802.3AT CLASSIFICATION AD HOC
4-PAIR SYSTEMS:
ALLOWING EACH 2-PAIR SET TO OPERATE AUTONOMOUSLY

CLAY STANFORD, LINEAR TECHNOLOGY, 5-2-06

Note 5/9/06 C Stanford: The Classification Ad Hoc group was given the task (due 5/3/06) to consider the feasibility of defining 4-pair PoE systems as two fully autonomous 2-pair systems wired into a single CAT5 cable. The recommendation and detailed analysis as presented on 5/3/06 was Clay Stanford's work and not the consensus of the group. This document was used as a basis for discussion. This document now includes commentary reflecting the group's reaction to Clay Stanford's original presentation.

RECOMMENDATION

Assuming 2-pair 802.3at is able to address the power needs for the majority of PDs (i.e. 2P > ~ 25 watts)
Implement 4-pair system as two fully autonomous 2-pair systems with these limitations:

1. **4-pair PDs must maintain isolation between pairs**
   This would be mandatory if we allow cable to be driven by two independent PSEs, like an endpoint and midspan.
   Maintaining isolation solves the top-rail current balancing issue. It is also possible to solve with active current balancing.

2. **4-pair power classification is handled as two, autonomous 2-pair ports**
   Each 2-pair port requests a portion of total PD power usage.

3. **4-pair PDs may only operate at power levels above $P_{max2pair}$ (~25W)**
   By restricting 4-pair operation to power levels above Pmax2pair, we solve some interoperability and classification issues. These issues are solvable with 4P< Pmax2pair, it is just more complicated. See Point #2 in Details of Recommendations, below.
   This is controversial. Several people in the group desire to allow 4P operation below 25W.

4. **We do not need to define pair-to-pair power turn on timing.**
   It would be difficult to control timing if we allow two PSEs driving one cable, for example an endpoint and midspan.

5. **We maintain requirement that if port is to be powered, it is to be powered within 1 second of detection**

6. **We do not allow combining two 802.3af PSE ports onto one cable, for example an endpoint and midspan.**
   This is controversial. We could write the spec to just not disallow it.
   Do we want to allow for example a 26W PD to be powered from either two .af ports or from a single .at port?

7. **Power Management would manage each 2 pair independently.**

DETAILS OF RECOMMENDATION

It would be possible to allow 4-pair systems to operate as 2 totally autonomously 2-pair systems. However there are some problems associated with this architecture detailed as follows:

- Expensive:

Point #1) Even if PD is in plastic housing, it must contain two independent and isolated front ends. This includes signature, classification circuit, load isolation (hotswap) switch, and DC/DC converter. If the front ends are not isolated, problems with (top rail) ground leg current balancing can occur if driven from a single PSE. Additionally, ground loop problems can occur if driven from two separate PSEs.

Point #2) If we allow 4-pair PDs to operate within the 2-pair power range we should mandate that the PD must also be designed such that it can be powered by a 2P PSE. Otherwise an interoperability problem will exist. For example, assume $P_{max2pair}$ = 30W, and we allow a 24 watt PD to be operated from a 4P PSE (two 12-watt ports). If we don't mandate that the PD must also be able to operate from a 2P PSE, the user may have a 30W 2P PSE that can not power a 24W PD. In addition, there are problems with the classification. If the 4P PD advertises 12 watts on each port, then a 2P PSE would not be able to power it. This can be fixed by encoding the total power in the classification, but this adds additional complications and the two ports are no longer autonomous. TO AVOID THESE PROBLEMS, I WOULD RECOMMEND THAT 4-PAIR PDs BE RESERVED FOR 4-PAIR POWER LEVELS.

- Power turn-on problems may occur. Because of the time needed to perform detection and classification, there may be a significant difference in turn-on time for two ports used to power one 4-pair PSE. Additionally, the first port may turn off before the second port turns on due to DC disconnect timing (300mS). Note: It would be possible to specify port-to-port turn-on timing requirements. In this case, the ports would no longer operate autonomously.

- The PD must contain advanced *Power Good* circuitry to determine when both ports are fully powered. This power good circuit must know what type of PSE is connected to each port. If two .at PSEs are connected and ready, it can give the green light. However, when many other combinations are connected, it must give the user an indication of a problem. (For example, 1 .af PSE, 2 .af PSEs. 1 .at PSE and 1 .af PSE, 1 .at PSE and 1 broken wire, etc.). If 24 watt 4-pair PSEs are allowed (as in the example above), the power good circuitry must be able to determine if it is powered by a 2P .at PSE or a 4P .at PSE. In this case, it may be difficult to know if it is getting 12 watts or 24W from the 2P PSE. I WOULD SUGGEST WE DISALLOW THE EXAMPLE 24 WATT 4P PSE.

- Will we allow 4-pair .af ports on one cable? This sounds like an easy way for users to up the power using existing hardware. But if we allow the use of a Y cable to combine two .af ports onto a single cable, the differences in wiring within the installed base will make for an interoperability nightmare. I RECOMMEND AGAINST THIS.

- System administration will not have good visibility as to what is plugged into system.