PoDL Tutorial

Dogs at the IEEE?

Agenda

- What is PoDL?
- Quick Overview of PoDL Operation
- Walk Through the Draft

PoDL = PoE for Single-Pair Ethernet

- 100BASE-T1 + PoDL: 100M and power over a single 24ga twisted pair
- 1000BASE-T1 + PoDL: Same but gigabit
- PoDL is generic enough that it will work with future speeds and reaches
  - High-voltage (48V) classes enable long-reach applications
  - High power (20W, 40W) classes support future high-speed PHYs with real applications
- Power + Data over the same cable
  - No wall warts
  - No AC wiring

Why PoDL Matters

- Small, single-pair ethernet devices (especially cameras) need power as well as data
- Two ways to get power to the device:
  - Send power over the same wires
  - Send power over a second set of wires
- If a second pair provides power and ground, it can also provide a second data pair (using PoE)
- This can use traditional 2-pair Ethernet (10BASE-T or 100BASE-TX) but uses twice as much wire
- This adds weight, cost, and size
  - Undesirable when the data center (i.e., the car) is moving

Andy's camera picture goes here

Why Not Use PoE?

- PoE requires (at least) two pairs to work
  - Connected between pair center taps
- PoDL requires only one
  - Connected with a lowpass/highpass bandsplitting network

- Picture goes here

PoDL for Dummies

- PSE puts power on the link, PD draws power from the link
- PSE sniffs the link before turning power on (Detection)
    - It tests for a ~4V zener with a 4-10mA current
- If it finds a PD, the PSE queries it before turning on full power (SCCP)
    - Low-speed, self-powered bidirectional serial communications
    - Exception: the PSE can skip this step if it knows in advance what PD is out there (like in an automotive wiring harness): this is Fast Startup Mode
- If the PSE likes what it sees, it turns on the power
    - Up to 5W at 12V or 50W at 48V
- If the PD no longer wants power or is disconnected, the PSE turns off power and restarts detection
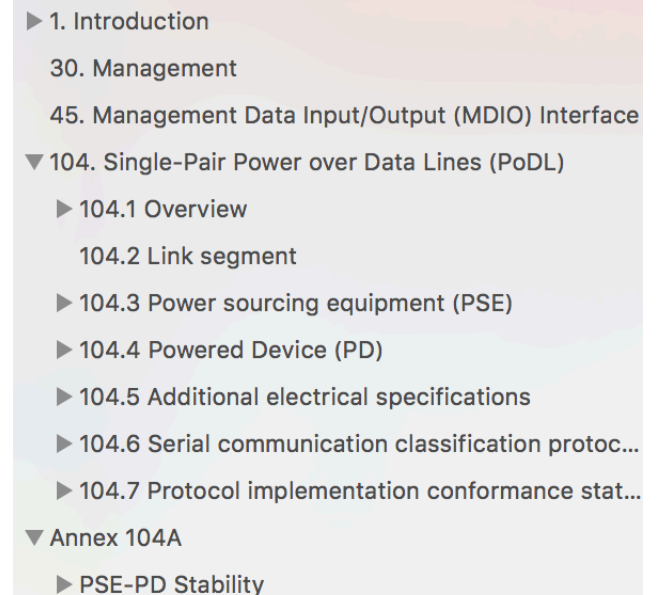
Simple block diagram here

Sleep Mode

- When not providing full power, the PSE continuously provides 3.3V to the PD at <1mA: this is **Sleep Mode**
- This allows the PD to maintain state in RAM or provide minimal functionality
- Both PSE and PD enter or leave sleep mode together
- Either the PSE or PD can enter or leave Sleep Mode at will
- Sleep Mode allows battery powered systems (i.e., parked cars) to maintain minimal functionality with minimal power draw (with PHYs asleep or powered off)
- SCCP works in Sleep Mode

Simple block diagram here

A Walk Through the Draft

- Clause 1: New definitions
  - XX new definitions
- Clause 30, 45: New management sections
  - Added xx, xx, xx
- Clause 104: the good stuff
  - Document structure mostly modeled on Clause 33 (PoE)

Clause 104: Where the PoDL Lives

- Key electrical information is in 3 sections (17 pages)
    - 104.2 Link Segment (and power levels)
    - 104.3 PSE (Power Sourcing Equipment, puts power on the link)
    - 104.4 PD (Powered Device, draws power from the link)
- SCCP (analogous to PoE Classification) is broken out separately in 104.6 (9 pages)
    - SCCP is optional for Fast Mode systems (most automotive systems)
    - SCCP is fairly complicated

104.1: Overview (combine with link seg slide?)

- Compatibility, Relationship to the rest of 802.3
  - Specs are defined at the PI (equivalent to the MDI)
  - All PoDL devices are compatible (they won't damage each other)
    - Not necessarily interoperable: see Types, below
- Definitions of PoDL Types
  - Type A: works with 100BASE-T1
  - Type B: works with 1000BASE-T1
  - Type A+B: works with both
  - Difference is coupling network bandwidth only
- Block diagram of PSE/PHY and PD/PHY relationship

104.2: Link Segment

- Specifies allowable loop resistance (matches 100/1000BASE-T1 links)
- **Table 104-1** (Class Power Requirements) lives here (should probably be in 104.1)
  - PoDL Class defines operating voltage and power level

Class	0	1	2	3	4	5	6	7	8	9
Voltage	5.5-18	5.5-18	14-18	14-18	12-36	12-36	26-36	26-36	48-60	48-60
Current, A	0.10	0.22	0.25	0.47	0.10	0.34	0.21	0.46	0.73	1.3
PD power	0.5	1	3	5	1	3	5	10	30	50

104.3: PSE

- **PSE = Power Sourcing Equipment**: puts power on the link
  - Usually an Ethernet switch
- .3.3, Figure 104-4: State Diagram
- .3.4: Detection details
  - How the PSE knows when to turn on the power
- .3.5: Classification overview (mostly a reference to 104.6)
  - How much power to supply
  - Classification is optional, omitted in "Fast Startup" mode
- .3.7: Power removal and MFVS
  - When to remove power and return to detection mode

104.3.3: PSE State Diagram

- Figure 104-4

104.3.6: PSE Power Details

- **Table 104-3** is the "heart" of the PSE spec: voltage, current, timing requirements

104.4: PD

- **PD = Powered Device**: draws power from the link
  - Usually a leaf node: camera, industrial sensor, IoT device
- .4.3, Figure 104-6: State Diagram
- .4.4: Detection Signature
- .4.5: Classification Signature overview (pointer to 104.6)
- .4.7: MVFS details
  - What the PD must do to stay powered

104.4.3: PD State Diagram

- Figure 104-XX

- This SD is pretty simple
- Largely voltage-driven

104.4.6: PD Power Details

- .4.6: Power details
  - **Table 104-6** has key PD electrical and timing specs

104.5: Additional Electrical Specs

- .5.1: Isolation requirements
  - PD must be isolated
  - PSE isolation is optional
- .5.2: Fault tolerance
  - Short circuits can't blow anything up
- **.5.3: MDI Spec Modifications**
  - Revised lower limits for 100BASE-T1, 1000BASE-T1 Return Loss specs
  - Allows for practical, compact PoDL coupling networks (lower inductors values)
  - These specs ended up in Clause 104 because the data clauses were complete when this was added

104.6: SCCP

- **SCCP = Serial Communications Classification Protocol**
  - Indicates PD voltage and power requirements to the PSE before it turns on the power
  - PoDL equivalent of PoE Classification pulses
  - Only works when power is off
- Fairly comprehensive low-speed (100bps) serial protocol
  - Based on a subset of the Maxim 1-Wire^{tm} serial protocol
- SCCP is optional for Fast Mode (engineered network) systems and Class 0 PDs

104.7: PICS

- No surprises here

Annex 104A: Stability

- PSE-PD stability guidelines (not normative) mostly inherited from PoE