4-PAIR POWER OVER ETHERNET CALL FOR INTEREST

IEEE 802.3 Working Group

CFI Panel Members

Presenters:

- Chad Jones – Cisco Systems Inc.,
- David Tremblay – Hewlett Packard
- Koussalya Balasubramanian – Cisco Systems Inc.,
- Francois Crepin – Akros Silicon
- Martin McNarney – Broadcom

Experts for Q & A Session:

- Dave Dwelley – Linear Technology
- Yair Darshan - Microsemi

Supporters – Page 1
(76 Individuals from 55 Companies)

Jim Theodoras	– ADVA
Francois Crepin	– Akros Silicon
Rick Rabinovich	– Alcatel-Lucent
Andrew Jimenez	– Anixter
Daniel Dove	– APM
Mikael Arnfelt	– Axis Communication
Paul Kish	– Belden
Joe Berry	– Belfuse
John Hess	– Belfuse
Yakov Belopolsky	– Bel Stewart Connector
Eric Lawrence	– Berk-Tek
Duncan Macey	– British Telecom
Kevin Brown	– Broadcom
Wael Diab	– Broadcom
Martin Mcnarney	– Broadcom
Scott Kipp	– Brocade
Koussalya Balasubramanian	– Cisco
Bill Delveaux	– Cisco
Chad Jones	– Cisco
Phillip Brownlee	– Coilcraft
Mabud Choudry	– Commscope
Wayne Larson	– Commscope
Richard Mei	– Commscope
Masood Shariff	– Commscope
George Zimmerman	– CME Consulting/ Commscope Inc
Dave Hess	– Cord Data
Brad Booth	– Dell
John D'Ambrosia	– Dell
Theodore Brillhart	– Fluke Networks
Steve Carlson	– High Speed Design, Inc.
David Tremblay	– Hewlett-Packard
Stephan Romano	– HillRom
Guyingjie	– Huawei
Hesham ElBakoury	– Huawei
Huarui Klinsmann	– Huawei
Shadi AbuGhazaleh	– Hubbell Inc.,
David Chalupsky	– Intel
Thananya Baldwin	– Ixia

Supporter – Page 2

Jerry Pepper	– Ixia
Raul Lozano	– Aruba Networks
Alan Flatman	– LAN Technologies
Mike Bennett	– LBNL
Dave Dwelley	– Linear Technology
Jeff Heath	– Linear Technology
Gavin Parnaby	– Marvell
Chris Diminico	– MC Communications
Daniel Feldman	– Microsemi
Pavlick Rimboim	– Microsemi
Yair Darshan	– Microsemi
Je-Hyuk Won	– Moa Telecom
Scott Sommers	– Molex
Martin Rossbach	– Nexans Cabling
Paul Vanderlaan	– Nexans Canada Inc
Sterling Vaden	– Optical Cable Corporation
Ron Nordin	– Panduit
John Senese	– Panduit
Rachel M Bugaris	– Panduit
Xiaofeng Wang	– Qualcomm
James Zhang	– Qualcomm
Joseph Chou	– Realtek
Bob Lounsbury	– Rockwell Automation
JungHyun Choi	– Samsung
Jimmy Jun-Pyo Kim	– Samsung
Fred Schindler	– Seen Simply
Valerie Maguire	– Siemon
David Lucia	– Sifos
John N Wilson	– Silicon Labs
Christian Beia	– ST Micro
Flemming Christensen	– Sundance Multiprocessor Tech Ltd
Bernie Hammond	– TE Connectivity
David Abramson	– Texas Instruments
Michael McCormack	– Unemployed
Dave Estes	– UNH
Mandeep Chaddha	– Vitesse Semiconductor
Marek Hajdeczunia	– ZTE Corporation

Objective

- Gauge the interest in forming a study group to develop
  - 4-pair Power Over Ethernet
- This presentation will NOT
  - Fully explore the problem
  - Debate strength and weakness of solutions
  - Choose a solution
  - Create a PAR or 5 Criteria
  - Create a standard or specification

Agenda

- Definitions
- Background
- Efficiency, High power and 10GBASE-T support
- Why now and Why in IEEE 802.3?
- Summary
- Q & A
- Straw Polls

Definitions

- IEEE Std 802.3-2012 Clause 33 power injection
  - Requires 2 pairs
  - Power is injected on either pairs 1-2,3-6 or pairs 4-5,7-8. (i.e. Alternative A or Alternative B configuration)
  - IEEE 802.3 Clause 33 Standard allows Alternative-A or Alternative-B, but not both

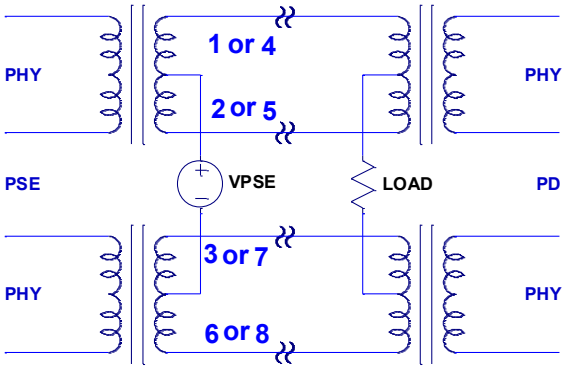


Fig.1 Clause 33 Power Injection

- 4-pair Power Injection
  Power injected on both 1-2,3-6 and 4-5,7-8 pairs. (i.e. All pairs are powered up)

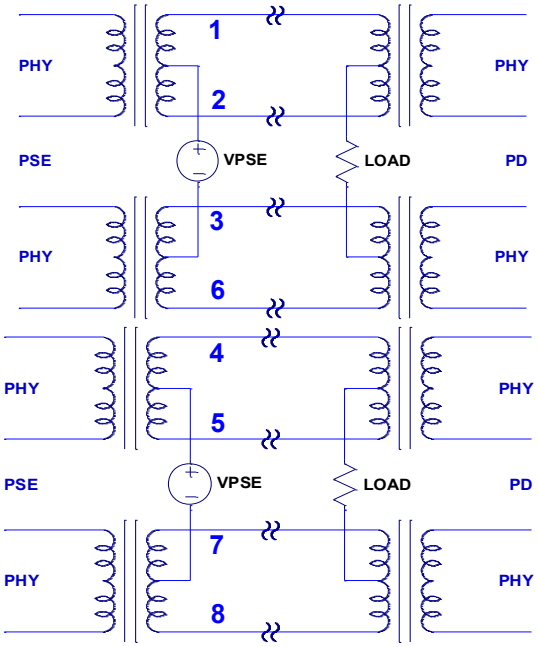
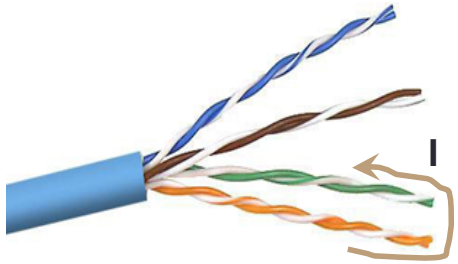


Fig.2 4-pair Power Injection

Background

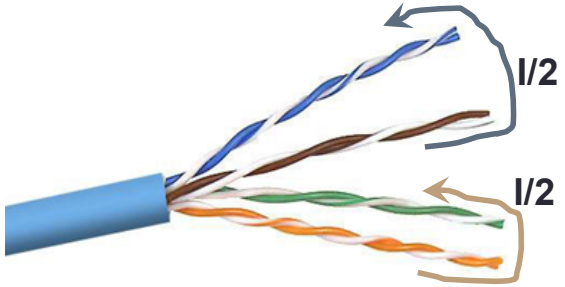
- 4-Pair PoE
  - For same load current, 4-pair is more efficient than 2-pair delivery
  - Markets can also utilize increased power that is possible with 4-pair
  - Today PoE supports 10BASE-T,100BASE-TX,1000BASE-T. Study feasibility of PoE support for 10GBASE-T.
  - Maintain backward compatibility with IEEE Std 802.3-2012 Clause 33

4-pair Vs 2-pair Efficiency



- As per IEEE Std 802.3-2012 Clause 33,
  Cable loss_2-pair = $I^2 * R$ (R is channel resistance)

- For the same channel current,



Cable loss_4Pair $= (I/2)^2 * R + (I/2)^2 * R$

$= 2 * (I/2)^2 * R$

$= ½ * (I^2) * R$

Cable loss_4Pair = Cable loss_2pair / 2

  - Power loss is reduced by half

- The actual efficiency advantage will be load dependent

- The simplified (pessimistic) calculation shows, 4-pair PoE effectively reduces the channel power loss by at least half compared to 2-pair PoE

Efficiency – Example Use Case

Using the simplified math model from previous slide,

Parameter	Average Case		Worst Case	
Voltage (at PSE)	48.834 V		50 V	
Voltage (at PD)	48 V		42.5 V	
PD Power	8 Watts		25.5 Watts	
Link Resistance	0.125 Ohms/meter			
Link length	40 meters		100 meters	
Hours in a Year	8760 Hours			
Cable Power Loss Per PD	**2-PAIR**	**4-PAIR**	**2-PAIR**	**4-PAIR**
	0.14 W	0.07 W	4.5 W	2.25 W
Loss Percentage Per PD	1.71%	0.854%	15%	7.5%
Cable Power Loss per PD per Year	1217 Watt-Hours	608 Watt-Hours	39420 Watt-Hours	19710 Watt-Hours

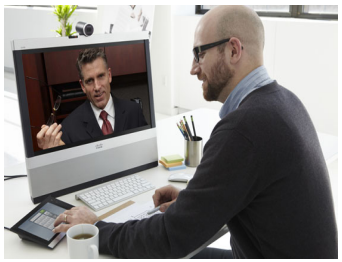
With a conservative assumption of 100million PDs deployed world wide, the average cable power loss numbers are, (average case from table above)

- Cable Power loss over all PDs/year on a 2-pair system ➔ 121.7 Million kWh
- Cable Power loss over all PDs/year on 4-pair system ➔ 60.8 Million kWh

Potential Energy Savings from 4-pair system →
(at least) 60.8 Million kiloWatt-hours/yr

4-Pair High Power Target Markets

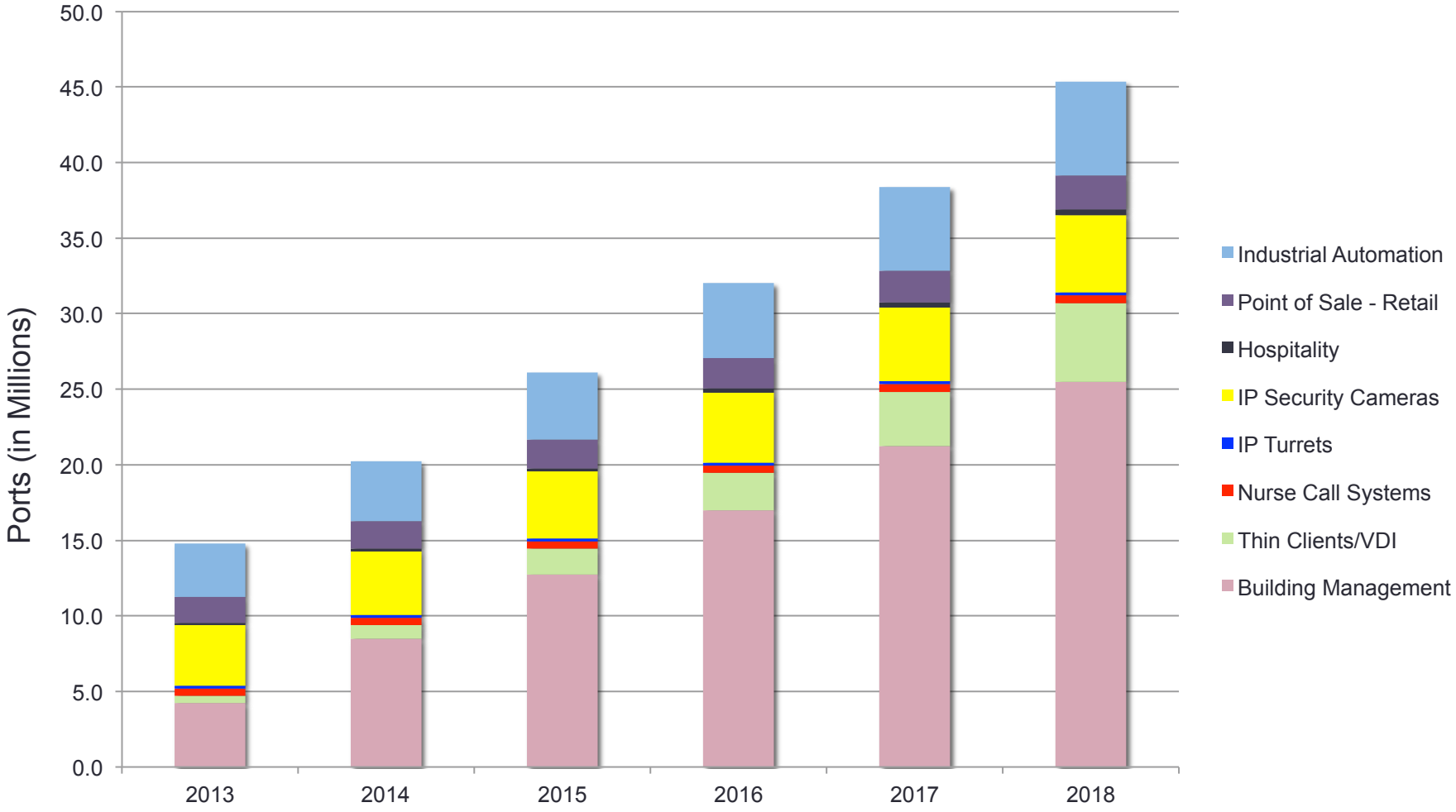





- **IEEE Std 802.3-2012 Clause 33, Max PD Power → 25.5Watts.**
- **Some markets are in need of >25.5W of power. 4-pair PoE can provide >25.5W of power**

Markets	Typical Power Consumption
Nurse Call Systems - HealthCare	80% market needs >30W (Typically 50W)
Point Of Sale –Retail (POS – credit card readers and printers)	40-50% in 30-60W range
IP Turrets – Banking, financial trade floor phone systems	Typically 45W
Building Management (Lighting Fixtures & Controllers, Access Controllers, etc.)	40-50W
Thin Clients, Virtual Desktop Infrastructure(VDI) terminals (High-end configuration)	~50W
Video Conferencing, Hospitality (e.g.,: PoE powered switches)	Typically 45-60W
IP Security Cameras (Pan, Tilt, Zoom cameras)	30-60W range
Industrial (Brushless and Stepper drives, Motor control units)	>30W

4-Pair High Power Market Potential

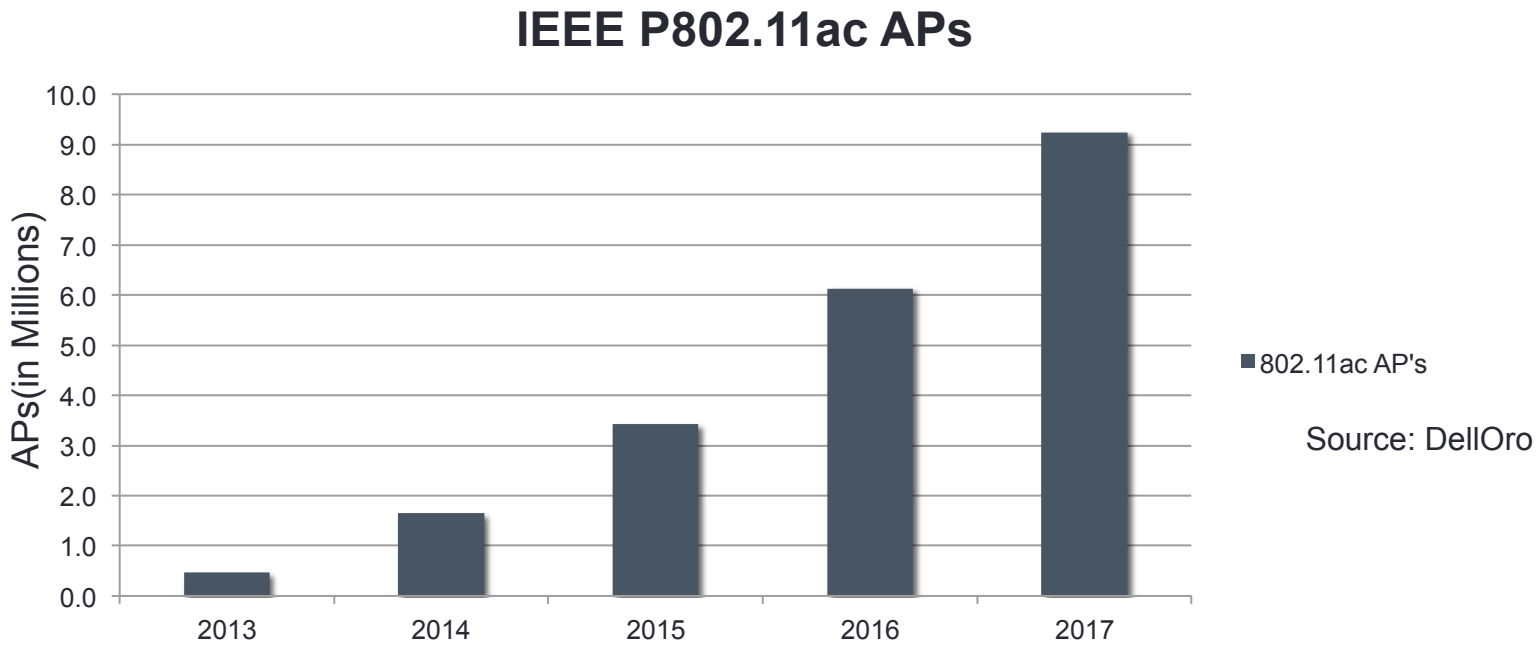


Sources:
VDC Research
IMS Research - Jenalea Howell
http://seekingalpha.com/article/101408-the-global-lighting-market-by-the-numbers-courtesy-of-philips and other research reports
Gartner Forecasts, BT Turret, Cisco Partners

High power→ Greater than IEEE 802.3 Clause 33 defined

PoE support for 10GBASE-T

- Next generation Wireless Access Point bandwidth is going up
- PoE APs are very common today
- We need to investigate into PoE support for 10GBASE-T.
- 10GBASE-T is a 4-pair Ethernet Standard.
- 4-pair will also efficiently power up APs.
- For example, forecast projection for IEEE P802.11ac APs is shown below



Why now and Why in 802.3?

- 4-pair PoE provides better efficiency over 2-pair and can deliver higher power. Opens up PoE to newer markets.
- There is market demand for 4-pair PoE.
- Several proprietary solutions exists in market – need for standardization is imminent.
- It's Power over Ethernet → It belongs in 802.3
  - IEEE 802.3 is recognized as the international standard for Power over Ethernet Solutions
  - PoE experts are in 802.3

Summary

- Clear market need to:
  - Amend PoE to support 4-pair
- Goal: A new study group that investigates
  - 4-pair Power delivery

4-pair Power Over Ethernet
Q & A

15 Minutes

Straw Polls

- _57_ Number of People in the room
- _42_ Individuals who would attend and contribute to a 4-pair Power over Ethernet Study Group
- _33_ Companies that support the formation of a 4-pair Power Over Ethernet Study Group

Straw Polls

- Request that IEEE 802.3 WG form a study group to develop a PAR and 5 Criteria for a :

4-pair Power Over Ethernet

People in the room	802.3 Voters only
Y: _50_	Y:_42_
N: _0_	N:_0_
A: _3_	A:_3_

Thank You!