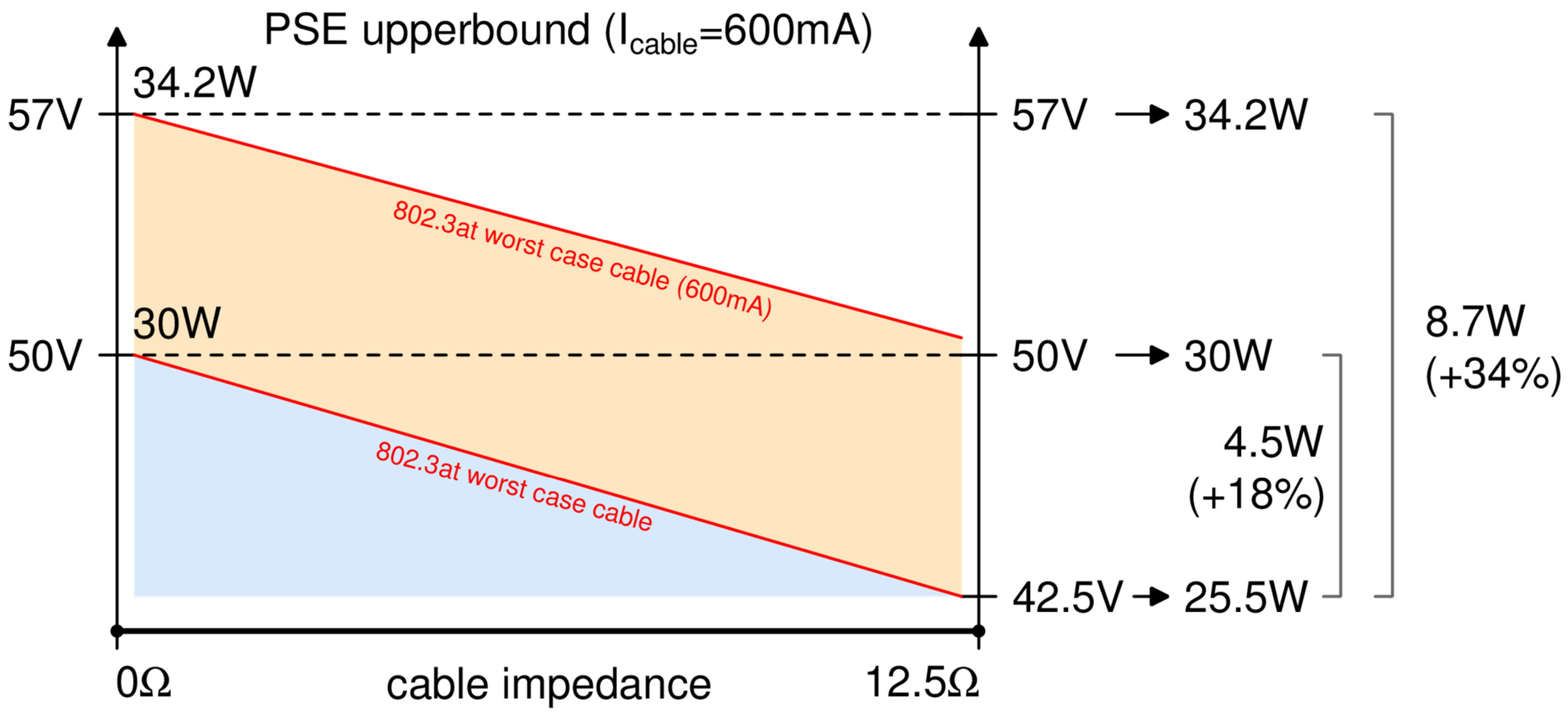
- Maximum cable current I_{cable} is 600mA (assumed to be maximum in further slides)
- Channel DC loop resistance 12.5 ohm



Referring to 802.3at as example, Proposal is for bt!

Cable reserves (in .at)

PD maximum power is 25.5W, PSE power is min 30W (lowerbound) to max 34.2W
Worst case cable means 125mΩ per meter.



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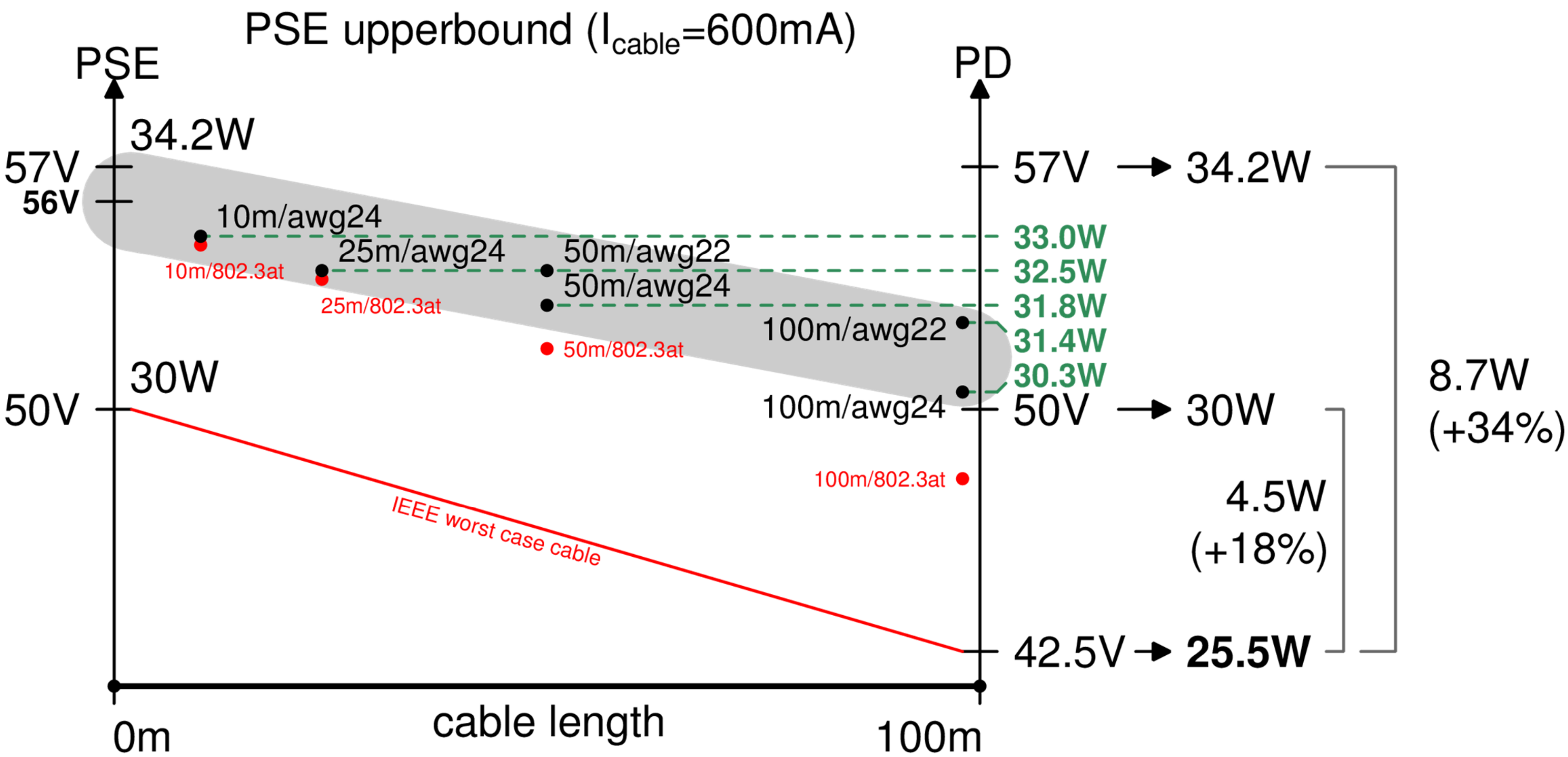
Real world cable

Injecting with a higher voltage, shorter cable or lower impedance cable increases the available power budget at the PD. Example, 56V V_{PSE} and typical awg24 & 22 cable.



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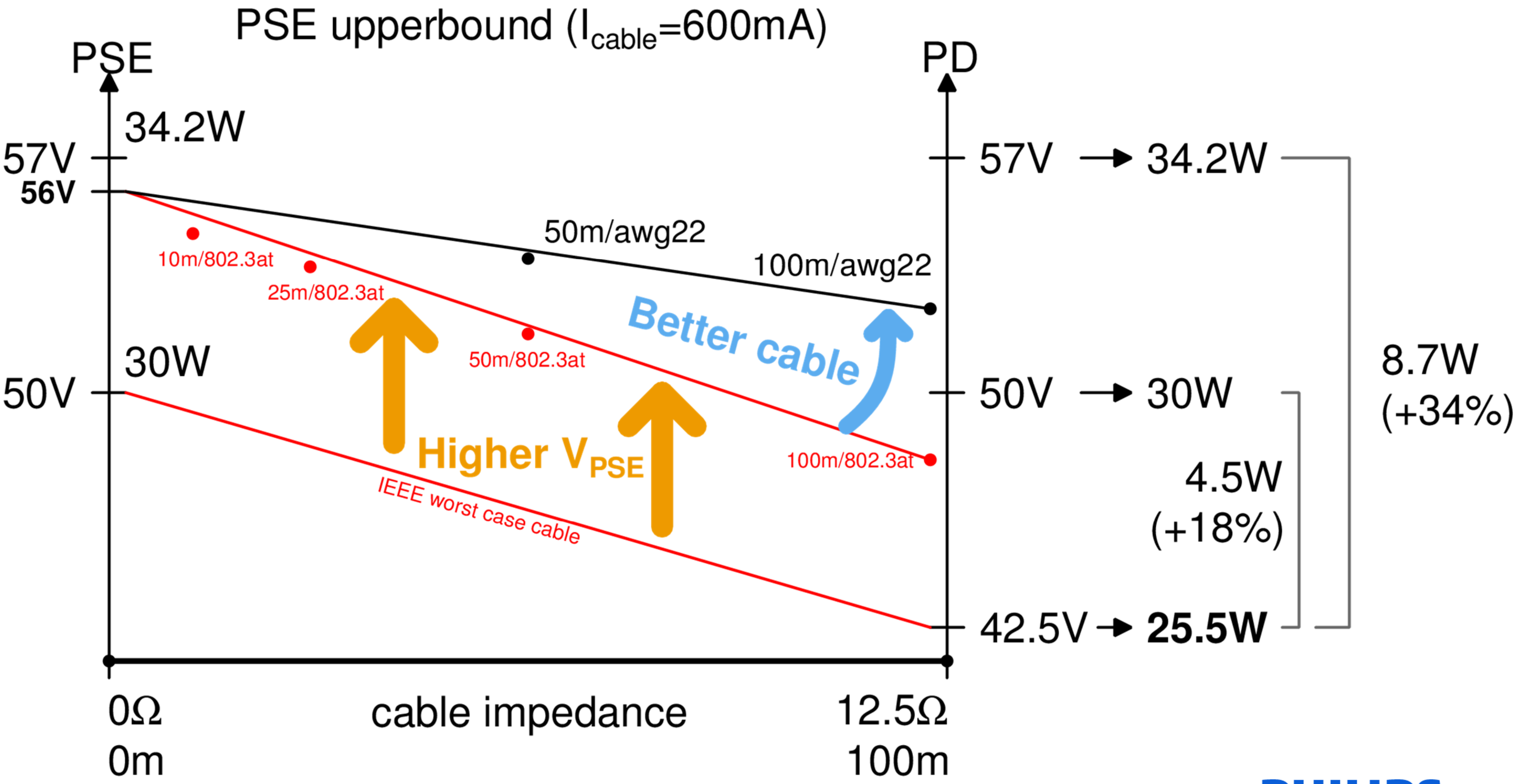
Extra Power

Blue = PSE lowerbound = PD consumes power reserved for cable (free)
Orange = PSE upperbound = Higher V_{PSE} increases available power (not free)



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Proposal

- There must be a single, unambiguous, answer to the question:
  “How much power is available for the PD?”.
  The current standard has such a number:
  Type 1: 13W
  Type 2: 25.5W

  Type 3: eg. 10W, 20W, 35W, 50W (TBD)
  Type 4: eg. 65W, 80W (TBD)

- Most PD designers should not exceed this as it directly affects interoperability
- However…
- Much like the car industry with RTPGE & PoDL, PoE Lighting/building automation is about engineered systems, done by electric installers with carefully designed high quality cable installations.
- It does not make sense to limit the PD to the minimum guaranteed power limit in all cases.

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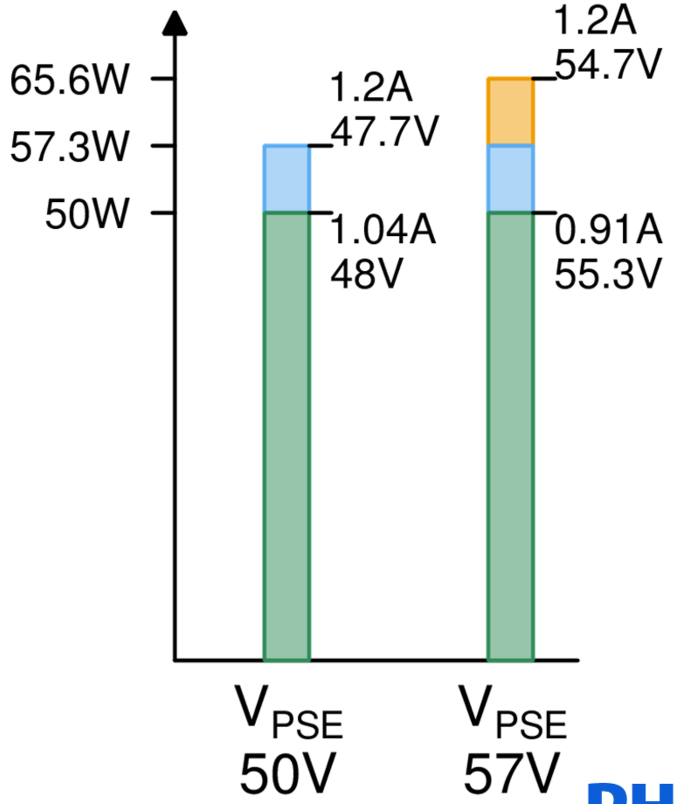
Proposal II

We introduce **a PD current limit** ‘on top of’ the guaranteed amount of PD power.
PDs will have a **guaranteed** amount of power available and on top of that they can increase power until they hit the current limit.
This allows PDs to make use of the power that is normally reserved for the cable and/or a higher PSE voltage **if it is available.**

Example based on simulation with realistic PSE and ideal PD using a CAT cable of 35 meter with AWG23.

Green: Guaranteed PD power 50W
Blue: Extra PD power taken from cable reserves
Orange: Extra PD power due to higher V_{PSE}



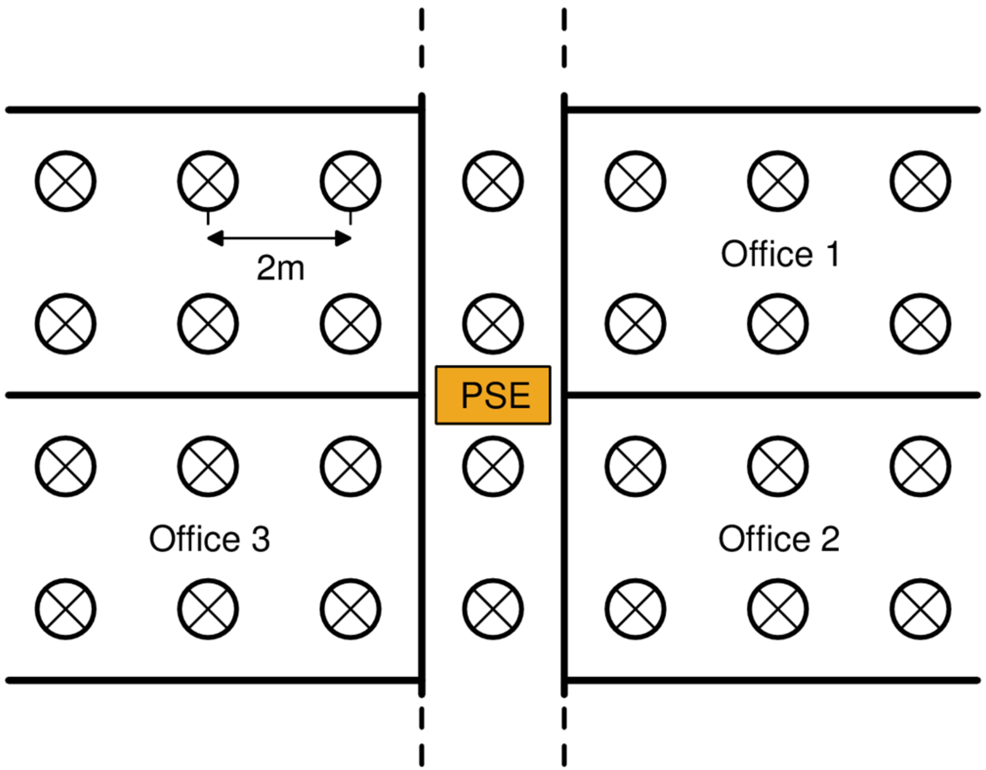
Referring to 802.3at as example, Proposal is for bt!

Example

- Efficiency of the PoE components is 95.9% (PSE + cable + PD)
- Cable losses are only 0.74% (CAT5, copper, awg 24, 2 pair mode, 25°C) → **6.5W**
- Equipment following 802.3at would allocate **126W to 244W** for cable losses.

Follow the rules:
28*25.5W = 714W (PD power)
28*56*536mA = 840W (PSE lowerbound)
→ 120W unusable in this case (15%)

Europe:
Typical office example, 4 rooms + corridor, 2m spacing, 112 sq m, 3000lm per luminaire (500 lux) = 28 luminaires



Total power delivered by PSE:	875.8	W
Total power dissipated in cables:	6.5	W
Total power in PD interfaces	22.7	W
Total constant power in PDs	840	W
Total power in PD (load+losses)	862.7	W
Average total PD power	30.8	W
Average current per luminaire	559	mA
Maximum current of all luminaires	560	mA
Lowest current of all luminaires	556	mA

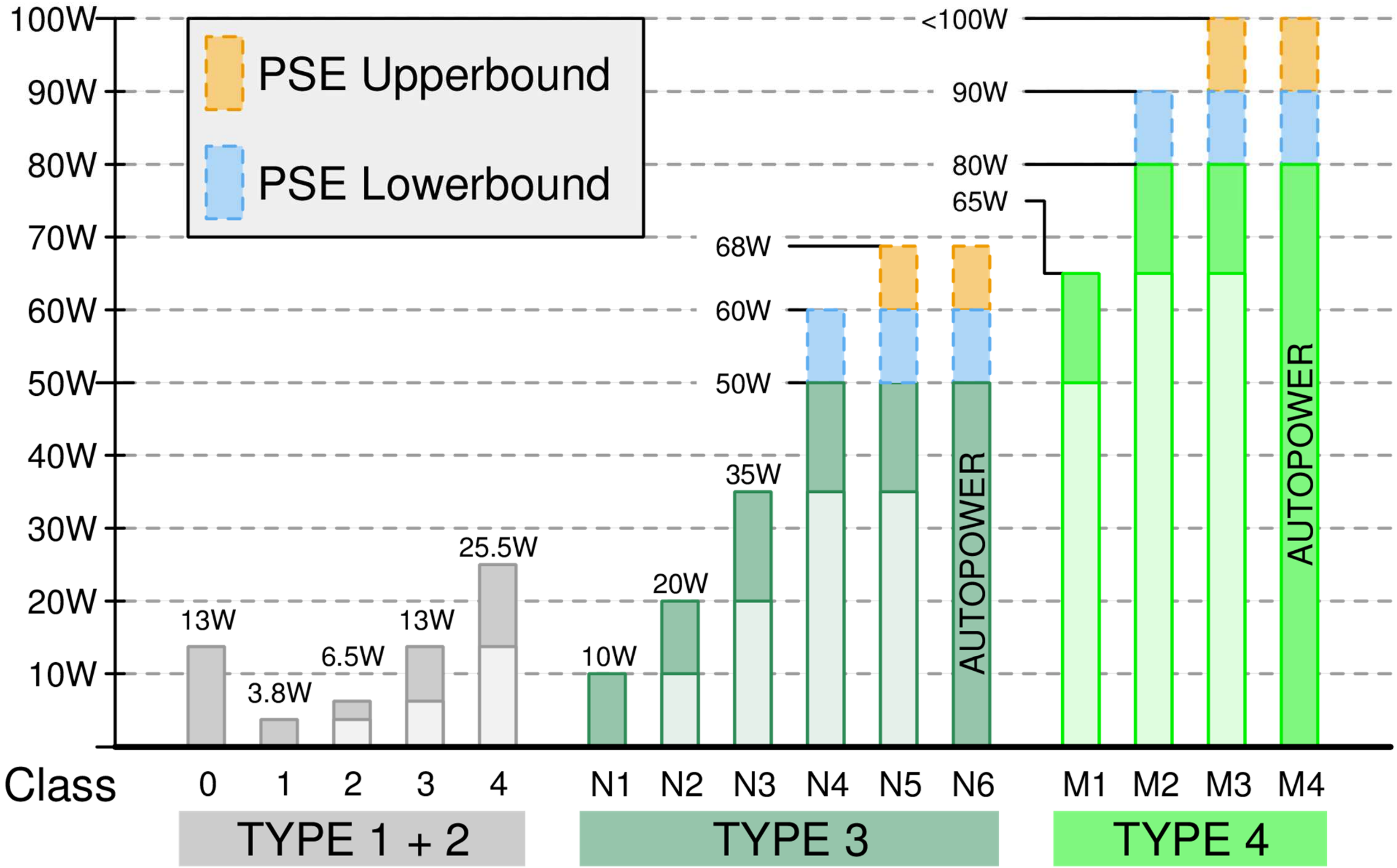
Expectations for Type 3/4

- Type 3
  - If Type 3 is 2 * 802.3at then the minimum guaranteed power will be 51W (minus unbalance).
  - Potential power is
    - At 50V → 60W (delta +9W)
    - At 57V → 68,4W (delta +17,4W)
  - In the highest power class of Type 3 allow extended power up to PSE lowerbound current
  - Add ‘Extended Power’ class for Type 3 allowing power up to PSE upperbound current

- Type 4
  - Type 4 will require a tighter channel specification.
    Shorter length or thicker copper ? Always a compromise!
  - Extended Power allows the PD designer to enable very high power applications.
  - Duplicate mechanism Extended Power class as Type 3

This is not a classification proposal!

Extended Power class



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Summary

- Introduction of a **current limit** for the PD extending the **available PD power** on top of the **guaranteed PD power.**
- PDs cannot depend on the extended power being available, the magnitude depends on cable, PSE and PD impedance as well as PSE voltage.

- Primary goal is to increase the available power at PD side.
- Mostly applies to engineered systems, we don't touch interoperability.

- At 802.3at power levels there is between 18% and 34% extra power possible.
  For Type 3 this will remain the same: between 9W and 17.4W extended power.
  Can extended PD power for Type 3 almost to 70W!

- For Type 4 the effect will even increase due to constant power nature of most loads.
  Extended power may be the best way to allow high power PDs approaching 100W enabling more applications.

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Moving forward

- Let's discuss implications

- Example:
  - Current unbalance
    - Higher currents are now possible at lower cable impedance. This may affect pair to pair current unbalance.

  - Classification

  - Additional advantages

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