IEEE 802.3dg ” Power over Data Lines (PoDL) of Single-Pair Ethernet”, Sep. 2024

Titel:

Power over Data Lines – Hybrid device support

Support from Cornelia Eitel, Dennis Lickay Hirschmann/Belden, Volker Goller ADI, …

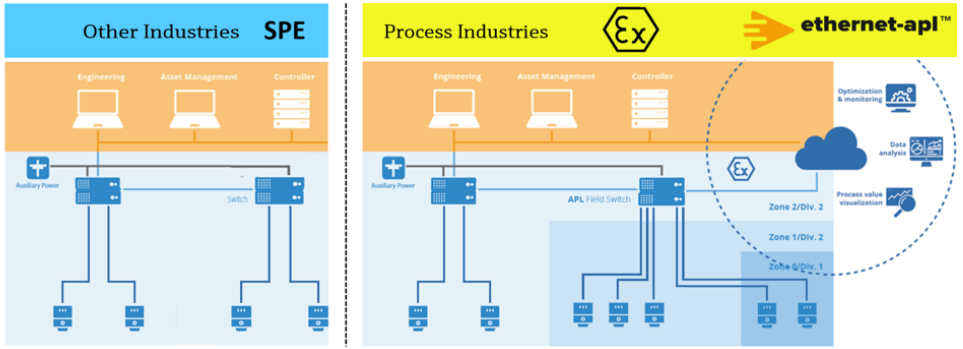
Harald Mueller
Endress + Hauser

Co- Author: Dennis Lickay / Hirschmann Belden

APL / SPE Field Device

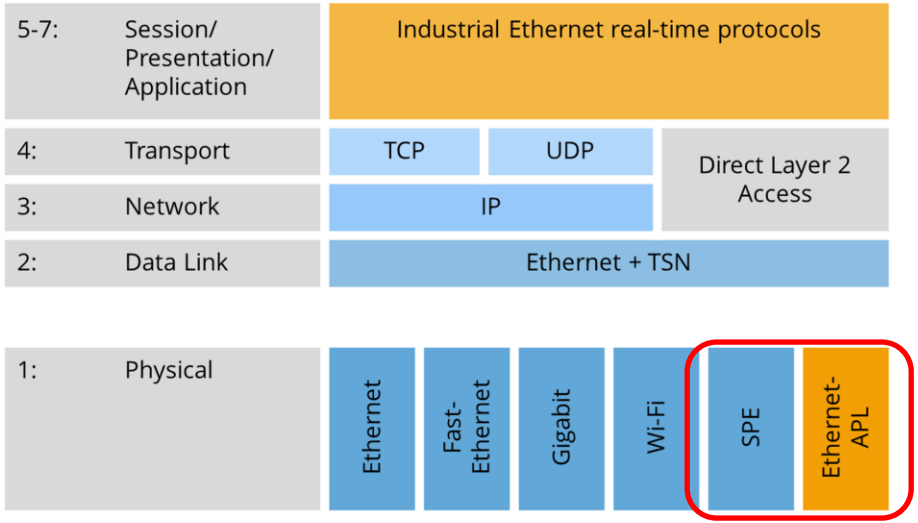
Field Device classification:

- Segment Class: (S) – Spur
- Port Class: (L) – Power Load
- Power Class: (A) 15 VDC / 0,54 W or
  (B) 15V DC / 1,17 W or
  (C) 15 VDC / 1,11 W
- Intrinsically safe Protection Class:
  (A) Ex ia IIC/ Class I DIV 1
  (C) Ex ic IIC/ N.I. Class I DIV 2
- Typical Field Device configuration:
  - APL: Ex-Area: SLAA, SLBA and SLCC
  - SPE: None Ex-area PoDL Port 10, 11 and 12, Manual Mode (engineered PoDL)



APL and SPE – JWG Joint Working group activities

- *APL / SPE*
- *Legal Host @ Profibus International*
- *Member Organisation (4):*
  FieldComm Group (FCG),
  ODVA,
  OPC Foundation
  Profibus International (PI)



"Independent Protocol Physical Layer Group (10Base-T1L)" plus extension 100Base-T1L

Lead technical team (JWG):
Harald Müller, E+H

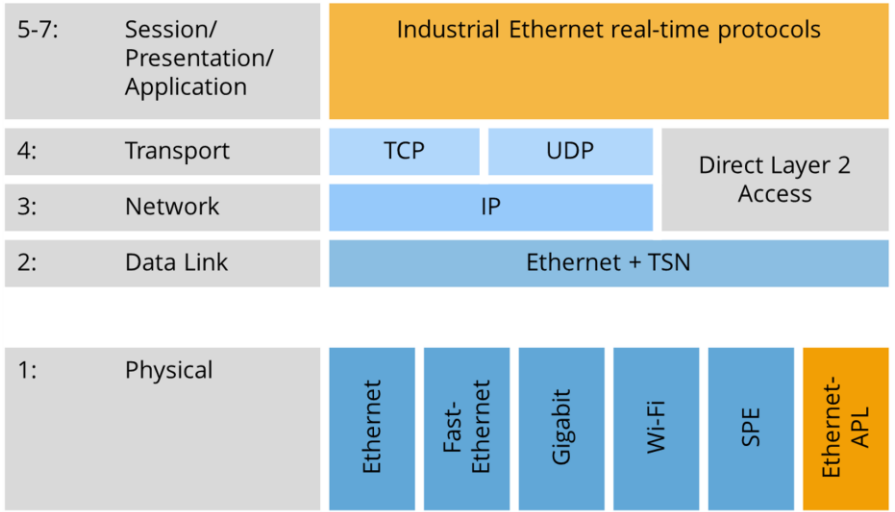
"Ethernet-APL/SPE Conformance Working Group"

Lead conformance team (JWG): Sean Vincent FCG

Goal:
Standardization IEC Level: IEC TS 63444 ED2, IEC61158 Update, etc. **and Ethernet part at IEEE802.3, plus 100BASE-T1L / IEEE802.3dg, etc....**

APL and SPE – A Common Physical Layer

- *10BASE-T1L* - 10MBit/s Ethernet physical layer
- *Single twisted pair for power and data*
- Long range up to *1000m*
- User friendly – 10BASE-T1L is *polarity agnostic*
- Compatible with existing field bus cables



APL And SPE – Different Approaches for Power

ethernet-apl™
advanced physical layer

- Engineered Power for Intrinsic Safe Applications in Process Industry
- Two device power classes for intrinsic safe operation at 15VDC nominal
  - “A” 0.54W
  - “C” 1.1W
- Two classes to power remote APL switches at nominal 50VDC up to 92W

SPE

- SPoE using digital communication (SCCP) for device classification
- *3 Power Classes at 24VDC nominal*
  - *Device power 1.23, 3.2 and 8.3W*
- 3 Power Classes at 55VDC nominal
  - Device power 7.7, 20 and 52W

Plus extension (Old Power Class 1 non EX from APL port Spec. SP1X, APL - SteCo decision !

Today

- Possible, yet requires manual configuration of each port
- Not supported by unmanaged switches

Our Approach

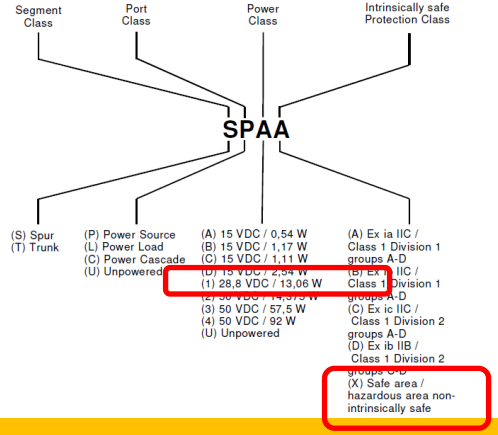
- Work towards an extension of the SPE power state machine to allow *automatic operation of APL devices* (*APL - Classification* SP1X and SL1X, in SPE networks
- *Unmanaged switches can be supported*
- Caveat:

  APL devices to participate *must be 24VDC rated* (most are already SL1X)

Plus extension (Old Power Class 1 non EX from APL port Spec. SP1X, inside SPE non EX use case ! Max. Power less than <= 1.5 Watt

History

- Inside APL Port Spec. old Rev. SP1X and SL1X



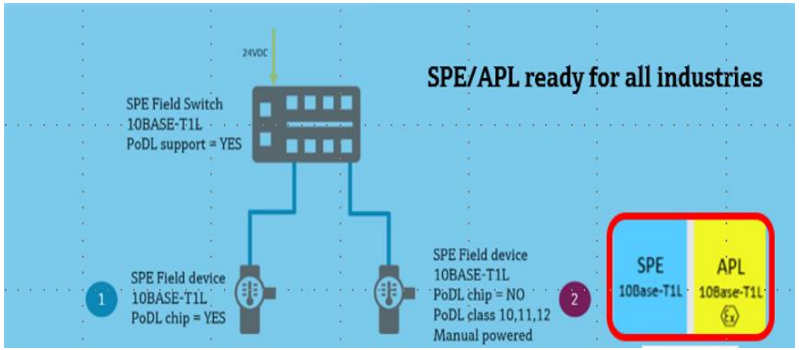
Ref. Harald Müller, PI, JWG Leader
APL Port Profile Specification Draft 0.6

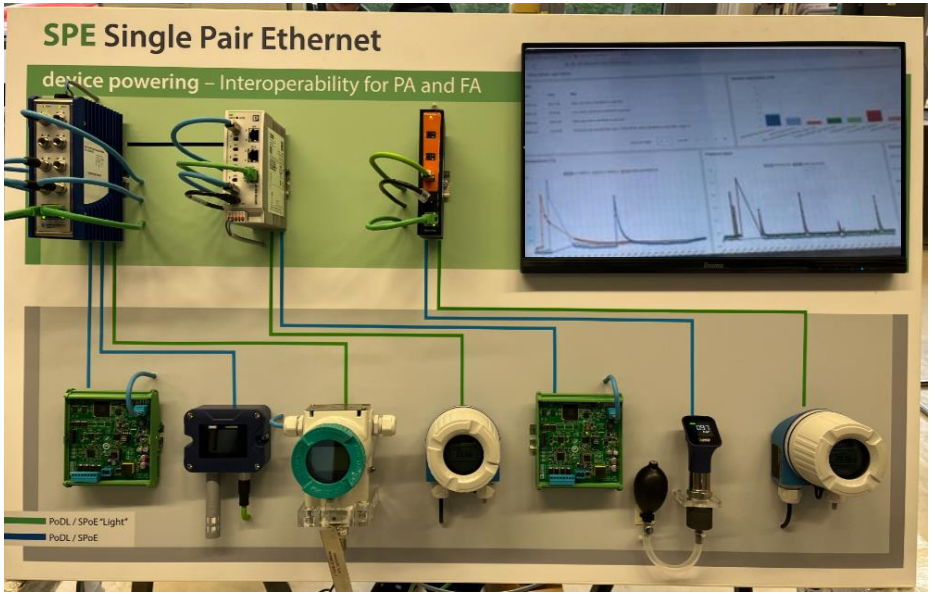
Our Approach

- Based on APL - SteCo decision,
- Change to Standardization IEC Level: IEC TS 63444 ED2, IEC61158 Update, etc. **and Ethernet part at IEEE802.3, plus 100BASE-T1L / IEEE802.3dg, etc....**
- Now Part of "**Independent Protocol Physical Layer Group (10Base-T1L)" plus extension 100Base-T1L JWG**

SPE show case: Hannover fair 2024 an Achema 2024 at Profibus International Boost

- Support Use-case parallel operation PoDL and SPE sensor with SPE switch
- On going work joint working group





Show case at PI Boost
HMI 2024 and Achema2024

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The Future Of SPoE

- The new interoperability will enable quicker growth of the SPE market
- The detection will be limited to APL devices (<1.5W) (old APL Power Class SL1X)
- SPE devices without APL / intrinsic safety heritage should utilize the advantages of the SPoE technology (PD-Controller)
  - Easy and robust detection
  - More power classes, including 55V classes

Device makers with no play in APL can go straight to SpoE (as shown in this demo) and take advantage of this technology

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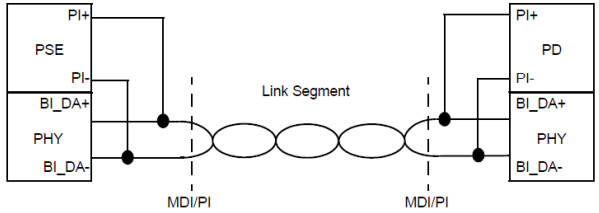
Our Advantage

Enabling the use of APL devices in SPE environments will give us two things - let sensor makers address two markets with one hardware design and let APL help kickstart the SPE market with available devices from the get-go.

IEEE 802.3 (2022) Chapter 104. Power over Data Lines (PoDL) of Single-Pair Ethernet

Figure 104–3 illustrates the block diagram for a PoDL system.



NOTE—PI elements that prevent loading of the data signal by the PSE and PD are not shown. PHY elements that block dc are not shown.

Figure 104–3—PoDL system block diagram

Table 104–2—Class power requirements matrix for PSE, PI, and PD for classes 10 through 15

Class	10	11	12	13	14	15
$V_{PSE(max)}$ (V)	30	30	30	58	58	58
$V_{PSE\_OC(min)}$ (V)	20	20	20	50	50	50
$V_{PSE(min)}$ (V)	20	20	20	50	50	50
$I_{PI(max)}$ (mA)	92	240	632	231	600	1579
$P_{class(min)}$ (W)	1.85	4.8	12.63	11.54	30	79
$V_{PD(min)}$ (V)	14	14	14	35	35	35
$P_{PD(max)}$ (W)	1.23	3.2	8.4	7.7	20	52

104.4 Power Sourcing Equipment (PSE)

The PSE provides power to the PD. The PSE's main functions are as follows:

a) To search the link segment for a PD
b) To supply power to a detected PD through the link segment
c) To monitor the power applied to a link segment
d) To remove the full operating voltage when no longer required, when transitioning to the SLEEP state, or when a short-circuit or other fault is detected

Voltage and power classification mechanisms exist via the Serial Communication Classification Protocol (SCCP) to provide the PSE with detailed information regarding the requirements of the PD and vice versa.

A PSE is specified by its electrical and logical behavior as seen at the PI.

Class	New Class
$V_{PSE(max)}$ (V)	30 V
$V_{PSE\_OC(min)}$ (V)	20 V
$V_{PSE(min)}$ (V)	20 V
$I_{PI(max)}$ (mA)	210 m'A
$P_{class(min)}$ (W)	5,5 W ?
$V_{PD(min)}$ (V)	14 V ?
$P_{PD(max)}$ (W)	5 W ?

Remark*
Detail Check of required values
Until end of Sep. 2024,
IEEE802.3 next Meeting !

New PD may present an invalid signature,
and NOT support SCCP

Harald Mueller
Endress + Hauser

IEEE 802.3 Chapter 104. Power over Data Lines (PoDL) PSE state diagram

Today

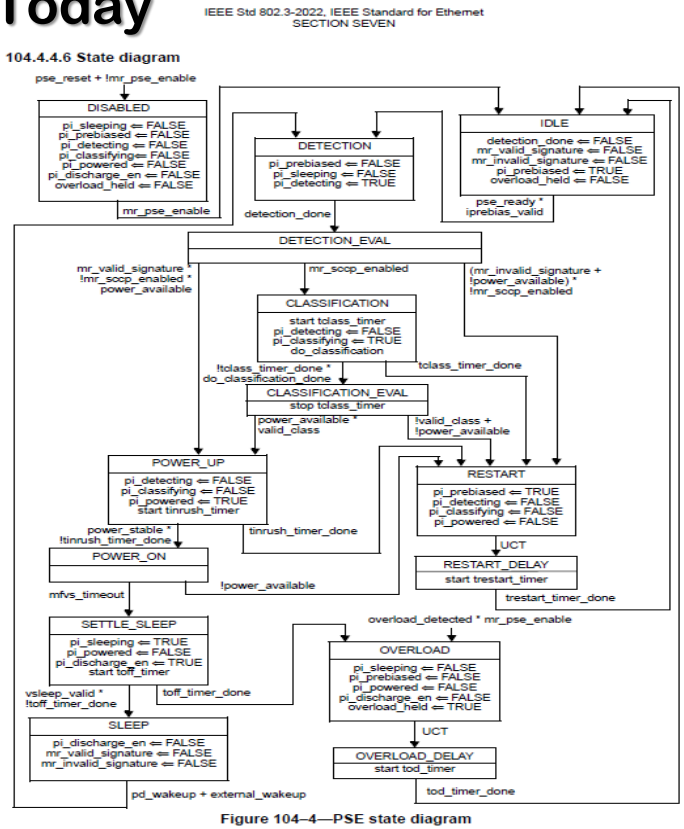


Figure 104–4—PSE state diagram

Our approach and proposal

Support the following use case:
A new 30 V PD class with APL voltage parameters (see Table 104-2).

That PD class may present an invalid signature, and NOT support SCCP.

Modify the PSE state diagram to allow powering of the PD class when a new optional mode is enabled and supported. - the proposal is to do this by checking the optional mode (enabled & supported) when the PSE enters CLASSIFICATION. (but not using SCCP) - similar to Clause 33 PoE "Forced Power" test mode.

Make sure the PSE state diagram removes power in a fault condition, power not available, or the PD exceeding the class power limits

etc….

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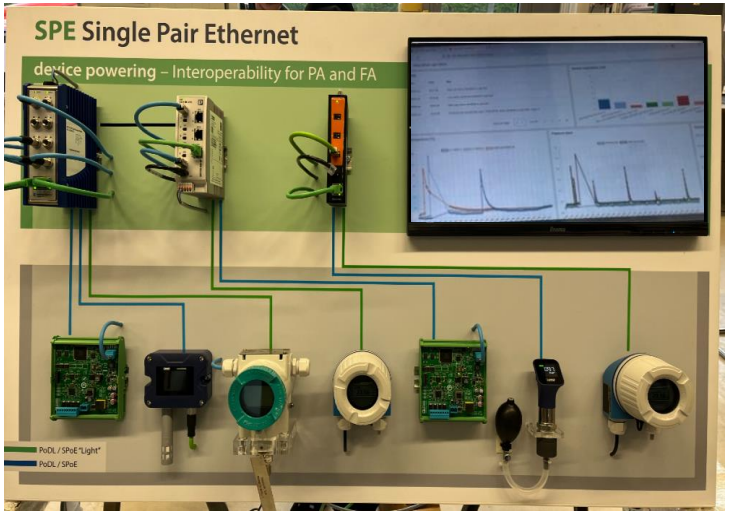

Show case at PI Boost
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Thank you!