

IEEE802.3at Task Force

Vport Ad Hoc

PSE dv/dt and PD di/dt issues

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Objective

- Effects on data integrity

- To demonstrate how the voltage and current slew rate were calculated at the IEEE802.3af standard in order to keep data integrity.

- Effects on False Under load and Over load



Basics

- Ensure that current or voltage steps during normal PoE operation will not infringe data transmission.
- Data transmission may be affected by crosstalk resulted by Electromagnetic fields.
- Crosstalk mainly affected by common mode (pair to pair mode)
- Data is in differential mode
- There is DM to CM transfer function
- High frequency transients → higher crosstalk

Simplified Calculation

- The slope of a sine wave:

$$A \cdot \text{SIN}(2 \cdot \pi \cdot f \cdot t)$$

$$\frac{d}{dt} [A \cdot \text{SIN}(2 \cdot \pi \cdot f \cdot t)] = 2 \cdot \pi \cdot f \cdot A \cdot \text{COS}(2 \cdot \pi \cdot f \cdot t)$$

- Max slope (dv/dt) happens when t=0

$$dv / dt = 2 \cdot \pi \cdot f \cdot A$$

Test Result data from the 802.3af work

- CRC errors were monitored while a sine wave was injected in pair to pair mode (common mode) in a 130-140 meter cable.
- In 100BT, data started to be damaged at 7MHz and amplitude of 795mV peak.
- Therefore max slope or voltage slew rate is:

Max dv/dt and di/dt in PSE and PD

- Using test data

$$dv/dt = 2 \cdot \pi \cdot (7 \cdot 10^6 \text{ Hz}) \cdot (795 \text{ mV}) = 3.497 \cdot 10^7 \frac{\text{V}}{\text{sec}}$$

- Taking 20dB margin:

$$= 3.497 \cdot 10^6 \frac{\text{V}}{\text{sec}} = 3.5 \frac{\text{V}}{\mu\text{sec}}$$

- 802.3AF PD with 12.95W at 37V presents 105 Ω \rightarrow $\sim 100\Omega$

$$3.5 \frac{\text{V}}{\mu\text{sec}} \cdot \frac{1}{100\Omega} = 35 \frac{\text{mA}}{\mu\text{sec}}$$

Other di/dt issues

- PSE voltage drop from 57V to 44V may cause under load for TBD time due to diode reverse bias in PD (false under load)
- PSE voltage rise from 44V to 57V may cause Overload or ILIM condition for TBD time (false overload)
- All of these issues were discussed in 802.3af
 - See: http://www.ieee802.org/3/af/public/jul01/darshan_2_0701.pdf
- Results of discussion were
 - Minimum current beyond the 10mA as function of Cpd was defined to handle false Over Load
 - PSE required to handle the false overload in specific setup which is not covering all cases
 - Objectives of 802.3af was not to impose additional requirements on PD or PSE in order not to increase cost involved in limiting dv/dt in PSE and di/dt in PD
 - Contradicting requirements
 - Fast dynamics in PDs to handle load changes vs limiting di/dt at input by increasing Cpd, Lpd

Summary and recommendations

- Our scope is to define single port requirements
- Although we can not ignore multi port system behavior and we may think of system issues and impose requirements on a single port
- The lesson from 802.3af is to allow wide design flexibility which means minimum requirements and let PSE/PD vendors to be innovative
- Imposing functional dv/dt in PSE and di/dt in PD may increase cost on both sides. It is not a common requirement in power systems
- To consider if 802.3af requirements are good enough



References

- http://www.ieee802.org/3/af/public/may02/darshan_1_0502.pdf
- http://www.ieee802.org/3/af/public/jul01/karam_1_0701.pdf
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