IEEE802.3at Task Force

An Extended Classification Proposal

Modified Time Based Concept

Updated

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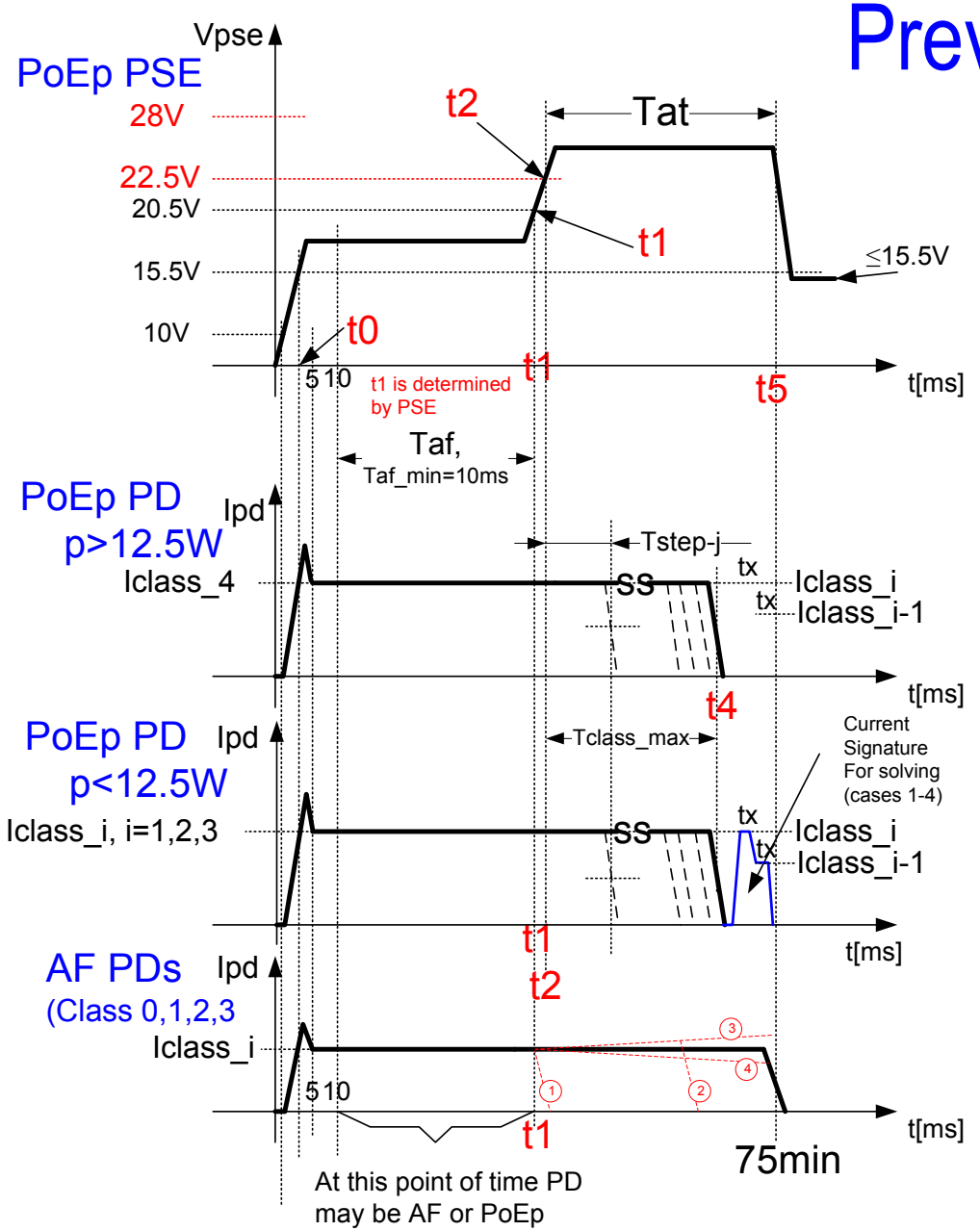
Background

- On November 2005, a Modified[1] Time Based Enhanced Classification[2] was presented that meets the following:
  - ☑ Backwards and Forward Compatibility.
  - ☑ PoEp PSEs detects PoEp PDs and Legacy PDs
  - ☑ Legacy PSEs detects PoEp <=12.95W PDs and Legacy PDs
  - ☑ No false detection of Legacy PSE as PoEp PSE due too poor load regulation of Legacy PSEs operating within 802.3af Classification voltage range
  - ☑ Unique distinction between 802.3af PDs and 802.3at PDs
  - ☑ Detects legacy non compliant 802.3af that are using class 4
  - ☑ Works with low cost, >10% accuracy clock
  - ☑ 802.3af range power dissipation
  - ☑ Works within 802.3af 75ms time range with 40 classes minimum.
  - ☑ Support PD indication

Background Cont.

- The next presentation suggest the following modifications for
  - ☑Improved power dissipation <=802.3af levels
  - ☑Increased number of classes to cover 100W for future use
  - ☑Supports logarithmic or linear power distribution with sufficient number of classes within 75ms time frame.
  - ☑PSE Power Supply Utilization >90% with no cost penalties (in PSEs or PDs) as defined by reference 7 analysis.
  - ☑Efficient classification table codes.
    - ☑ No illegal codes detected so far.
    - ☑ No extra testing cost and time

Previous proposal

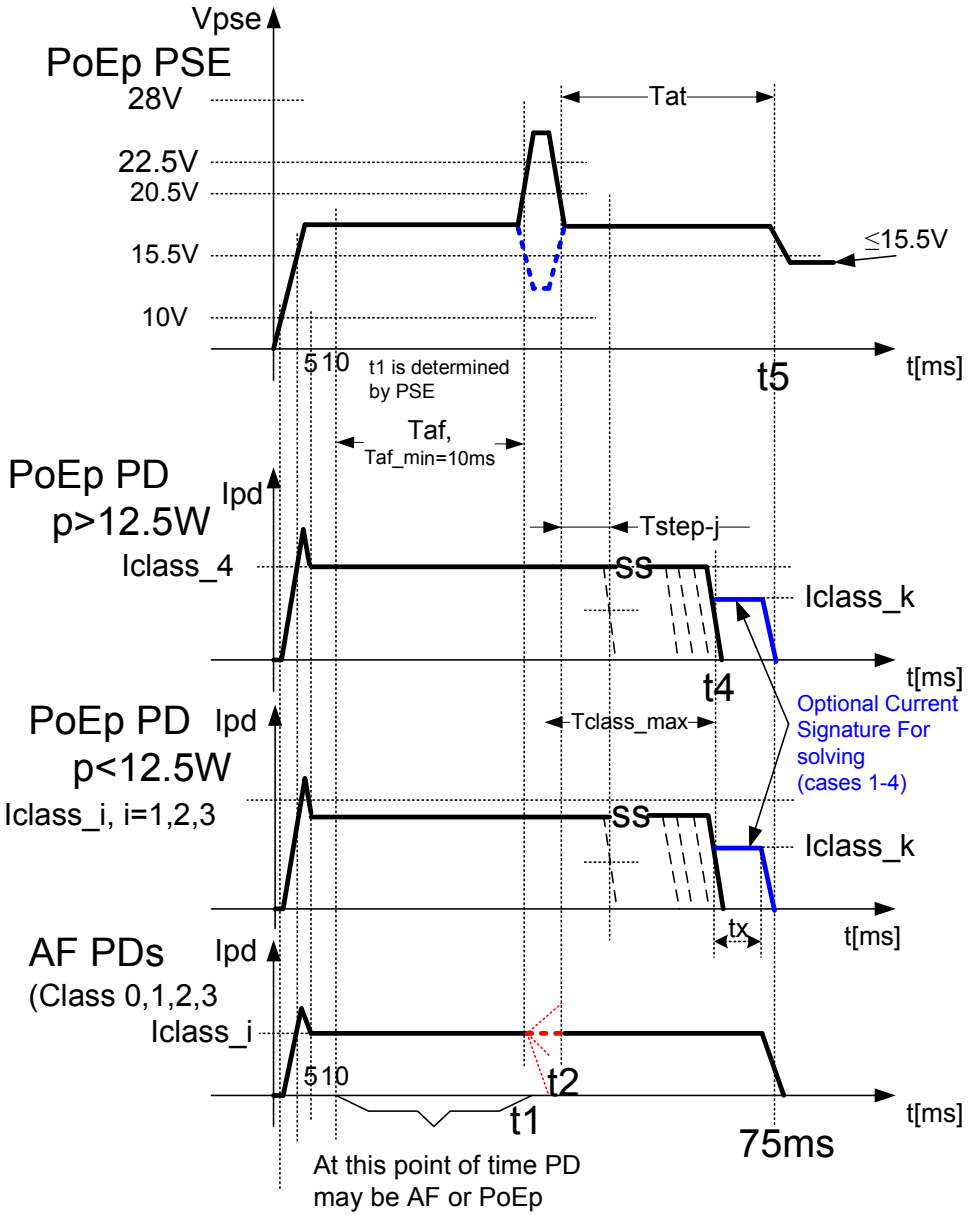


PoEp PSE vs all PDs

All time points are with respect to t0.

Drawings are not to scale

Modified proposal



PoEp PSE vs all PDs

All time points are with respect to t0.

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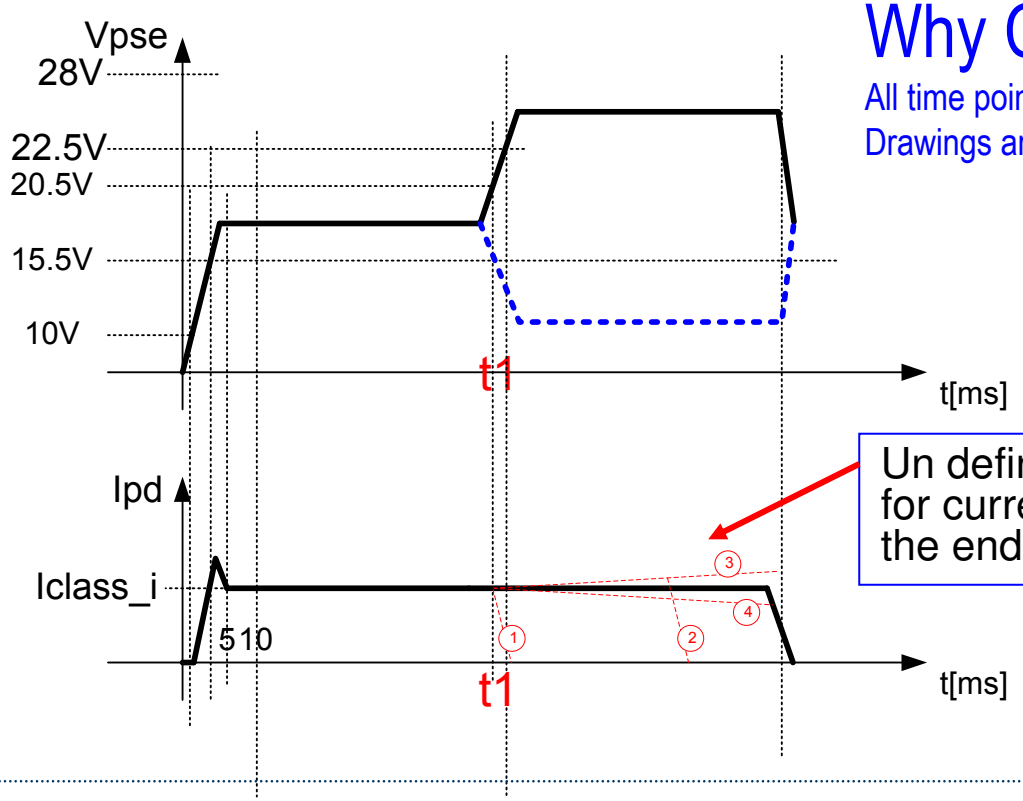
Why Current signature?

All time points are with respect to t0.
Drawings are not to scale



Un defined in IEEE802.3af, hence the need for current signature or change in Iclass at the end of Tclass-j

Why Current Signature:

- To differentiate between deterministic current stop/change in PoEp PDs to random current stop/change in 802.3af PDs when Vclass>20.5V or <15.5V.

- IEEE802.3af doesn't specify Iclass behavior for > 20.5V or <15.5V. Hence cases 1-4 may happen. Therefore we may not know if current was stopped due too deliberate change of .at PD or protection circuitry of .af PD

PoEp Enhanced Classification Rules

PSE	Test #1	Test #2	Test 3	**PSE final tests Results**
PSE Time Interval	Taf	Tat		
PSE Classification Voltage Range	15.5 to 20.5	12.5 to 28 (Example)	Current Signature	
PD Ipd (Iclass,Tclass) and Current Signature	Iclass-i, **i=0**	Ipd<5mA→No Class No need for Test2	No need	802.3af PD, Class-0
	Iclass-i, **i=1,2,3**	Iclass = Anything	Fail	802.3af
	Iclass-i, **i=1,2,3**	Iclass-i, Tclass-j	PASS	PoEp PD<12.95W
	Iclass-i, **i=4**	Iclass-i, Tclass-j	No need	PoEp PD PD>12.95W

Worst case Analysis results of minimum number of classes required to maintain PSu

- See detailed analysis presented in this meeting

			Psu	
Psu	0.7	0.8	0.9	0.95
1/Psu	1.429	1.25	1.111	1.053
N	12	19	39	78

Number of classes N, for 100W over 2P.

			Psu	
Psu	0.7	0.8	0.9	0.95
1/Psu	1.429	1.25	1.111	1.053
N	11	16	32	64

Number of classes N, for 50W over 2P, 100W over 4P

Extended Classification Table

Tclass	t1	t2	t3	t4	t5	t6	t7	t8	t9	t > t9
I_class (802.3af)	Power Allocated [Watts]									
10mA	2.00	2.2	2.5	2.8	3.1	3.4				3.8
18.5mA	4.2	4.7	5.2	5.7						6.49
28mA	7.2	7.9	8.7	9.7	10.8					12.95
40mA	13.3									50/100

- All spare location can be used for linear distribution whenever necessary for optimization of System performance
- Table can be arrange in many ways

Timing details

- .at PSE:
- Total max. classification time=75ms
  - Taf_min=10ms. Taf max=20ms.

  ➔Tat_max=55ms.
  - Tx_min=10ms. Tx_max = 15ms max.
  - Tclass=Ta+Tclass-j, Ta=5ms
  - Tclass_max = 55ms-15ms-5ms=35ms
  - Tclass_step=2ms (includes 100% margin to cover all timing errors)
  - Numbers are not final however already works with >10% clock accuracy + 1ms spare to cover all timing errors[3]

Available 802.3at Classes limited by Tclass

Available 802.3at Classes and Sub classes	
Linear Tclass	Log Tclass
68	40
Sufficient for 50/100W per 2P support	Sufficient for 50/100W per 2P support

- Higher number of classes available in linear Tclass distribution to improve system utilization in high power classes
- Power levels can be assign to Tclass in logarithmic or linear distribution
- All codes are 802.3at codes. No “illegal” codes, No class_0 unused codes.

Available classes vs minimum required

- Available 40-68 minimum
- Required 31-32 to 38-39 minimum
- We are good.
- And if Pmax =60W , 30W for each pair it is even better which results with much lower classes.

Summary of the Time Based concept

- ☑ Meets Objectives. Meets 5 Criteria.
- ☑ Backwards and Forward Compatibility of 802.3af/at PDs and PSEs.
- ☑ Legacy PSEs detects PoEp <=12.95W PDs and Legacy PDs
- ☑ Guaranteed Unique Distention.
- ☑ Not sensitive to poor 802.3af classification voltage regulation.
- ☑ Works with low cost, >10% accuracy clock which is there in most applications
- ☑ 802.3af range power dissipation or lower
- ☑ 40 to 68 available classes minimum. 240 to 408 maximum within 802.3af 75ms time range.
- ☑ Support PD indication

Summary of the Time Based concept

- ☑Detects legacy non compliant 802.3af that are using class 4
- ☑cover 100W for future use
- ☑Supports logarithmic or linear power distribution with sufficient number of classes within 75ms time frame.
- ☑PSE Power Supply Utilization >90% with no cost penalties (in PSEs or PDs) as defined by reference 7 analysis.
- ☑Efficient classification table codes.
  - ☑Inherently No illegal codes.
  - ☑No extra testing cost and time

Recommendations

- With any enhanced classification concept (Time based or others) whenever Vclass is above or below 802.3af range, to use a current signature in the PD which its hardware is there any way and is simple alternative to get the unique (No false detection) distinction per Objectives and 5 criteria.

- Information received by 802.3at PD for determine that it is connected to 802.3at PSE can not be used if it was based on voltage changes within the 802.3af classification voltage range.

- To evaluate Time Based enhanced classification by the group together with 1-2 other promising concepts in order to get high quality decision and prevent revisiting this issue in the next decade.

Questions and Discussion

Additional information and Reference material from previous meetings

Calculating Tclass and number of classes

- Number of available sub classes for each Iclass:
  - Tclass-j=Ta+Tstep-j
  - (Tclass_max-Ta-Tx)/Tclass_step=(55ms-5ms-15ms)/2ms = 17.5 ➔ 17 Sub Classes
  - Total number of classes and Sub classes: =4*17= 68Classes
  - Total number of extended classes and Sub classes with coded current signature: 68*6 = 408 Classes.
- With logarithmic distribution of # Tclass:
  - 4*10= 40 Classes
  - # of Classes with coded current signature: = 240 Classes

Available 802.3at Classes limited by Tclass

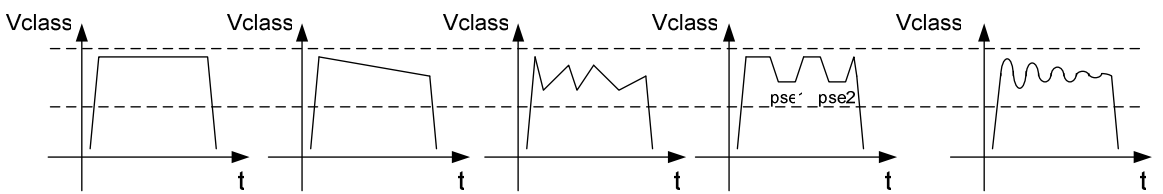
Available 802.3at Classes and Sub classes			
Linear Tclass		Log Tclass	
W/O Current Signature	With Current Signature	W/O Current signature	With Current Signature
68	408	40	240
Sufficient for 50/100W per 2P support	Keep all or part for: -future use -Vendor specific games - Or ignore..	Sufficient for 50/100W per 2P support	Keep all or part for: -future use -Vendor specific games - Or ignore..

Logarithmic Tclass distribution

Logarithmic Tstep-j= j*Tstep*(1+k)^(j-1), j=1,2…m, k is optional, k<1 (e.g k=0.1)		
j	t[ms]	k
0	5	
1	7	0.05
2	9.2	0.05
3	11.6	0.05
4	14.3	0.05
5	17.2	0.05
6	20.3	0.05
7	23.8	0.05
8	27.5	0.05
9	31.6	0.05
10	36.0	0.05
11	40.8	0.05
12	46.0	0.05
13	51.7	0.05
14	57.8	0.05

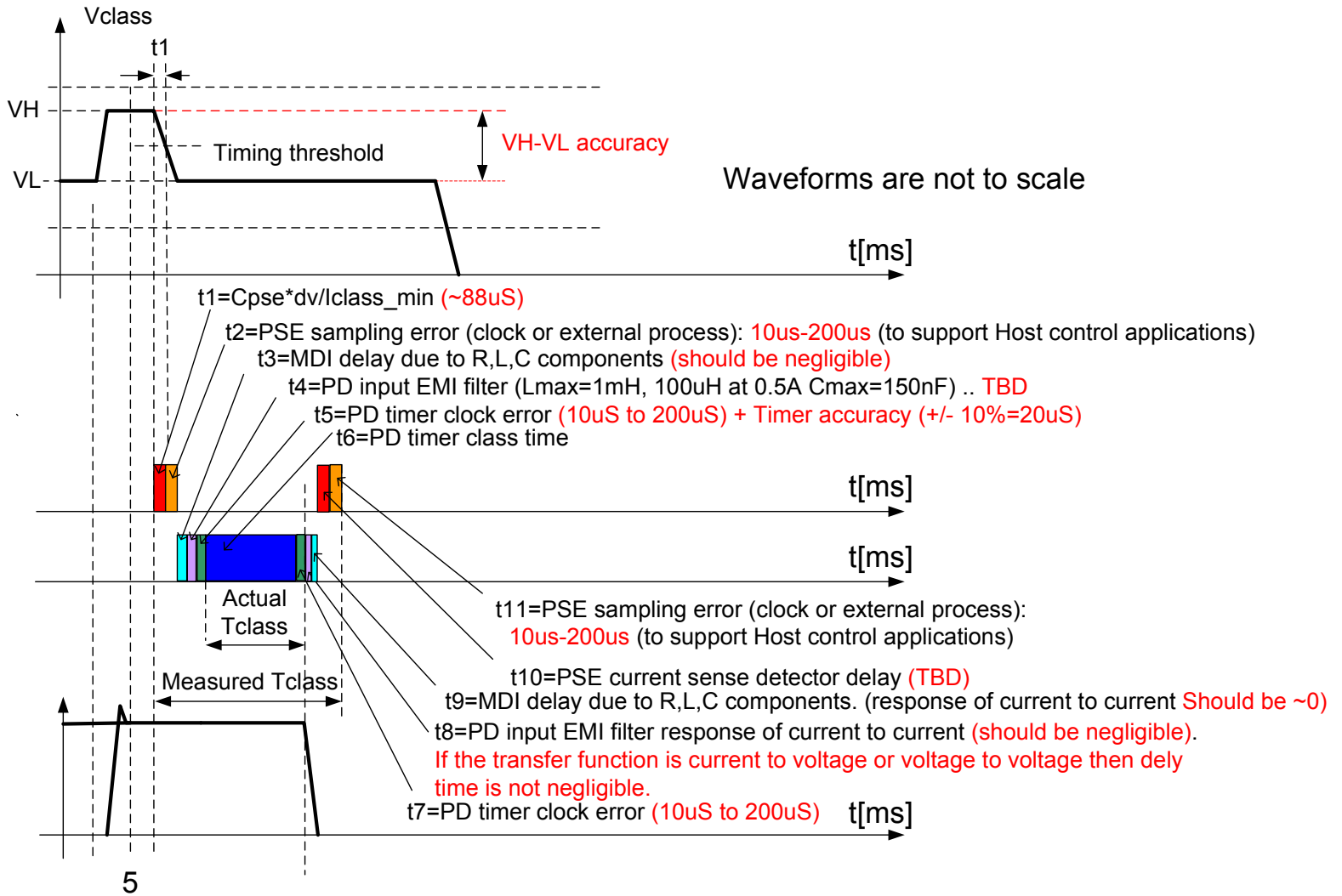
How Objectives affect potential concepts

- We need to ensure (~100%) that the operation of PoEp PD or 802.3af PSEs will not be affected by Vclass load regulation response of IEEE802.3af PSEs during multi-ports operation. Otherwise objectives 4, 13 and 14 are impaired.
- Arguments such:
  - Low probability to happen *(true if error free filters and protocol are used. Cost?)*
  - Such scenario was not observed etc. *(The standard allows it so it will and actually it was observed)*
- Are not relevant from standard point of view if it was permitted previously.
  - It will cause some of the PD's (false triggering) or some of the PSE's (shortening Iclass of AF PDs) to fail in compliance tests or in the field while they are OK per IEEE802.3af specifications.

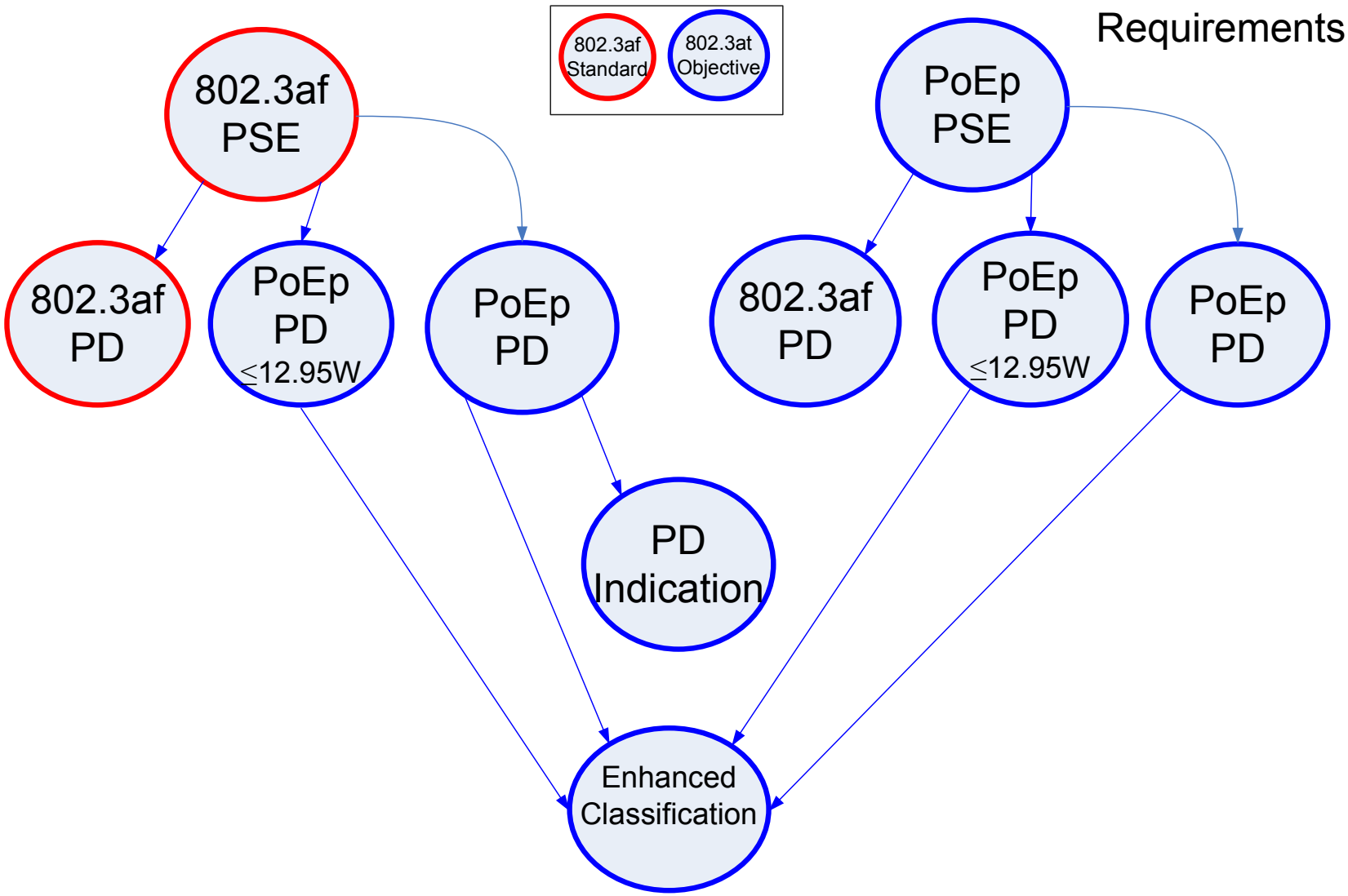


IEEE802.3af Possible Load response of Vclass regulator in multi-port environment

Time error analysis for Time Based concept



Requirements Analysis for meeting the 802.3at Objectives



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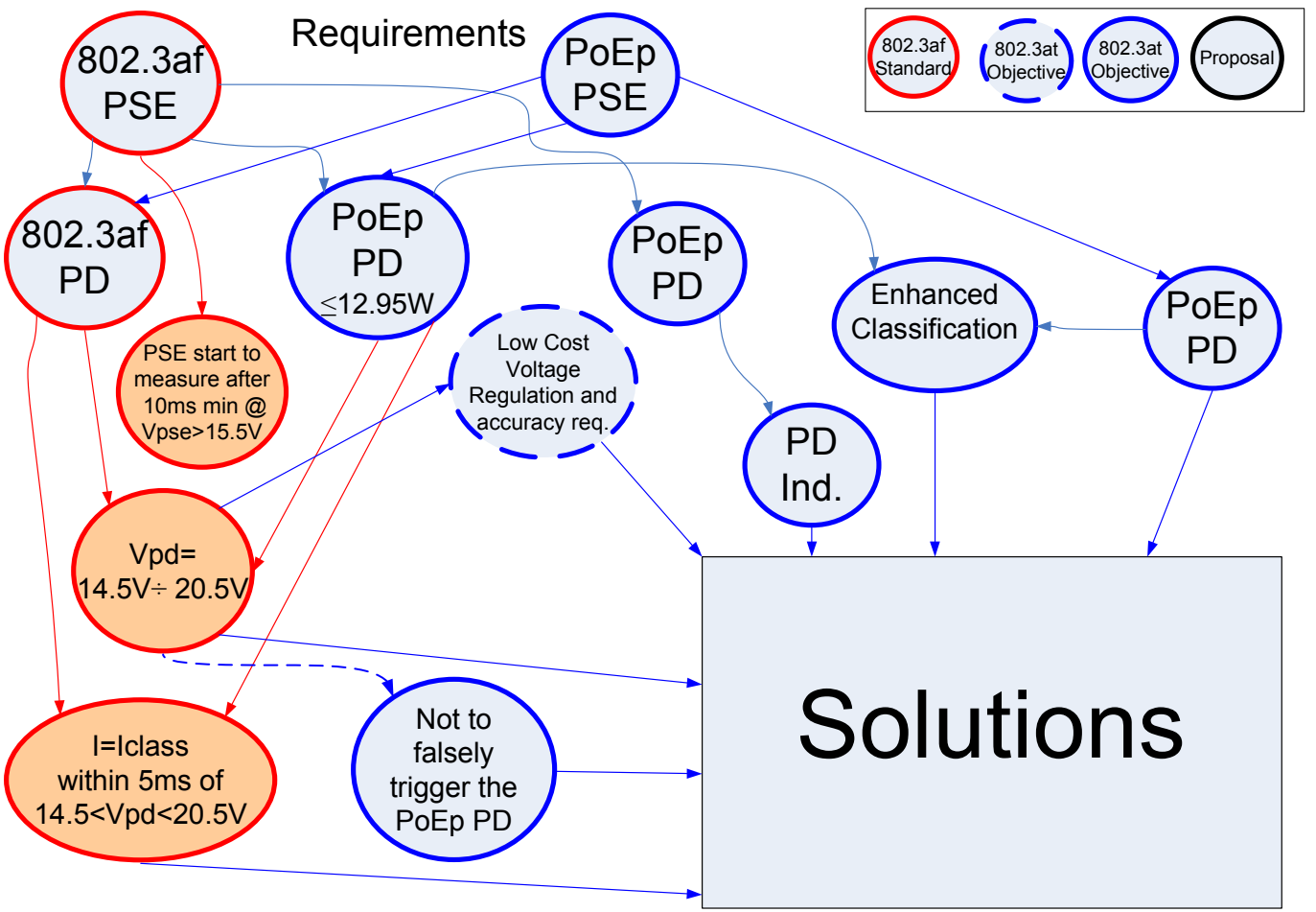

PD indication concept

If Vpd

a) is {0V, (14.5-20.5V, 10ms min)} and

b) {22.5-28V } and

c) {14.5-20.5V}

Then it is PoEp PSE

else

It is not PoEp PSE

Note: there are other ways to do it. This is just an example

References

1 An Extended Classification Proposal – Proposal #1, Yair Darshan, November 2005.

2. An Extended Classification Protocol for PoE Plus (Revised) Steve Robbins, July 2005

3. Recommended guidelines for enhanced classification concepts. Yair Darshan Nashua, NH September 2005

4. IEEE802.3at list of objectives:
http://www.ieee802.org/3/poep_study/802_3_poep_objectives.pdf

5. Cost effective detection and classification, Mat Landry, July 2005

6. IEEE802.3af clause 33.3.4, Table 33-10, the note regarding compliancy of IEEE802.3af with Class 4.

7. Classification Worst case Analysis, Yair Darshan, March 2006.