HUAWEI ENTERPRISE A BETTER WAY

Thinking on 4 Pair PoE Architectures

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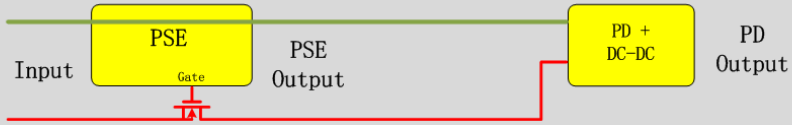
Supporters

- **Gaoling Zou (MAXIM)**

- **David Tremblay (HP)**

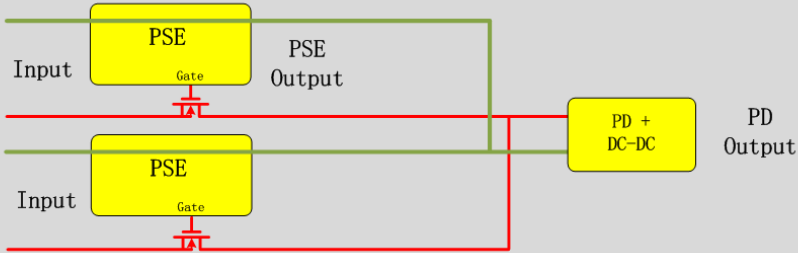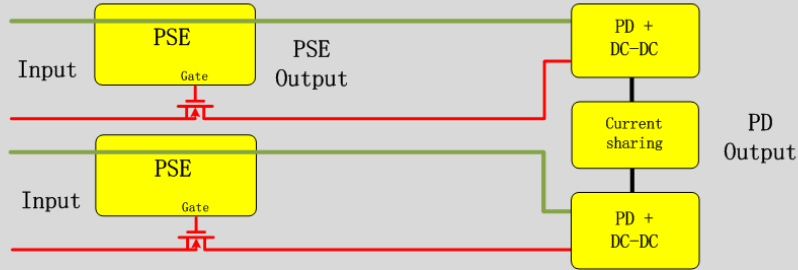- **Phil Brownlee (Coilcraft)**

Outlines

One-by-One

Two-by-one

Two-by-Two

4 Pair PoE Architecture

There are three architectures for 4-Pair high power PoE,

➢ *1-by-1 Architecture*
➢ *2-by-1 Architecture*
➢ *2-by-2 Architecture*

Architecture	PSE	PD
1-by-1	1	1
2-by-1	2	1
2-by-2	2	2

PSE – A PSE in this presentation represents a PSE controller channel and associated circuitry

PD – A PD in this presentation represents a PD controller channel and associated circuitry

BT Type 3 – Used in this presentation to describe 4P PoE > 25.5W Power (~51W)
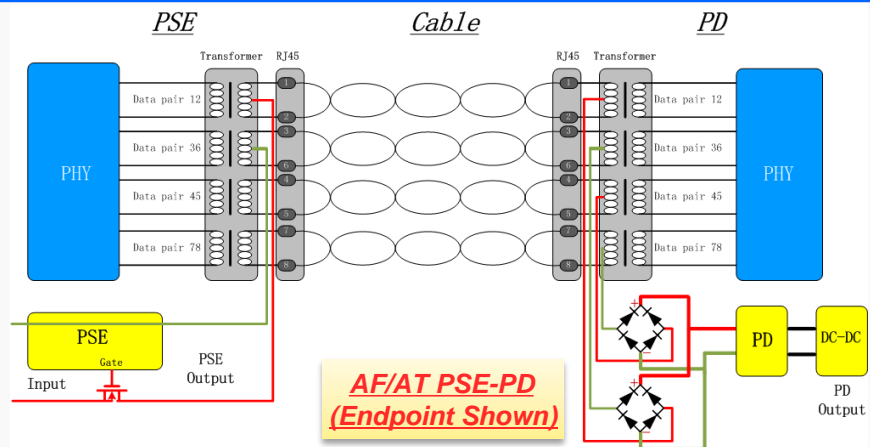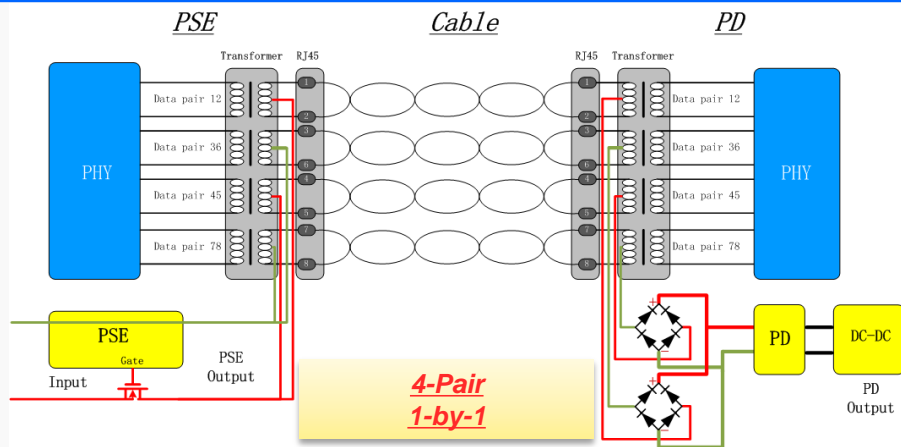
One PSE-by-One PD Architecture

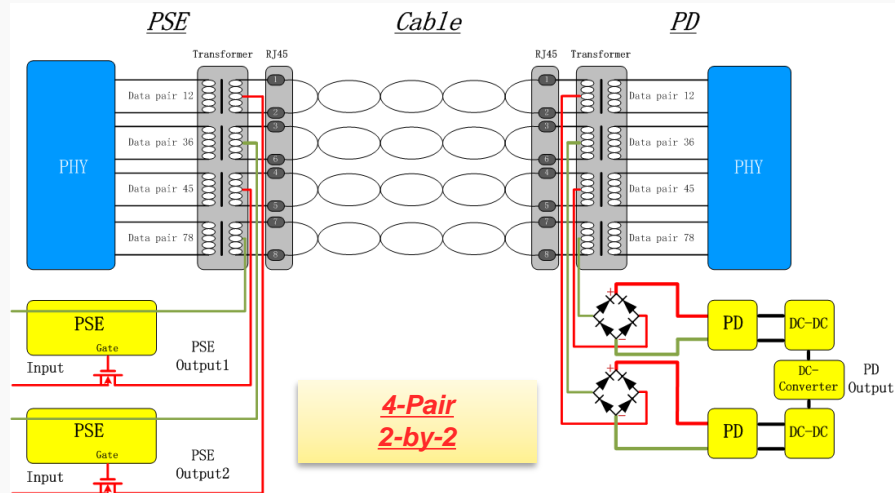Uses **1 BT PSE and 1 BT PD**

1 PSE delivers power on 4 pairs

1 PD receives power on 4 pairs

4-Pair 1-by-1
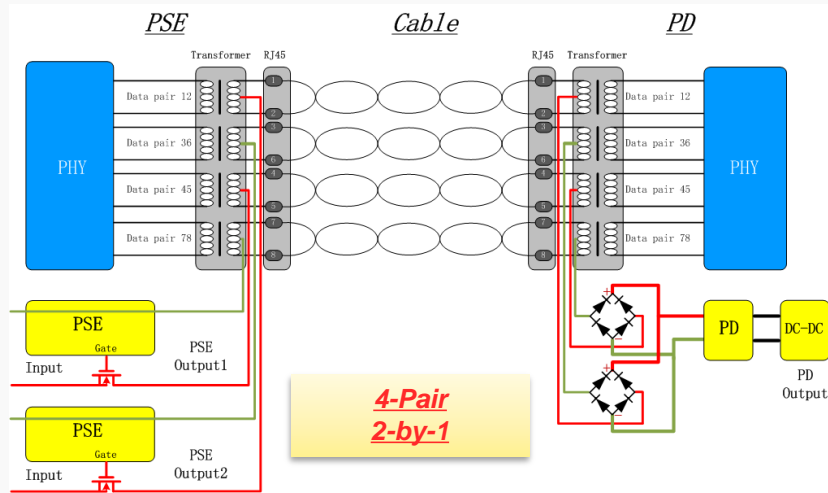
AF/AT PSE-PD (Endpoint Shown)

2-by-1/Two Architecture

Two PSE-by-Two PD Architecture	Two PSE-by-One PD Architecture

Uses **2 BT PSEs and 2 AF/AT PDs**

Each PSE delivers power on 2 pairs

Each PD receives power on 2 pairs

Uses **2 BT PSEs and 1 BT PD**

Each PSE delivers power on 2 pairs

1 PD receives power on 4 pairs

Outlines

➢ Potential 4-Pair PoE Architectures

➢ Gap Analysis of 4PPoE Architectures

➢ Estimated Costs of 4PPoE Architectures

➢ Conclusions

4-PAIR POWER OVER ETHERNET CFI

CFI and 5 Criteria require 802.3at Type 1 and 2 PDs to be powered over all 4 pairs in order to increase power efficiency

4-PAIR POWER OVER ETHERNET 5 CRITERIA

➢ For this evaluation, the PoE process will be divided into 6 procedures of interest:

Idle, Detect, Class, Power up, Power on and Disconnect

➢ Based on the previous potential 4-Pair PoE architectures, we'll study:
1. How these 4PPoE architectures leverage 802.3at/af standards
2. Point out technical gaps with the at/af standard

1-by-1 Architecture Gap Analysis

There is only 1 PSE in both architectures
The 4-Pair PD N-by-1 architecture is the same as AT/AF PD
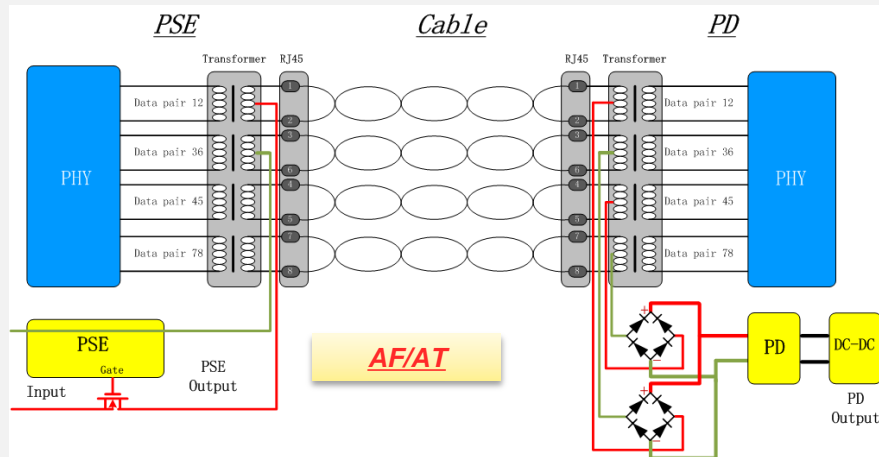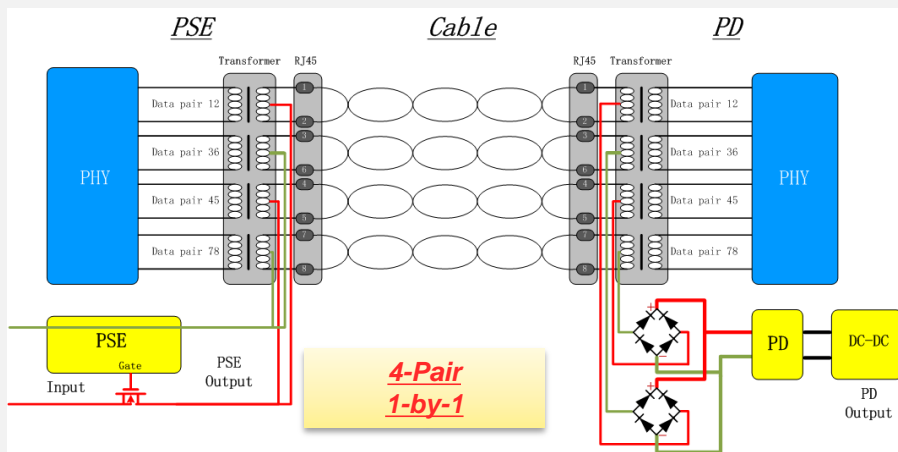
Reuse of the existing standard:
The idle, detect, power up, and disconnect procedures are the same as AT/AF standard.

Gaps between AT/AF and 4-Pair 1-by-1 architecture:
1. **Class**: New class bin to be added
2. **Power-on:** A new higher current level is provided

How to use 2 PSEs to control only 1 PD?
The 4-Pair PD N-by-1 architecture is the same as AT/AF PD
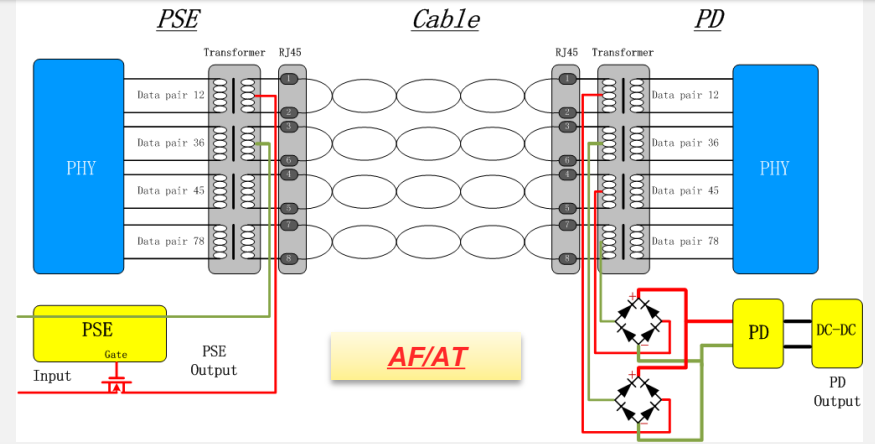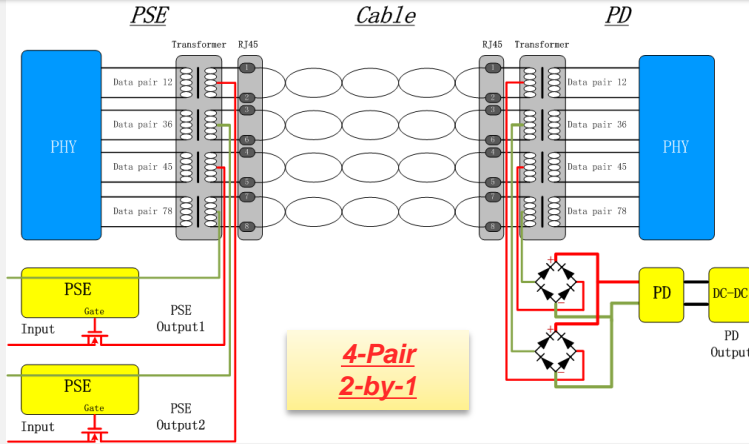
Reuse of the existing standard:
  The idle procedure is the same as AT/AF standard

Gaps between AT/AF and 2-by-1 architecture:
1. **Detect:**   PSE detections can collide and pollute each other. Careful time-sharing definition and sequencing is required.
2. **Class:**   PSE classifications can collide and pollute each other. Careful time-sharing definition and sequencing is required.
3. **Power Up, Power-on:** Each PSE provides half the inrush current. Due to known current imbalance issues, currents from each 2-pair side must be summed in real-time for the purpose of tracking cutoff, limit and dc disconnect.
1. **Disconnect**:   Consumes twice the 802.3at MPS power (or more due to small but significant current imbalances.)

2-by-2 Architecture Gap Analysis

How to use 2 PSEs to control only 1 PD (when AF/AT PD is connected)?
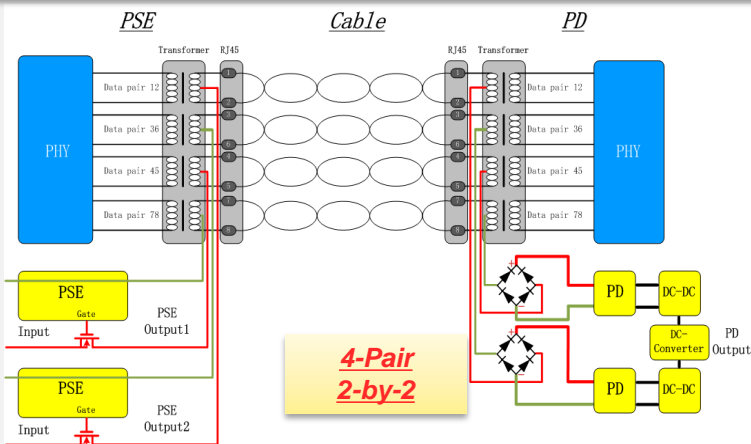
4-Pair 2-by-2

AF/AT

Reuse of the existing standard:
The idle procedure is the same as AT/AF standard

Gaps between AT/AF and 2-by-2 architecture:
1. **Detect:**   PSE detections can collide and pollute each other when AF/AT PD is connected.
2. **Class:**   PSE classifications can collide and pollute each other when AF/AT PD is connected.
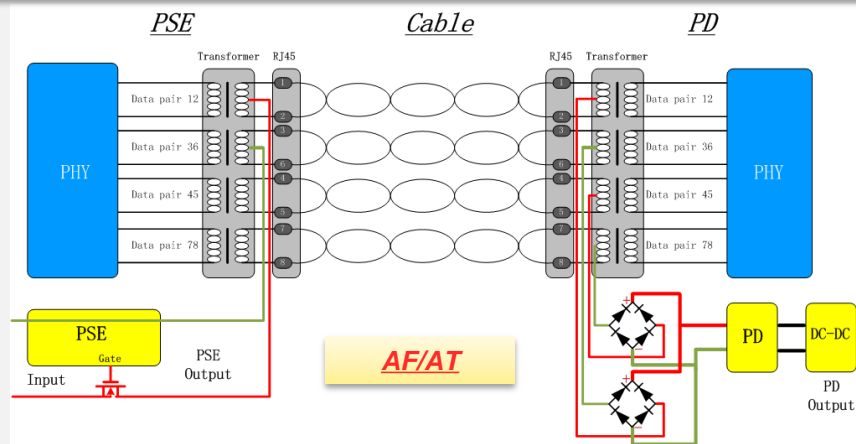3. **Power Up, Power-on:** Each PSE provides half the current when AF/AT PD is present. Due to known current imbalance issues, currents from each 2-pair side must be summed in real-time for the purpose of tracking cutoff, limit and dc disconnect.
1. **Disconnect**:   Consumes twice the 802.3at MPS power (or more due to small but significant current imbalances.)

Conclusion of Gap Analysis

Conclusion:
1. The 1-by-1 design **naturally inherits the 802.3at standard** with simple class and power-on current extensions.
2. The 2-by-N designs **need added controls in detect, class, power up and power on, and disconnect procedures.**
3. The 2-by-N designs **consume around twice the standby power as 802.3at does.**

Mode	PoE Status					
	Idle	Detect	Class	Power up	Power on	Disconnect
1-by-1	AF/AT	AF/AT	New[1]	AF/AT	New[2]	AF/AT
2-by-1	AF/AT	New[3]	New[3]	New[4]	New[5]	New[6]
2-by-2	AF/AT	New[3]	New[3]	New[4]	New[4]	New[7]

Note:

1. Requires a **new** class for higher power delivery.

2. Requires a **new** current cutoff and limit for higher power delivery.

3. Requires **added controls** in detect and class procedures and direct coordination between PSEs.

4. Requires **added controls** in power up and power on procedures. Real-time summing of currents complicates hot swap, cutoff and DC disconnect.

5. Requires **added controls** in power on procedure; procedures differ depending on discovered PD type.

6. Consumes (at least) **twice the 802.3at MPS power.**

7. Consumes (at least) **twice the 802.3at MPS power.** Complicated by discovered PD type.

Outlines

➢ Potential 4-Pair PoE Architectures

➢ Gap Analysis of 4PPoE Architectures

➢ Estimated Costs of 4PPoE Architectures

➢ Conclusions

- 2-by-N architectures incur the following additional costs as compared to a 1-by-N solution:
  - 2x hardware cost due to duplicated hardware
  - Added controls for:
    - Detection and Classification – Sequencing requirements
    - Power-up, Power-on and Disconnect – real-time current summing for cutoff, limit and dc disconnect
  - Possible IP licensing costs

➤ N-by-2 architectures incur the following additional costs as compared to a N-by-1 solution:

   ➤ 2x hardware cost due to duplicated hardware

   ➤ Possible IP licensing costs

Outlines

➢ Potential 4-Pair PoE Architectures

➢ Gap Analysis of 4PPoE Architectures

➢ Estimated Costs of 4PPoE Architectures

➢ Conclusions

From previous analysis on technical gaps, compatibility and estimated costs of the 4-Pair PoE architectures:

- ➢ N-by-1 PD design fully adopts the AT/AF design and supports requesting and receiving BT Type 1/2/3 from all 4-Pair PSE architectures and remains backwards compatible with AT/AF PSEs.
- ➢ 1-by-1 PSE design supports 1-PD design in AT/AF PoE as well as BT Type 3 levels with only the addition of a higher power classification bin.

- ➢ 1-by-1 architecture is the most efficient and cost-effective choice for 4-Pair PoE design.

Thank you!