The POWER Behind Your Designs

PoE Plus - IEEE 802.3at

Extended Classification
Using
Ping-Pong Scheme

January 10, 2005 – Phoenix, AZ

Martin Patoka

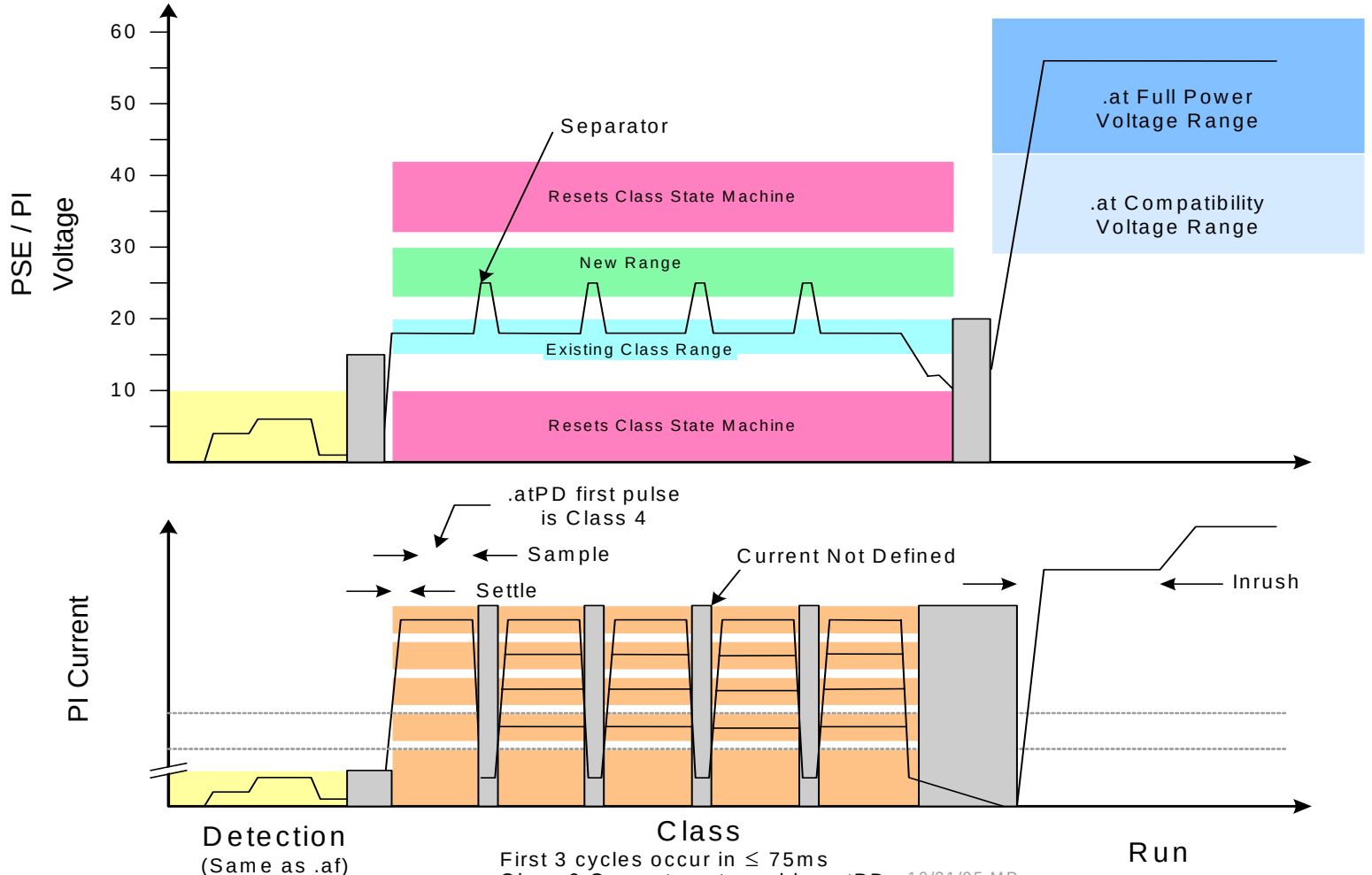
Ping-Pong Classification - Review

- Basic idea is to extend existing Classification to multiple cycles
- Classification method is similar to the existing method
- Handshake system
  - .at PD learns PSE type
  - .at PSE learns PD type
- Misidentification avoided with multi-cycle operation and coding techniques
- Allows for large number of classes by either endpoint or midspan PSE
- The number of classes can be easily increased

IEEE 802.3at Ping-Pong Review

Example of Ping-Pong 802.3at Classification Plan

Note: Waveforms Uncontrolled in Gray Areas

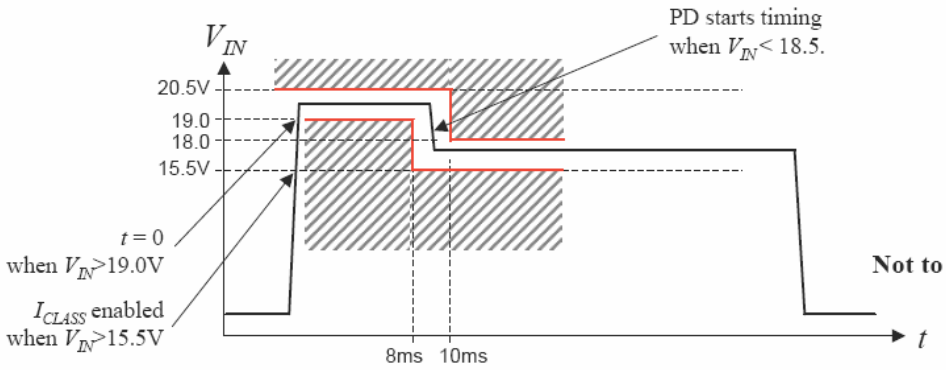


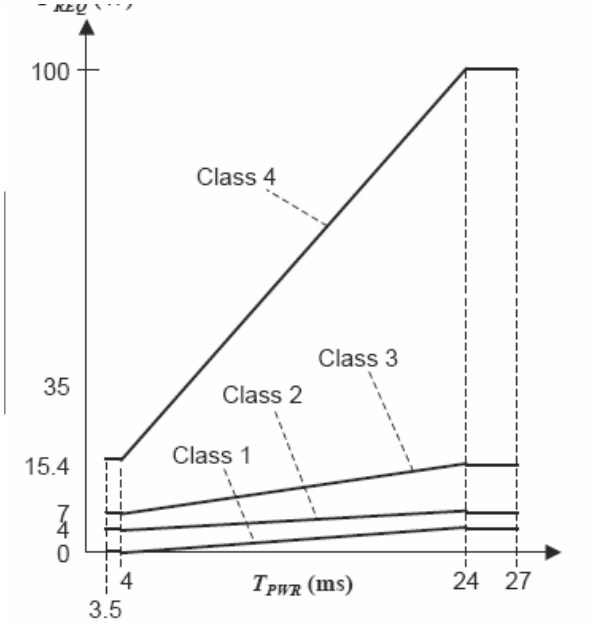
10/31/05 MP

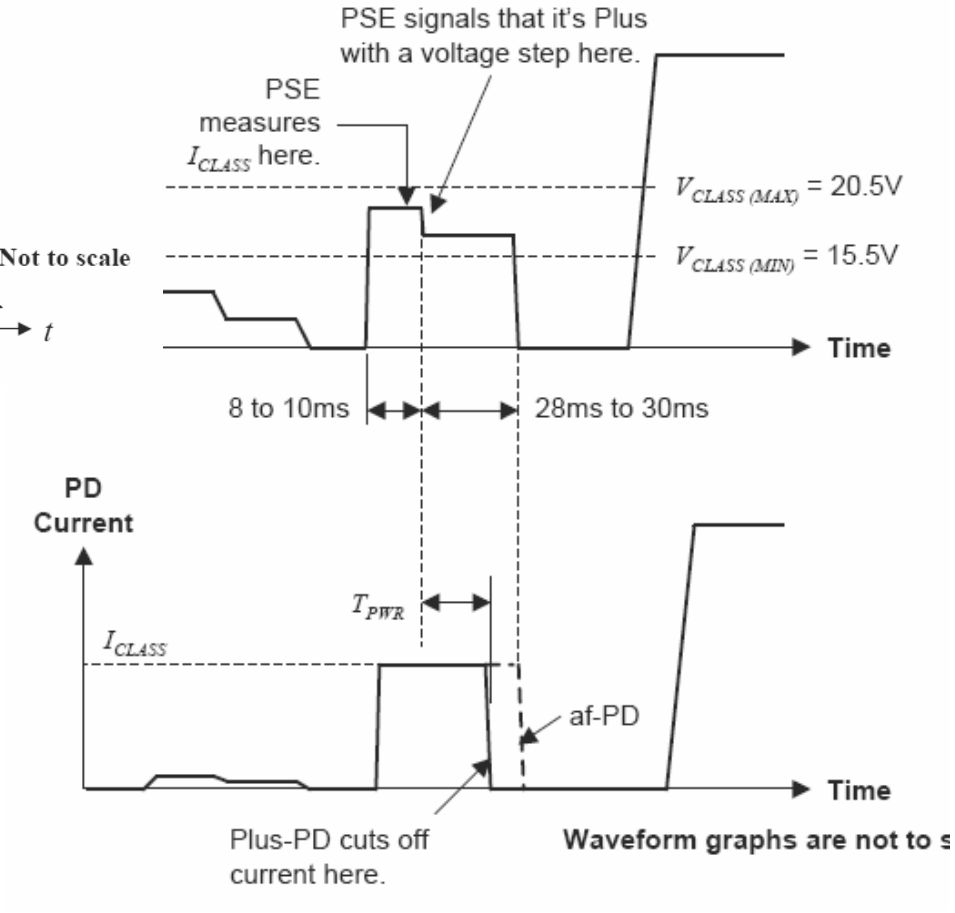
Survey of Proposed Techniques

Apologies to any that I might have missed

Pulse Width and Period Mapping

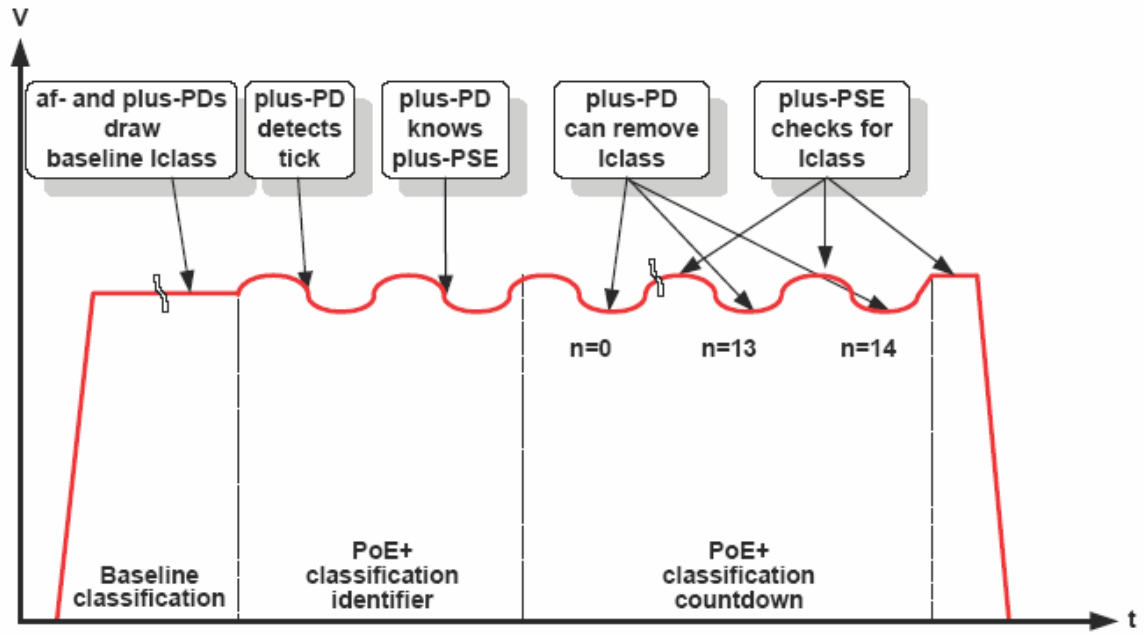


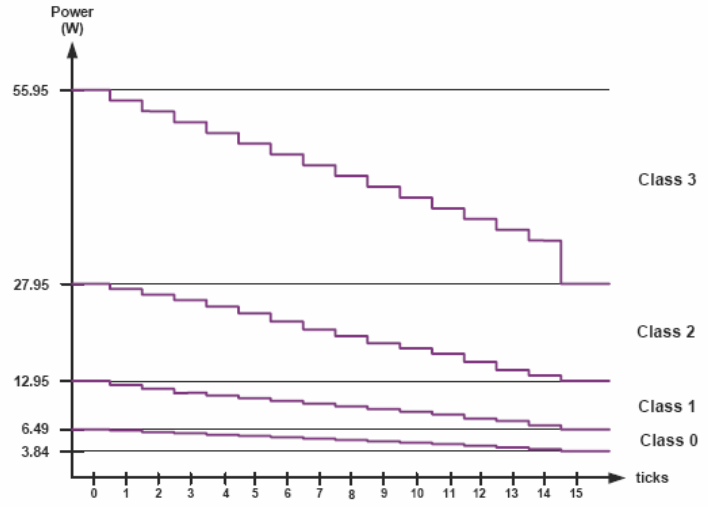




From: robbins_2_0705

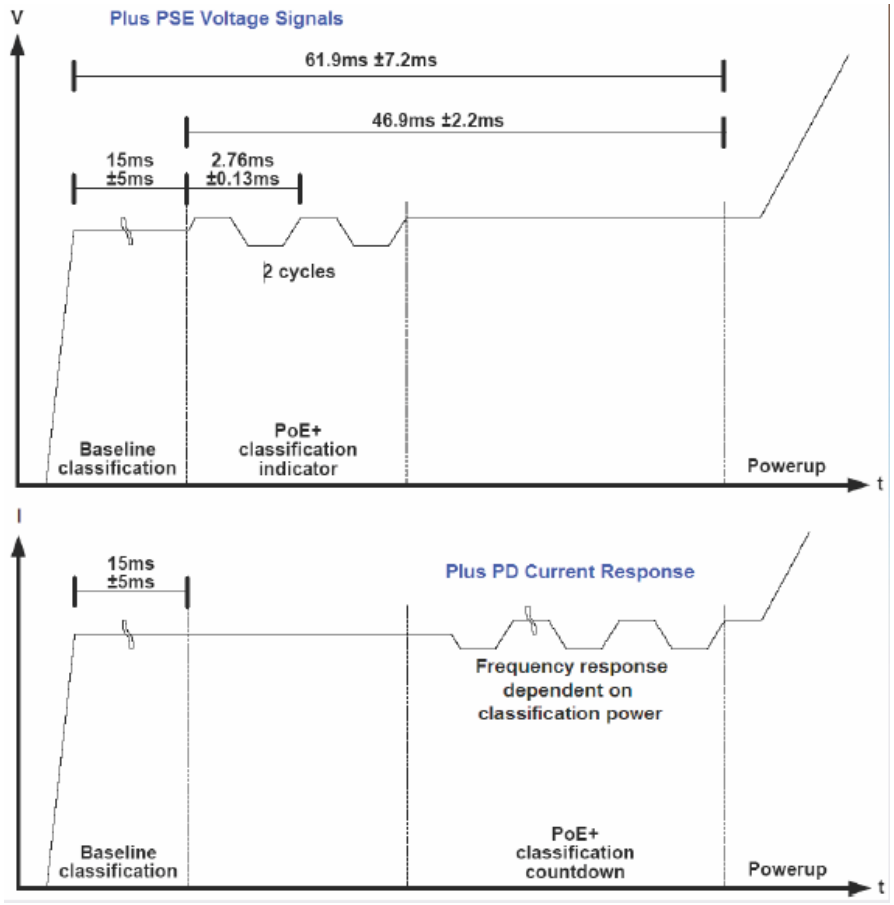
Embedded Clock & Early Termination





From: landry_1a_0705

Send-Receive Clocks



PSE initiates with 2 cycle burst

PD replies with a clock embedded in the current signature. P = F(f)

From: koonce_1_0705

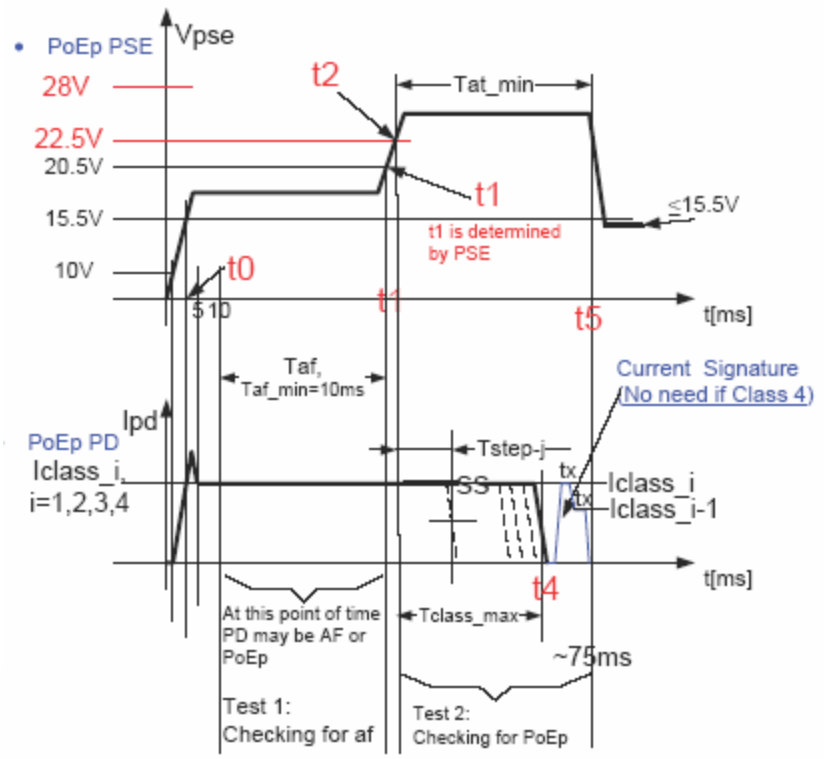
Dynamic Negotiation

Layer 1 analog dynamic power negotiation

- Coexists with enhanced hardware classification method
- Allows non-disruptive renegotiation of power delivery
- Optimizes power supply utilization regardless of classification granularity
- Hardware based classification does not preclude midspan solution
- Effectively allows system-level power management on both ends of the link
- Optional implementation dictated by market forces
- Nonzero implementation cost
- Some implementation methods may be covered by preexisting IP

Gordon Kapes 9/2005; Survey of Options

Modified Pulse Width / ACK



Tclass	t1	t2	t3	t4	t5	t6	t7	t8	t9	t > t9
I_class (802.3af)	Power Allocated [Watts]									
10mA	0.44	0.6	0.7	0.9	1.1	1.5	1.9	2.4	3.0	3.8
18.5mA	4.8	5.0	5.2	5.3	5.5	5.7	5.9	6.1	6.3	6.49
28mA	6.7	7.2	7.8	8.4	9.0	9.7	10.4	11.2	12.0	12.95
40mA	13.9	15.7	17.6	19.8	22.3	25.0	28.1	31.6	35.6	40.0

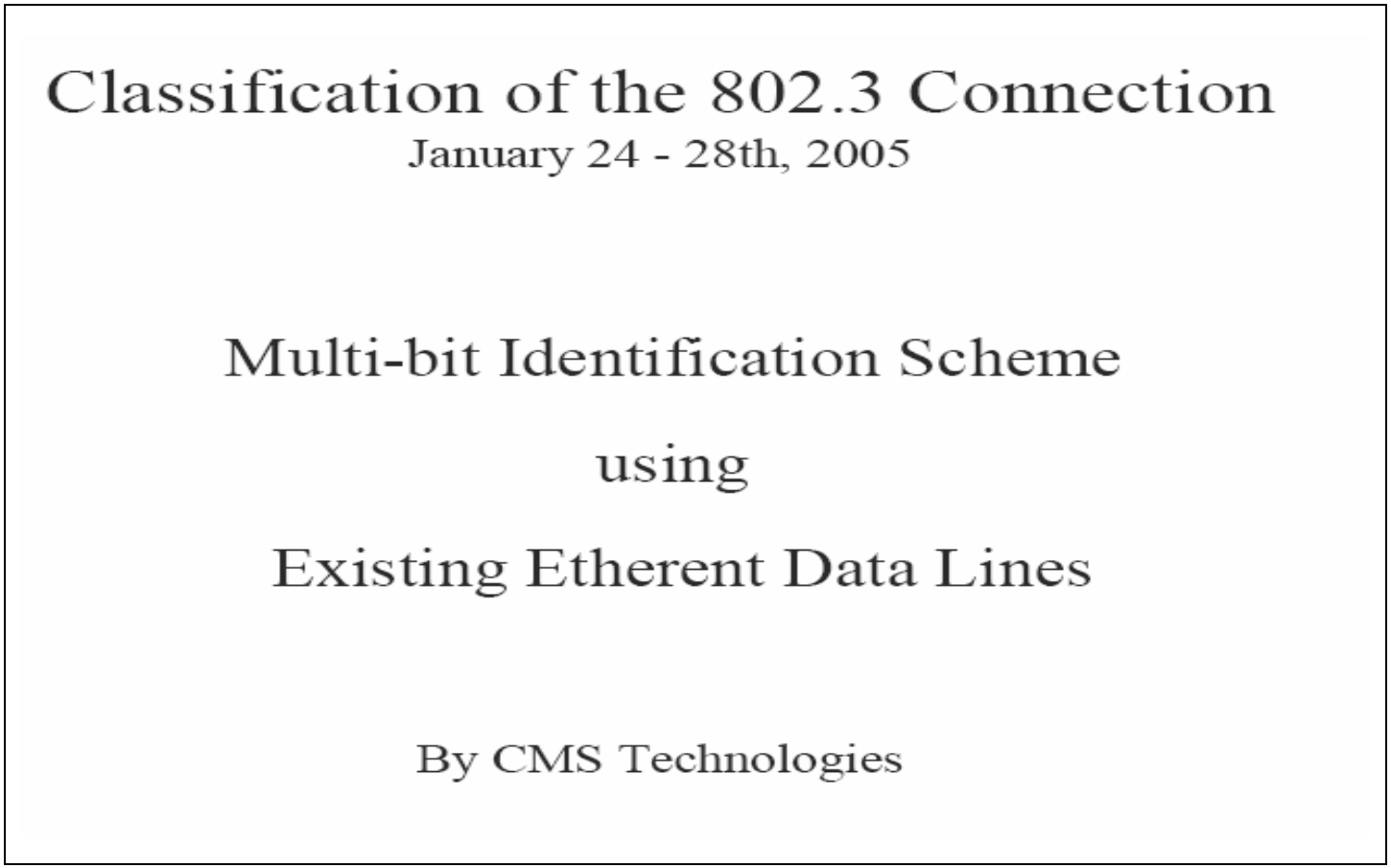
From: darshan_1_1105

Advantages / Disadvantages

Technique	Advantage	Disadvantage
Pulse Width and Period Mapping	Simple, low pin count	Clocks on both sides/ Tolerance Windowing for Start Limited Classes
Embedded Clock / Early Termination	Digital technique	Unknown .af PD response Clock recovery / noise rejection Requires PD "programming"
Send / Receive Clocks	Simple, low pin count	Unknown .af PD response Tolerance Limited Classes
Modified Pulse Width / ACK	Simple, low pin count	Clocks on both sides / Tolerance Limited classes Potential PD power issues ACK is added complexity
Dynamic H/W Negotiation	Solves over-capacity issues	Most complex Requires intelligence at both ends Potential IP issues
Ping Pong	Uses existing techniques Digital technique Large number of classes	Requires PD "programming" PD higher thermal requirement

Concern about Existing Technology

Presentation to PoE Plus Study Group in January 2005



Classification of the 802.3 Connection

January 24 - 28th, 2005

Multi-bit Identification Scheme

using

Existing Etherent Data Lines

By CMS Technologies

KEY Differences

- **Ping Pong DOES NOT**
  - Signal while data is present
  - Contain unit-unique ID information
  - Present continuous fixed - bit rate signaling
  - Have a method of blocking data signals
  - Maintain a database of each PD, its location, and unique ID
  - Require two power sources
  - Involve (continuous) modulation and demolulation
  - Transmit using variable impedance (current sink ≠)
- **Ping Pong DOES**
  - Use existing technique multiple times

Summary

- Propose that the committee choose a basic technique and move forward

The POWER Behind Your Designs

APPENDIX
Additional Slides from 11/05

IEEE 802.3at Ping-Pong Classification

- System Rules
  - First 3 Class periods complete within 75ms (.af requirement)
  - .at Class Duration is limited; example 150ms
  - .at separator pulse is something like 5ms
  - Only one Class cycle if first value is not a "4"
  - PSE applies current-limited voltage to loop (like .af)
  - PD signals via current (like .af)
  - Existing Class current definitions are used (0 – 4)
  - Not all codes are used to avoid accepting non-.at PD devices
  - Class 0 is not used for .at PDs because this system requires some pull-down load

IEEE 802.3at Ping-Pong Classification

- PD Rules
  - .at PD first Class must be “4” to signal PoE+
  - .at PD does not use 444xx code (eliminate Class 4 .af PD)
    - Other codes eliminated that could be caused by non-.at devices
  - .at PD is required to pull Class 1 current to discharge the internal capacitor, and perhaps link capacitance
    - Input diode bridge might prevent identification of separator
  - .at PD state machine reset when port voltage enters reset or operational range
  - .at PD indicates wrong PSE type if there are not 5 Class cycles before powering
  - .at PD signals as Class 0 if too many cycles occur

IEEE 802.3at Ping-Pong Classification

- PSE Rules
  - .at PSE does only one Class if first value is not a "4"
  - .at PSE interprets Class "444" as .af PD ($\Rightarrow$ Class 0)
  - .at PSE stops after receiving code "444"
  - Class coding scheme may render other codes invalid
  - .at PSE has same privileges to power PD or not
  - .at PSE may do multiple Detection-Class-Detection cycles
    - Must assure that a reset is applied before reclassifying
  - Power devices with invalid class as .af PD

IEEE 802.3at Ping-Pong Classification

- Advantages
  - PSE detects presence of .af or .at PD
  - PD detects presence of .af or .at PSE
    - .at PD may choose to operate at reduced functionality
    - .at PD has the ability to signal presence of inadequate PSE once powered
  - Adequate number of new classes for reasonable power utilization
  - Simple technique uses existing practice
  - Works for both end-point and midspan
  - A .at PD that is not powered up after classification can attempt to reclass at a lower power
- Disadvantage
  - Dynamic reclassification cannot be done at this signaling layer
    - The door is open to reclassification via Ethernet