Power Matters

IEEE802.3bt 4-Pair Power over Ethernet Task Force

DC disconnect (MPS) Use Case Analysis

Rev 008

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Objectives

- Review main DC disconnect system use case: Slides 2-11.
- Propose DC disconnect base line text:
  - See separate presentation darshan_01_0515.pdf.

Working assumptions and roadmap.

- Type 1 & 2 PDs need to use existing methods when connected to Type 3 or 4 PSEs.
  - 10mA minimum total over 2P or 4P is the only guaranteed parameter.
  - PD Vdiff or P2P_Iunb of Type 1 and 2 are not defined if connected to 4P PSE.
  - We know that MPS P2P_Iunb can't be >75% at worst case per previous work (See Annex A) however it is preferred to minimize PD MPS P2P_Iunb requirements **if possible** by simple solutions addressed by PSE.

- Type 3 or 4 PDs with power class 0-4 will be treated as Type 1 and 2 PDs
  Same power levels, same class codes ➔ PSE cannot know the differences between class 0-4 power of all PD types.

- Type 3 or 4 PDs with power class 5-8 will have total 4P current sum=16mA
  - Simplifies PD Type 3 and 4 designs. The only requirements stays : Total current sum.

Working assumptions and roadmap.

- Allowing flexible MPS detection implementations at PSE per PSE architecture.
  - In a single signature PD:
    - Pair with maximum current: Measuring Iport_2P on one of the pair-sets for Present of Absent MPS (IHold).

    Or
    - SUM: Measuring total Iport current (both pair sets of the same polarity) for Present of Absent MPS (Ihold_SUM).

    Or
    - One of 2P is OFF: Disconnecting one of the pair sets and measuring Iport_2P (=Ihold_SUM).
- In a dual signature PD:
  - Measuring Iport_2P on every pair-sets for Present of Absent MPS (IHold).
- The above is allowed by using different Ihold range for a pair-set and for total sum of both pair-sets.
- Whenever possible, to define grey area between PSE Ihold_max and PD minimum MPS current e.g. If total MPS minimum current at PD is 10mA then Ihold_sum max=9mA. See details in slide 13 vs. 15 tables.

PSE Type 1 / 2 connected to any PD

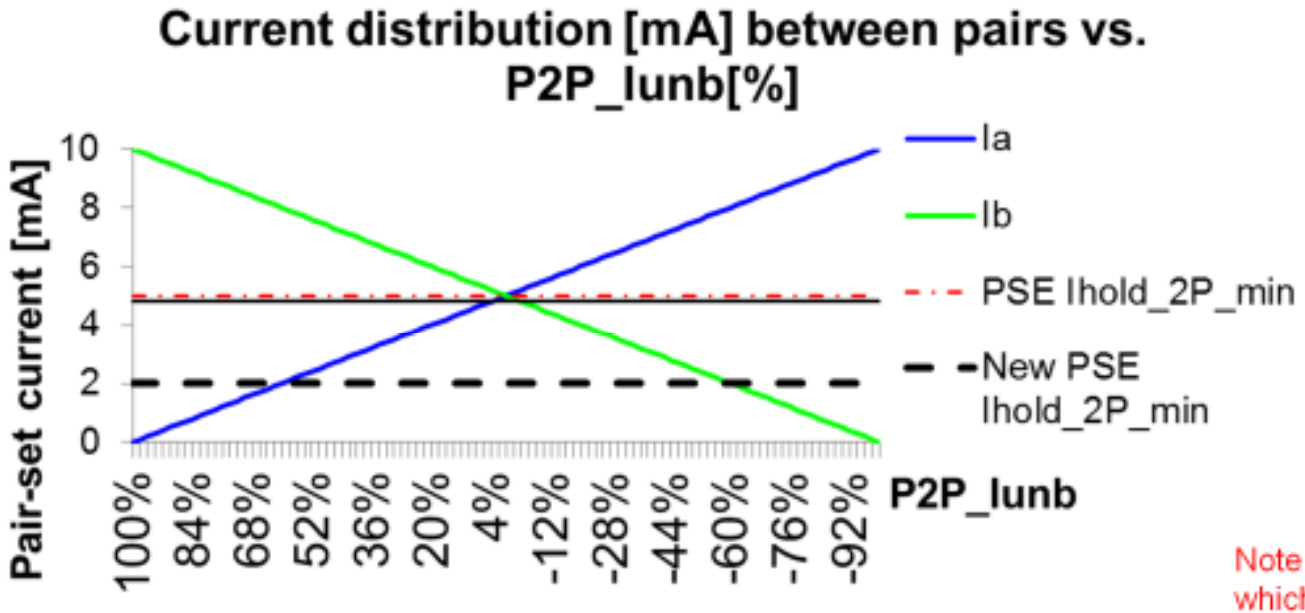
- Type 1 / 2 PD MPS current cannot be changed.
- Single signature PD and Dual Signature PD looks the same over each 2P.
- PSE Ihold limits must stay as defined for Type 1 / 2 PSEs

PSE	PD	Single Signature (SS) or dual Signature (DS)	PSE Requirements		PD Requirements		
			Ihold	Timing	Iport_mps	on every powered pair set	Timing
Type 1,2	Type 1,2	-	5-10mA	Old	10mA	-	Old
Type 1,2	Type 3,4	SS	5-10mA	Old	10mA	-	Old
Type 1,2	Type 3,4	DS	5-10mA	Old	-	10mA	Old

- Old means the PSE and PD Type 1 / 2 MPS modulation timings

Type 3, 4 PSE connected to Type 1, 2 PDs -1

- Total PD current over all 4Pair=10mA. **(a) Can not be changed. (b) P2P_Iunb can be theoretically 0%.**
- At P2P_Iunb=0%, Each pair will have 5mA.
  - Problem #1: 5mA is close to old PSE Ihold_min=5mA. PD may be disconnected.
  - Solution #1: If single signature PD was detected, check MPS for the total current SUM OR disconnect one of the 2P and apply Type 1,2 MPSE rules.
  - Problem #2: Doing SUM is not always practical (Accuracy loss, SYSTEM architecture limitations etc.)
  - Solution #2: If the PD is single signature PD, check MPS for the pair with highest current and use PSE Ihold_min=2mA[1] and Ihold_max=5mA.



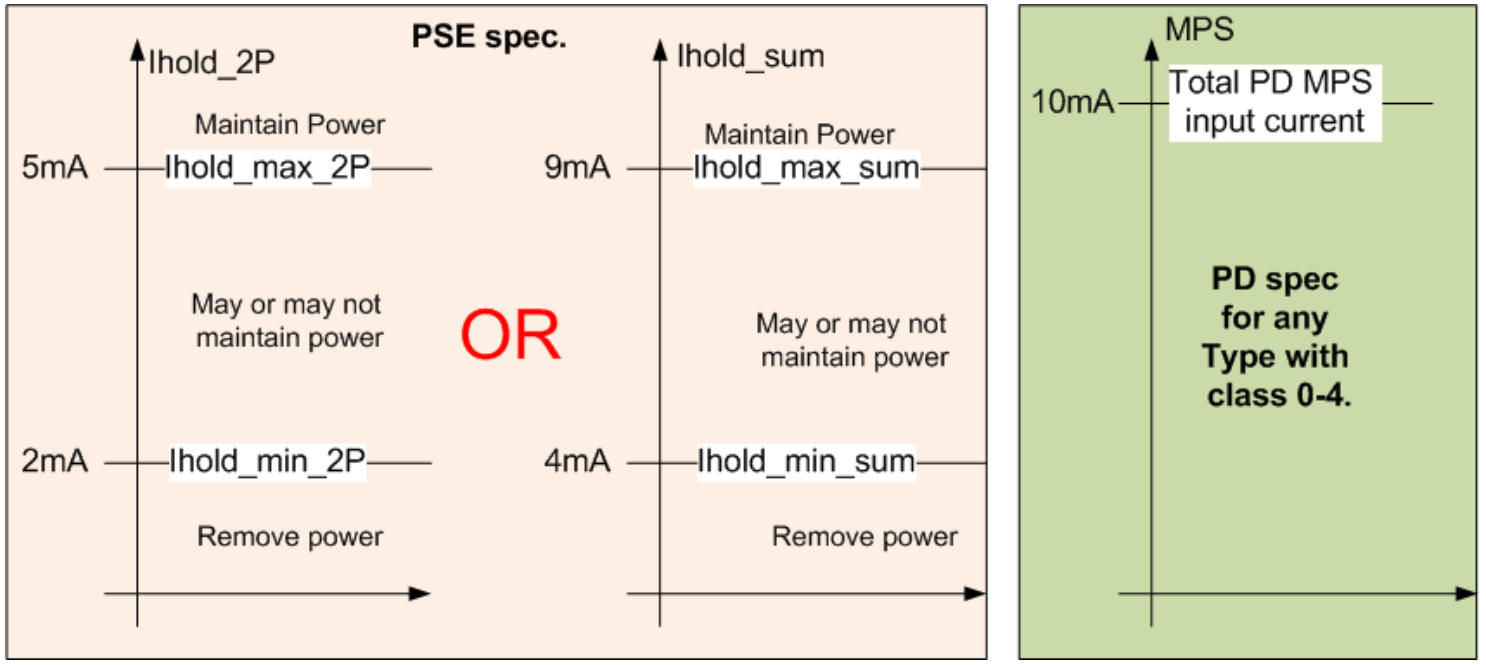
Note 1: PoE system noise floor is ~1mA which makes 2mA cost effective new lowest value instead of 5mA.

Type 3, 4 PSE connected to Type 1, 2 PDs -2

- As a result: If Single signature PD was detected by Connection Check then:
  - PSE shall maintain power if:

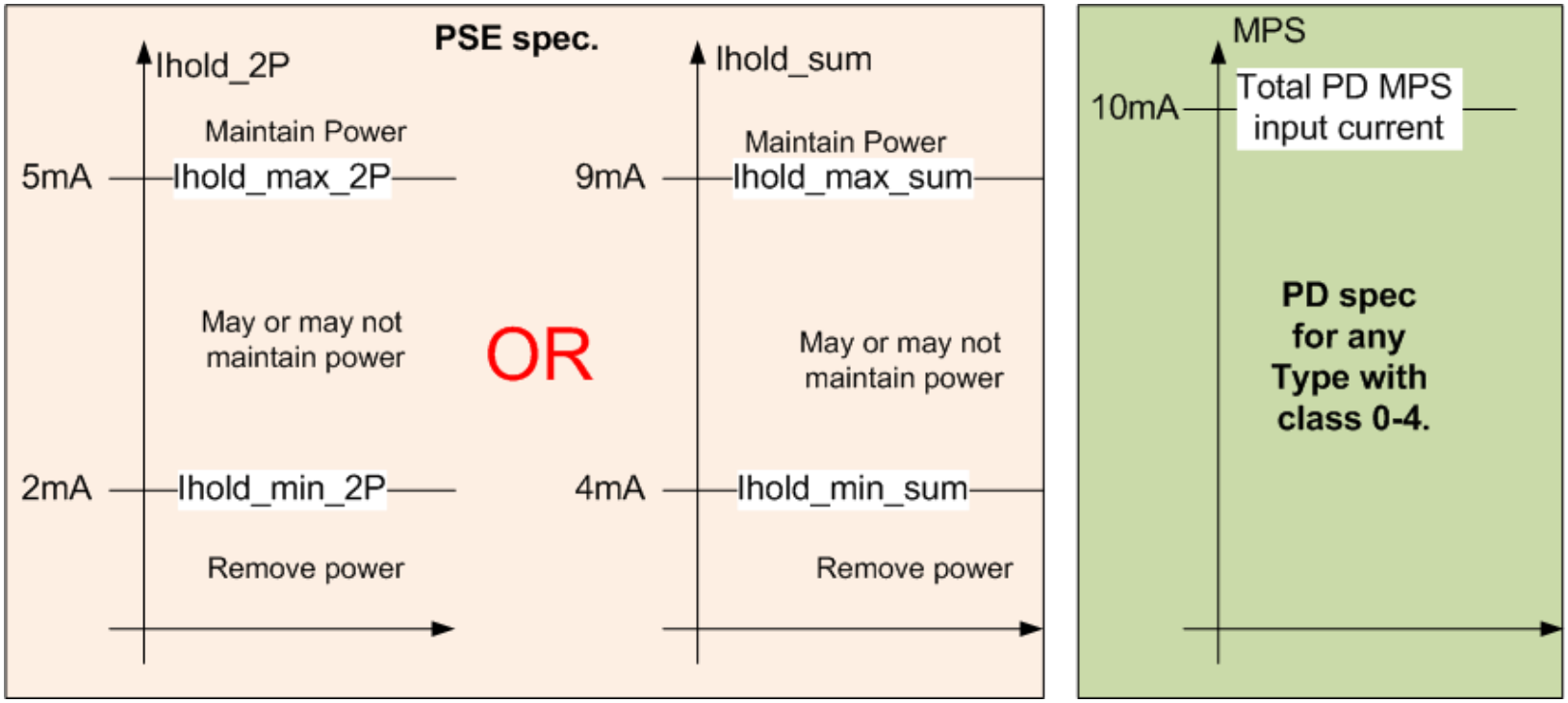
    The current of at least one of the pairs >Ihold_max_2P=5mA or the total 4P current >Ihold_max=9mA.
  - PSE shall remove power if:

    The current of the same measured pair <Ihold_min_2P=2mA or the total 4P current <Ihold_min=4mA.
- Note: Group to consider changing 4mA to 2mA to unify Ihold_min for simpler spec. if possible.



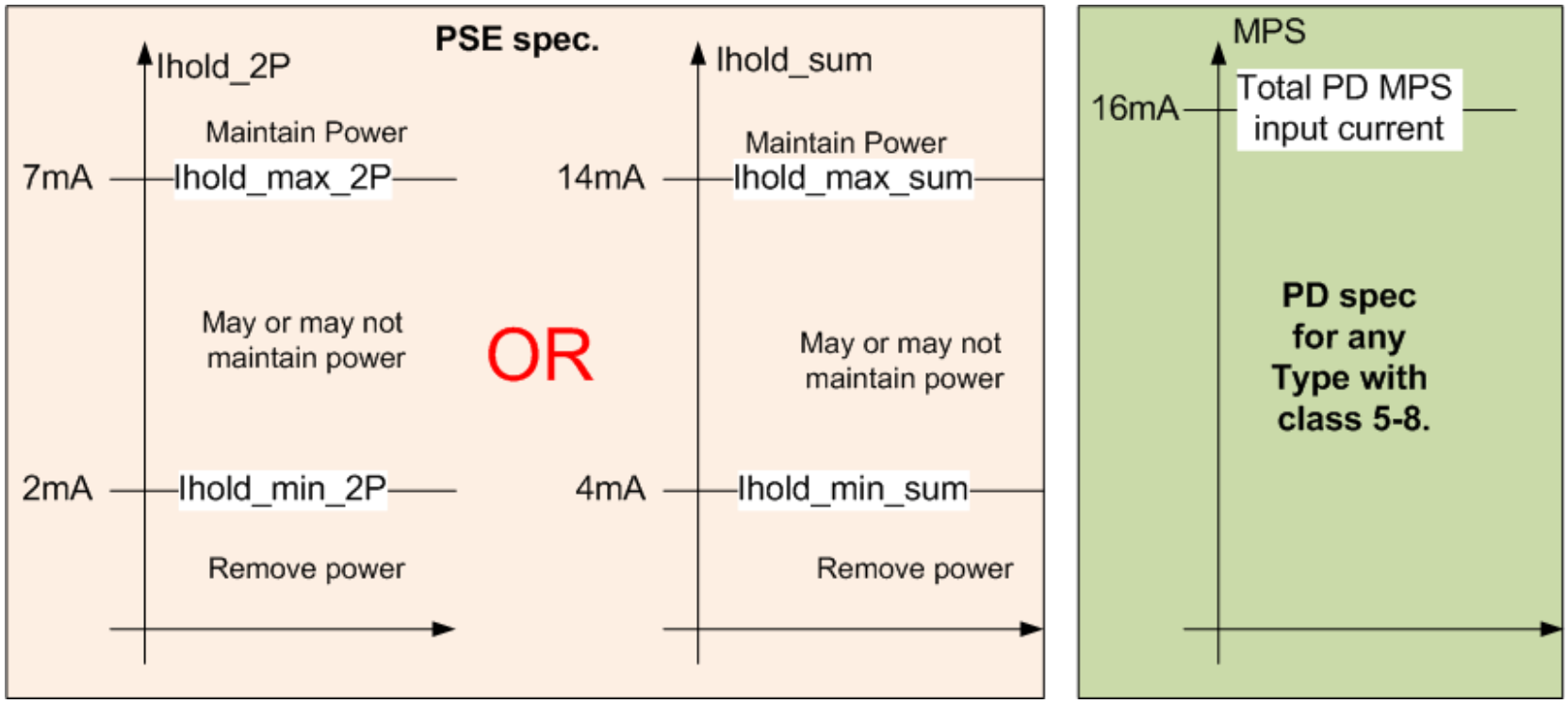
Type 3, 4 PSE connected to Type 3 PD with power class 0 – 4.

- Type 3 PD with class 0-4 has the same power levels as Type 1 or Type 2 PD
- PSE can't differentiate between Type 2 Class 4 PD and Type 3 class 4 PD.
- Therefore
  - PSE and PD requirements are identical for **any PD Type** with class 0-4 when PSE class events ≤4.
- Note: Group to consider changing 4mA to 2mA to unify Ihold_min for simpler spec. if possible.



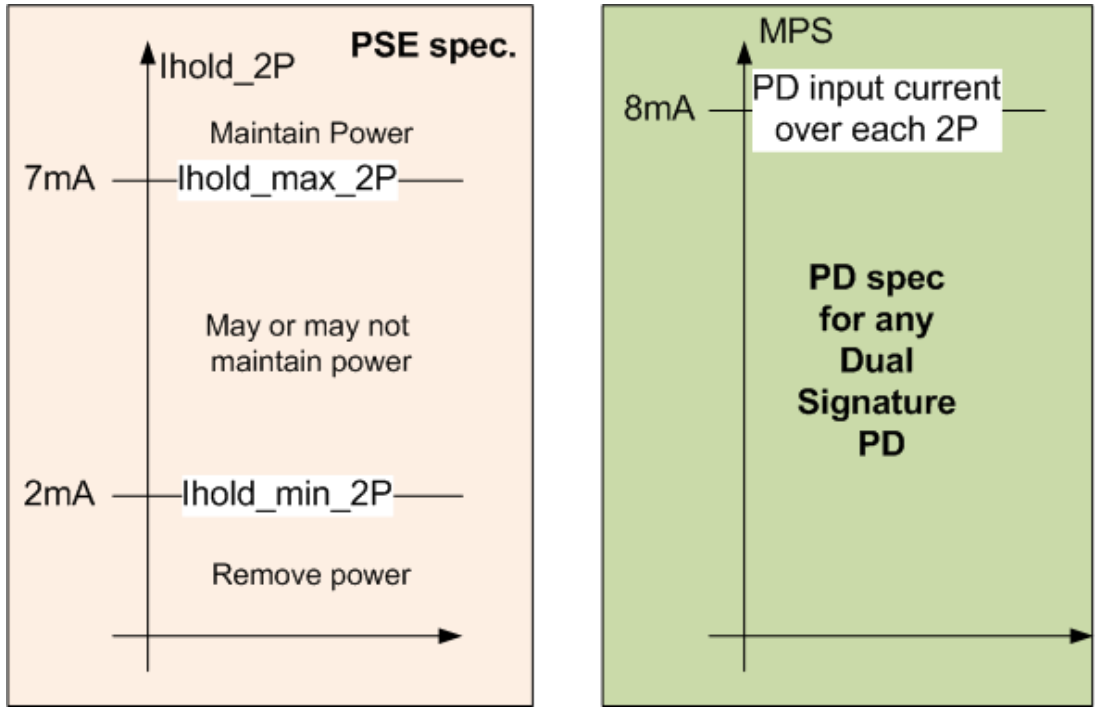
Type 3, 4 PSE connected to Type 3 ,4 PD with power class 5 – 8.

- Incentive to relax specifications for PSE by increasing MPS current at PD
  - Improved design margins
  - Improved addressing MPS P2P_Iunb different solution implementations
- Type 3 and 4 PDs (or actually any PD type with class 0-8 may use the higher MPS current of class 5-8 for simpler implementation and logistic considerations.



Type 3, 4 PSE connected to Dual Signature PD of any Type.

- Same concept of Type 1 and Type 2 Dual Signature PD
  - PD need to guarantee MPS current for each powered pair.
  - If there is P2P_Iunb effect in PD, it is resolved by guaranteeing the minimum MPS current so no issue on this topic.
  - In this case only Ihold_min_2P and Ihold_max_2P limits are relevant in this case.



Summary – Proposed PSE and PD MPS requirements

PSE	PD	Single Signature (SS) or Dual Signature (DS)	PSE Requirements					PD Requirements		
			Ihold	on at least one pair	on every powered pair set	Total current sum	Timing	Iport_mps	on every powered pair set	Timing
Type 1,2	Type 1,2	-	5-10mA	-	-		Old	10mA	-	Old
Type 1,2	Type 3,4	SS	5-10mA	-	-		Old	10mA	-	Old
Type 1,2	Type 3,4	DS	5-10mA	-	-		Old	-	10mA	Old
Type 3,4	Type 1,2	SS	-	2 - 5mA or	-	4-9mA	New	10mA	-	Old
	Type 3,4 class 0-4									New
Type 3,4	Type 3,4 class 5-8	SS	-	2 - 7mA or	-	4-14mA	New	16mA		New
Type 3,4	Type 3,4 class 0-8	DS	-	-	2-7mA		New		8mA	New

- Base Line Text – Proposals
  - See darshan_01_0515.pdf.

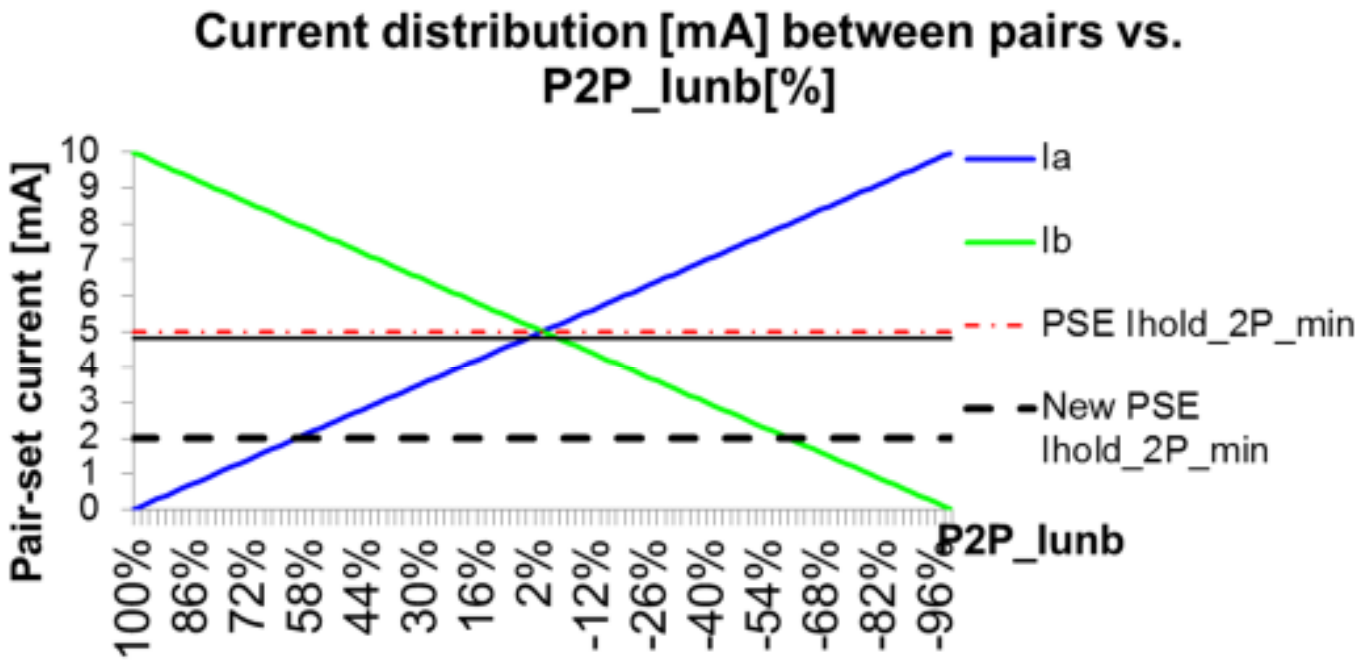
Thank You

Backup Slides

Annex A: PD Vdiff and P2P_Iunb at low current

- See reference 8 for complete work.
  - Worst case system Vdiff (PSE +PD) found to be 60mV.
  - Since PSE Vdiff was set to 2mV
  - PD Vdiff worst case is 58mV.
  - At this conditions, P2P_Iunb is 75% which cause a 10mA PD load to distribute the current to 1.25mA and 8.75mA.
- It is preferred if possible, to minimize P2P_Iunb requirements from the PD regarding MPS behavior for cost optimization. Especially due to the fact that PSE Type 3 need to support PD Type 1 and 2 without additional requirements for the PD.
  - This approach allows using any same diodes and Ideal diode bridge as used today in the market for 2P and 4P.
- As a result, we assume that Ia and Ib can be any numbers as long as Ia+Ib=10mA minimum for the sake of generating simpler base line text for MPS only.
  - Actual extreme operation scenarios could be:
    - A) Ia=Ib=5mA (p2p_Iunb=0%)
    - B) Ia_min=1.25mA, Ib_max=8.75mA per worst case field data
    - C) Ia=0 and Ib=10mA with probability<10^-11.
- For high current (maximum Type 3 and 4 operating current), PD Vdiff will need to be defined and limit to 58mV since it limits maximum pair current and system worst case P2P_Runb/Iunb.

Annex B: Type 3 , 4 PSE connected to Type 1, 2 PD. PD is single signature.



- Ia may be >5mA and Ib may be <5mA.
- Also Ia=Ib is possible.
- Therefore PSE Ihold_min=2mA and Ihold_max=5mA need to be used in PSE to cover all PSE dc disconnect solutions.