This application note is to aid customers implementing fully compliant power negotiation using the Data Link Layer (DLL) when using a Silvertel powered device (PD) module and require more than 13W of power. This is an extension of the information provided in ANX-POE-AT-Detect-v1-0.

The IEEE802.3at specification has two mechanisms for negotiation of power supplied by the PSE. Layer 1 classification refers to physical layer classification (hardware) and Layer 2 refers to the DLL classification (software). Most PSEs' only use the physical layer classification (or can be manually setup) and although many manufacturers of PD products choose not to implement the DLL, a Type 2 PD product is only allowed a '2-Event' (physical layer classification) with DLL classification.

The physical layer classification consists of 1 or 2 events produced by the Power Sourcing Equipment (PSE). One event either means that the PSE is only type 1 and can only provide 15.4W, or that it requires the DLL to provide more power. Two events indicates to the PD that the PSE is type 2 and capable of providing 30W. Most PSEs' at this point will provide 30W immediately, however some require the DLL negotiation before allowing more than 15.4W to be drawn. Our modules manage the physical layer classification and produce a flag on the AT-Detect pin that the customer can use that indicates 2 events have occurred.

The DLL classification consists of sending information over the Ethernet link between the PSE and PD. Silvertel's PD modules provide the physical layer classification (Class 4) to the PSE but do not have the hardware to interface over the Ethernet data layer. If the customer uses a PSE that requires the DLL to provide more than 15.4W then they will have to implement the DLL in their controller's network software. The following information is to help guide and explain how to implement the DLL classification for a PD but it's up to the end user to ensure that the Layer 2 protocol is followed and conforms to the IEEE specification. For full details please refer to Section 33.6 and 79.3.2 of the IEEE802.3at standard and IEEE802.1AB standard.

DLL classification Procedure

The basic procedure for DLL classification is:

- The PSE completes signature and physical classification and applies power to the PD
- The PD powers up limiting its load to less than 13W
- PD receives LLDP frame from the PSE within 10 seconds of power up (if no LLDP is received and at-flag is set from the 2 event physical layer classification, the load limit can be removed at this point and skip LLDP negotiation. If no at-flag is set the PSE must be type 1 and the power limit cannot be removed.

- If it is received the PD checks the TLV info by checking for type 2 PSE in the type/source/priority field of the received LLDPDU, bit 7 and 6 should read "00" (see DLL data format section)

- The PD sends response with requested power level (in both allocated and requested field) within 5 minutes of power up. (This time allows for any initialisation time in the PD).

- PSE should then respond with updated TLV with the new allocated power.

- PD checks response. If allocated power is equal to the requested power then the power limit can be removed.

It is also possible to dynamically request new power requirements when in the normal running state. For example an IP camera that at night might need 25W for powering the camera and IR lights but only needs 15W in the day when the light is off and therefore power management can be achieved by helping the PSE optimise its power allocation. The PD could reduce its requested power during the day and request an increase at night by using the following process:

For power increase:

- The PD sends a TLV with a new PD requested power value.

- When the PD receives a TLV from the PSE with an updated PSE allocated power value, the load can be increased.

For power reduction:

- The PD load is reduced to the new level

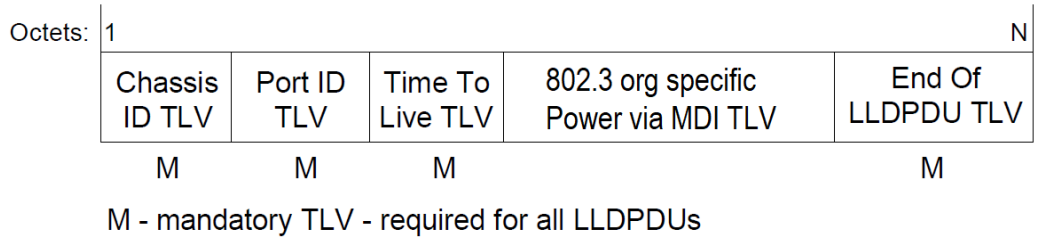
- The PD sends a TLV with a new PD requested power value.

- The PD should check it receives the TLV from the PSE with an updated PSE allocated power value.

DLL data format

The DLL classification is completed using Ethernet frames with ethtype of LLDP (0x88CC). The source address for the frame should be set to the MAC of the transmitting station and destination address should be one of the LLDP_broadcast addresses or the actual mac address of the destination station. We would suggest it is set to "01-80-C2-00-00-0E" this will only be propagated over 1 link to the PSE.

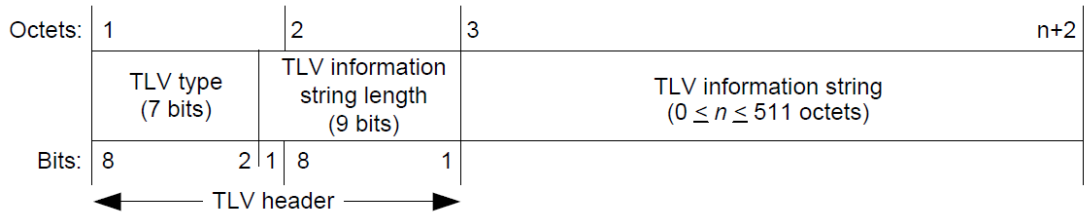
The frame payload will be a LLDPDU that contains the IEEE802.3 Organizationally Specific TLV Power via MDI to complete the DLL classification and conform to all mandatory parts of IEEEStd802.1AB. This means that the LLDPDU shall take the following form:



Note additional optional TLVs can also be included.

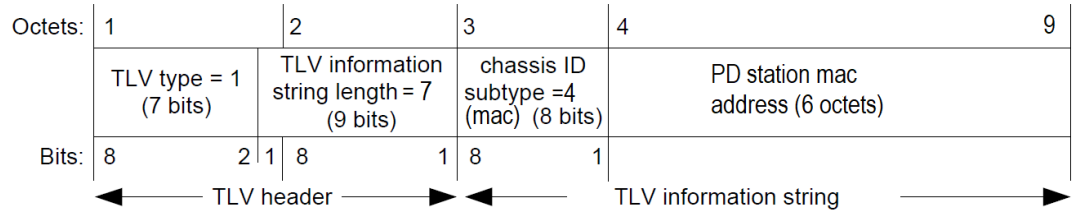
To follow the requirements of LLDP the system will regularly repeat the LLDPDU to keep the information stored in the PSE up to date. It is normal for this to be repeated 2-4 times per "time to live" time given in the LLPDDU.

The basic TLV format is as follows:

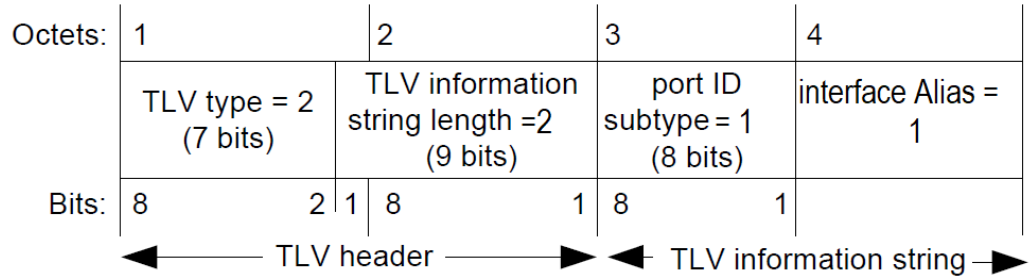


The mandatory TLVs formats and definitions can be found in section 8.5 of the IEEE Std 802.1AB and the IEEE802.3 Organizationally Specific Power via MDI TLV format as defined in IEEE802.3AT section 79.3.2. A basic example of them that could be used by the PD is:

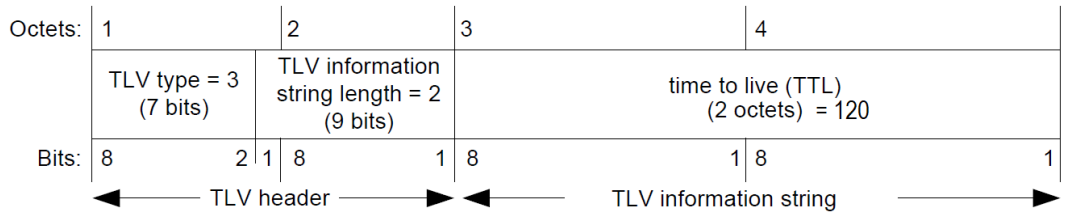
Chassis ID



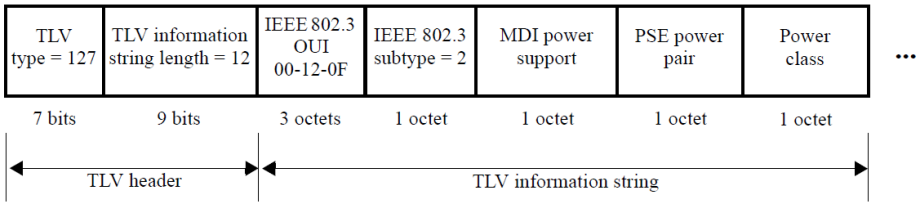
Port ID

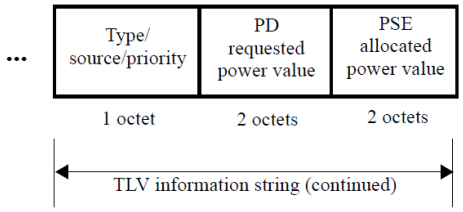


Time To Live



IEEE802.3 Organizationally Specific Power via MDI TLV.
This TLV contains all the DLL negotiation. It takes the following format:





- The length of this TLV is fixed and the first 4 octets are fixed.
- MDI power support which can be set to 0x00 for a PD
- PSE power pair which can be set to 0x00 for a PD
- Power class is set to 5 (class 4) to indicate you want more than 13W
- type/source/priority will be set according to the following table:

Bit	Function	Value/meaning
7:6	power type	7 6 0 1 = Type 2 PD
5:4	power source	Where power type = PD 5 4 1 1 = PSE and local 1 0 = Reserved 0 1 = PSE 0 0 = Unknown
3:2	Reserved	Transmit as zero, ignore on receive
1:0	power priority	1 0 1 1 = low 1 0 = high 0 1 = critical 0 0 = unknown (default)

- PD requested power value and PSE allocated power value are used to set and negotiate the power level provided by the PSE. These values are modified during the negotiation process and the following formula can be used to determine the value.

Power = {0.1 · *X*}W
Where X is the decimal value of the bits in each of the two fields. The max value of the two fields is 255 equating to 25.5W requested by the PD.

The PD should have both the requested and allocated fields set to the desired power for the first LLDP transmission. After which it will echo the last received "PSE allocated power" from the PSE.

End of LLDPDU

Octets:	1		2
	TLV type = 0		TLV information string length = 0
Bits:	8 2	1	8 1