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IEEE802.3bt 4-Pair Power over Ethernet Task Force
Part A: Existing compliant PD implementations
Part B: Proposal for detecting Type 1/2 capable of 4P operation
Layer 1 Method to Detect 4PPoE Capable Legacy Type 1 & 2 PD

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Yair Darshan
Microsemi
ydarshan@microsemi.com

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Supporters

- Rick Frosch / Phihong

- Christian Beia / ST

- Sesha Panguluri / Broadcom

- Tremblay, David / HP

- Lennart Yseboodt / Philips

- Matthias Wendt / Philips

- Rimboim Pavlik / MSCC

- Fred Schindler / Seen Simply

Objectives

- To show examples of existing Type 1 and Type 2 PDs that meets IEEE802.3-2012 requirements

- To propose a layer 1 detection method of Type 1 and Type 2 PDs that are capable of 4P operation.
  - Allow LLDP as optional part of the solution

The question

- How we verify that Type 1 and Type 2 PDs that are already in the field, are capable of getting 4P power and work.

- A 4P PSE is connected to Type 1 / 2 PD. What is the possible behavior?

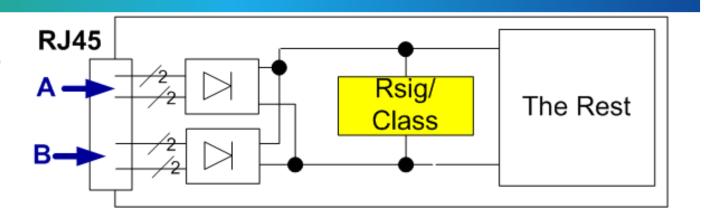| #	Possible behavior	Notes
1	Work with 4P	OK
2	Work with 2P (either on Mode A or B)	OK
3	Work with 4P with higher current unbalance than permitted by specification of 802.3bt	OK
4	Not working with 4P	Backwards compatibility issue.
5	Damage with 4P	Not acceptable.
	We care about items 4 and 5.	

IEEE802.3-2012 standard requirement

- **33.3.1 PD PI**

- The PD shall be capable of accepting power on either of two sets of PI conductors. The two conductor sets are named Mode A and Mode B.

- NOTE—PDs that implement only Mode A or Mode B are specifically not allowed by this standard. PDs that simultaneously require power from both Mode A and Mode B are specifically not allowed by this standard.

- When a PD presents a valid or non-valid detection signature, it shall present the detection signature at the PI between Positive VPD and Negative VPD of PD Mode A and PD Mode B as defined in 33.3.1.

  When a PD becomes powered via the PI, it shall present a non-valid detection signature on the set of pairs from which it is not drawing power.

option 1 – Single PD load implementation

Per IEEE802.3-2012, Rsig/Class are defined to be the same if measured on Mode A or Mode B.

- **Single load**
- Inherently invalid/open signature will be seen at the unpowered pair
- This PD behavior could be:
  - Capable of getting 4P. Designed to accept power over 2P and 4P simultaneously.
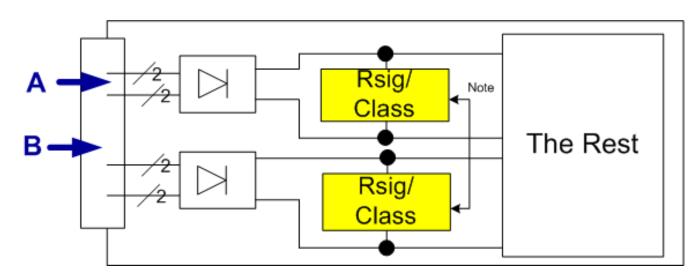 - Not Capable of getting 4P (*)

(*) Examples:
1. A PD that work with Type 1 and Type 2 power levels and when connected to 4P PSE will required power beyond its advertised class. Such PDs exists.
2. Mode A getting power. After some delay time, mode B gets power. The voltage at the DC/DC inputs get voltage transient/change (Va-Vb)* resulting with current transient (soft start function already ended at this point of time, resulting with secondary mode inrush) that may affect some circuitry e.g. logic false triggering.

Both examples and others can be solved relatively easily by reusing existing mechanisms in our standard as will be shown in part 2 of this presentation.

*Short cable. Di=0.18A for dv/dt=1mV/1uS. dVi=0.18V for di/dt=0.18A, L=1uH.

Option 2/2a/2b–separate and equal dual PD signatures with optional dual loads
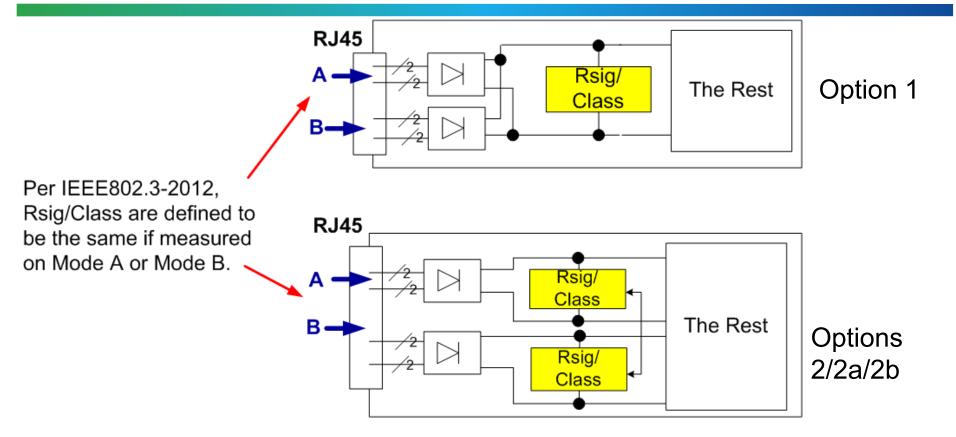
Per IEEE802.3-2012, Rsig/Class are defined to be the same if measured on Mode A or Mode B.

- The PD Rsig/Rclass behavior at the PI is the same as in Option 1 PD.
- Interoperability and compatibility are maintained as in PD option 1.
- Note: The arrow means Invalid signature on the unpowered pair as required by IEEE802.3-2012 standard for Type 1 or 2 PDs.

Comparison

Per IEEE802.3-2012, Rsig/Class are defined to be the same if measured on Mode A or Mode B.
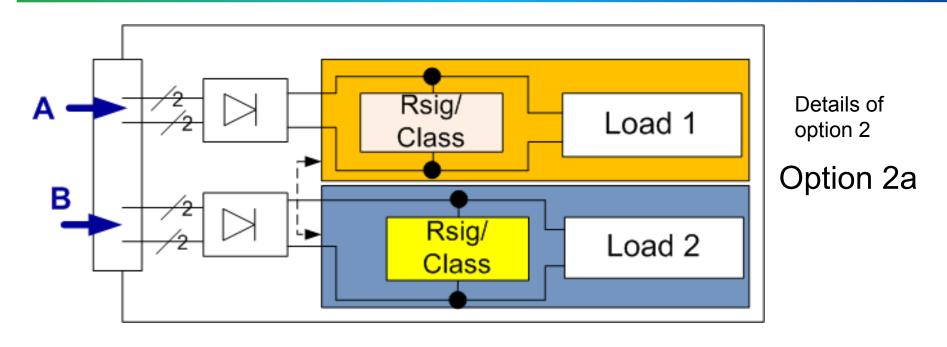
Option 1

Options 2/2a/2b

Therefore both Implementations are meeting the requirements specified in the PI and are interoperable with their PSE partner in the system.

Base on the above both implementations are used in the market today (Type 1, 2 PDs) in various applications and implementations.
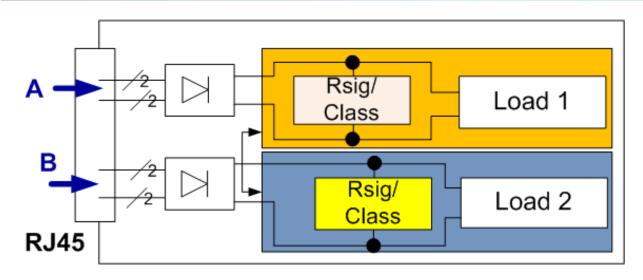
Implementation examples for Option 2 PDs

Details of option 2

Option 2a

-The PD was designed to work with 4P or 2P.

  -It has two loads.

  -The total power of the two loads are Type 1 or Type 2 levels.

  -Both loads can work simultaneously (No thermal issues. Ppd<Type 1/2)

  -The "Arrow" that indicates invalid detection signature on the un-powered pairs when connected, is disconnected now, to allow valid signature on Mode A and Mode B pairs so PSE knows that it is allowed for 4P operation.

Implementation examples for Option 2 PD

Option 2b

Example why 4P-ID is required.

- Not 4P capable:
- Two identical loads, only one is operated at a time (Redundancy and backup).
- Each load works at maximum type 1 or 2 power.
- NOW if both will work:
  - (a) thermal issues➔ damage or
  - (b) thermal protection ➔ nothing will work while in 2P mode it will work.

-The "Arrow" that indicates invalid detection signature on the un-powered pairs is connected.

-This is fully compliant PD (obeying all the rules)

Main PD options summary.

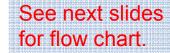| #	PD option	Characteristics	Notes
1	PD Option 1	Single load	-High probability that will work with 4P. (Some will stop work)
			-If total current of 2P is maintained, no potential damage issue.
2	PD Option 2a	two different loads with total power of Type 1 or Type 2.	Will work. Designed for 4P.
3	PD Option 2b	two identical load, each requires full Type 1 or Type 2 power. Only one load is capable working at a time.	If all loads are powered by 4P, there is damage risk or will not work.

Conclusions

- There are Type 1 or 2 PDs that may be damaged if 4P Power is applied.

- The internal PD implementation is irrelevant to the ad-hoc objectives. Since 4P PD behavior was not defined in 802.3-2012, for 4P operation, PDs that work fine with 2P may not work at all with 4P or may damage.
  - These concerns can be resolved by having L1 based on existing IEEE802.3-2012 features and requirements and/or L2 4P-ID mechanism.

- See part 2 for proposal to detect Type 1 or 2 PDs that are capable of working with 4P power.

- Notes: IEEE802.3 required PDs to accept 0 to 57V on all ins without damage.
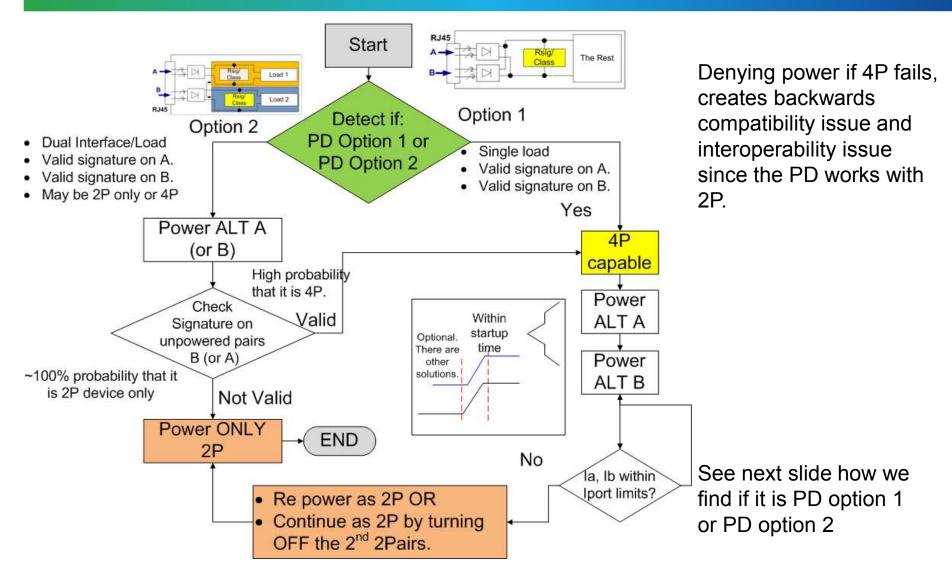
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Part 2 - proposal to detect Type 1 or 2 PDs that are capable of working with 4P power.

- The general Idea
- Using the following pieces of information:
  - If the unpowered pair has invalid signature then it should not be powered. Resulting with disabling 4P operation (required by the standard for any PD that works at 2P)
  - Detecting If the PD is option 1 or option 2 by using exiting detection function
  - If the operating current over each pair is per the PD Type power limits
  - Additional information such as LLDP (optional)

- Find if it is Option 1 or Option 2 PD.
- Detect if
  - 4P Capable or
  - 2p capable
  - Or not compliant PD
- Power 4P or 2P or disconnect accordingly.
  - If 4P deviates from standard parameters, turn OFF and reconnect as 2P
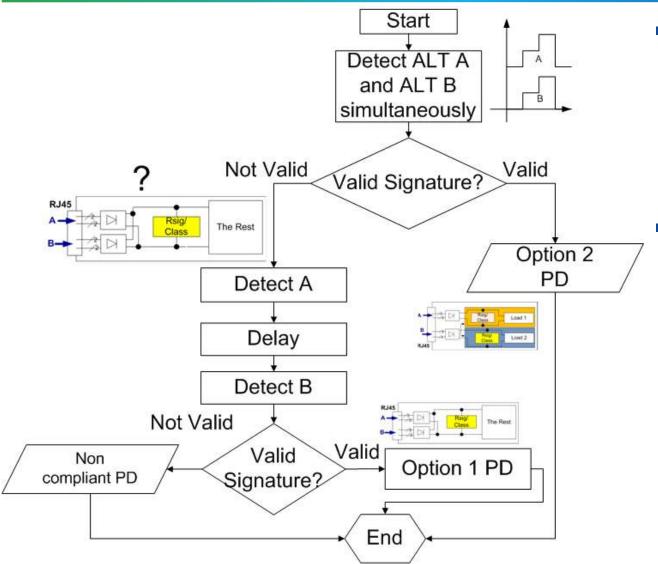 - If additional information is available through LLDP it will have priority.

See next slides for flow chart.

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Part 2 - proposal to detect Type 1 or 2 PDs that are capable of working with 4P power.

Denying power if 4P fails, creates backwards compatibility issue and interoperability issue since the PD works with 2P.

See next slide how we find if it is PD option 1 or PD option 2

Detect if PD option 1 or Option 2

- If PD is option 1, signature will fail if done simultaneously.

- There are other ways to detect if PD is option 1 or 2 (single load connection check) and are not addressed here.
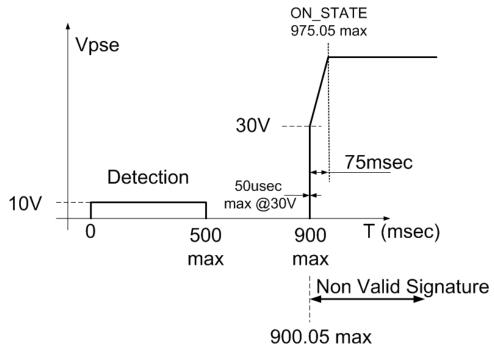
Invalid Signature timings on the unpowered pairs

- **33.3.1 PD PI**

  ……When a PD becomes powered via the PI, it shall present a non-valid detection signature on the set of pairs from which it is not drawing power.

Does the time were the invalid signature on the unpowered pairs is specified?

From the drawing above, it looks that all the information needed is already specified.

Lab tests

- Testing detection of option 1: Algorithm works.
- Testing invalid signature on unpowered pair with option 1 PD: Works.
- Testing valid signature with option 2 PD: Works.
- Testing 4P current at Power ON state over each 2P separately that current is within pair limits: Works.
- All the above was implemented and reusing exiting signature detection and current monitoring functions over each 2P. As a result no surprises as for the positive results

Summary

- **Existing standard mechanisms:**

  - Detection per the current standard definitions for accept and reject criteria over each two pairs separately

  - Invalid signature on unused pair

  - Current monitoring and current limiting

- **Allows L1 discovery of Type 1 and Type 2 PDs with 4P power capability.**

  - **Allows 2P powering if not capable of powering 4P**

- LLDP is also a valid solution for PDs that support this feature.

- Reuse of already defined functions in IEEE802.3-2012, will help to get faster to market while keeping the high reliability and interoperability of our standard, which grandfathers in existing equipment in the field.

  - As a result, technical and economical feasibility is proven by similarity and verified by lab tests.
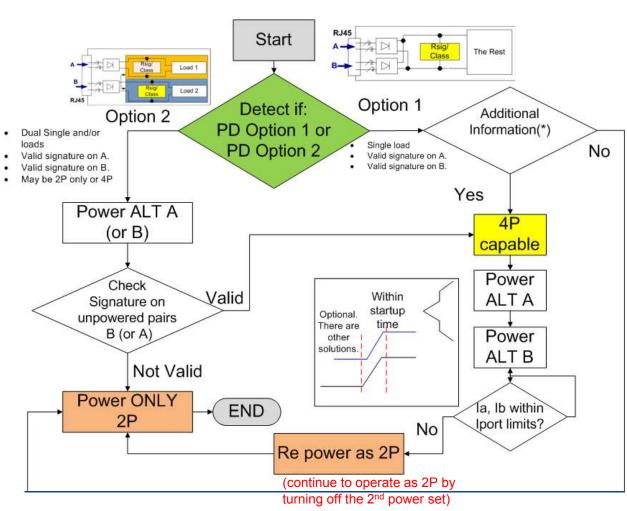
Revision History

- Rev 006:
  - Adding slide to show invalid signature timing on unpowered pairs per the current standard
  - Updating summary slide
  - Rev 007:
  - Flow chart was updated: Removing "additional information". It is not part of the 4P-ID and s feature that can be placed in higher level flow chart of the system.
  - Adding to " re power as 2P" additional option: "continue as 2P by turning OFF the 2nd 2P"

Part 2 - proposal to detect Type 1 or 2 PDs that are capable of working with 4P power. (REV06)

- High Level Flow Chart.

(*) Additional information means that user configuration allows the following flexibility (examples):

a) No additional information. Allow only 2P power.

b) Allow 4P. If option 1 is detected, continue the flow.

c) LLDP is supported. Follow LLDP results after ALT A is powered.

> LLDP needs power in the PD first so it can be powered first as 2P and repower as 4P. Details TBD.

Supporting of pre 802.3bt option 2, Type 1 and Type 2 PDs that are not presenting invalid signature on the unpowered pairs is required to enable these PDs to operate at 4P which is the purpose of this adhoc work.

Denying power if 4P fails, creates interoperability issue since the PD works with 2P. As a result, denying 2P is not an option.

See next slide how we find if it is PD option 1 or PD option 2

Detecting Existing compliant Type 1/2 PDs implementations capable of 4P, Rev_007.
Yair Darshan , September 2014 2014

Power Matters

Q&A

Backup slides

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