LLDP Extensions v120

Lennart Yseboodt, Matthias Wendt
Philips Research
September 10, 2015

innovation + you

PHILIPS

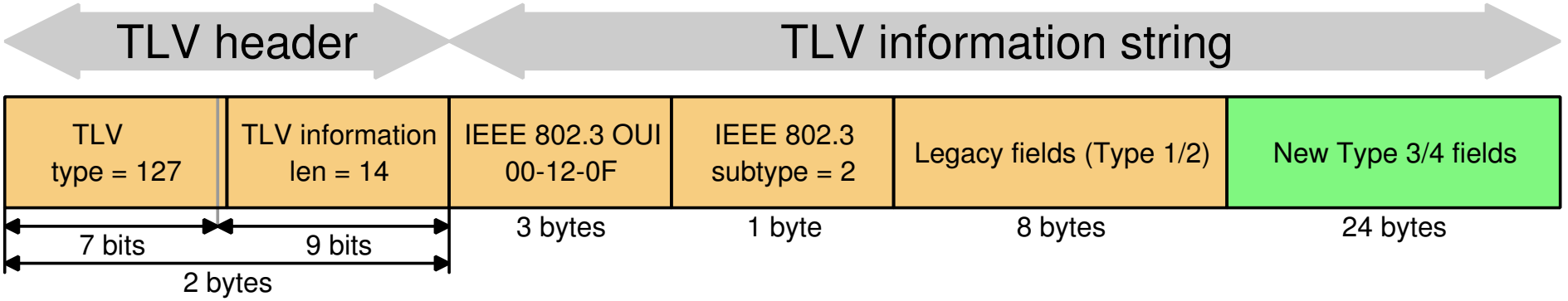
Overview

These slides explain new LLDP capabilities & technical details of how they will work.

1. **Maximum available power**
   PSE can indicate the maximum power it can grant through LLDP.
2. **Autoclass LLDP**
   Using LLDP to trigger a new Autoclass cycle, allows a PD to change maximum power consumption. In addition it enables Autoclass for PSEs or PDs that cannot meet the physical layer Autoclass requirements.
3. **Power down**
   Allow a PD to request power-down by means of LLDP. This can be used to reboot the PD completely or indicate power is no longer desired.
4. **Synchronized measurements**
   PSE/PD measurements of voltage, current and energy with rudimentary synchronization.

PHILIPS

Where does this fit?



New fields will be appended after the 8 legacy bytes needed for the Type 1/2 'Power via MDI' fields.

PHILIPS

Maximum available power

Purpose: This allows PSEs to indicate how much power it is able to grant via LLDP, taking hardware capability and available power budget into account. This is useful to indicate power capability beyond 90W or in case the PSE is oversubscribed and in power management mode.

Bit	Function	Value/Meaning
15:0	PSE available power	Power = 0.1 × (decimal value of bits) Watts. Valid values for these bits are decimal 1 through 999.

It is also possible to use the existing 'PD Requested Power' field for this purpose. This field would then be written by the PSE on an outgoing LLDPDU.

PHILIPS

Autoclass

Purpose: PDs may want to trigger Autoclass for a number of reasons.

- The PD is reconfigured in a way that impacts maximum power consumption (feature unlocked, driver current reconfigured, …)
- The PD cannot boot fast enough to meet Autoclass timing requirements
- The PD is not equipped to perform physical layer Autoclass

Autoclass requires synchronization between the PSE and PD:

- The PSE must know when the PD is in a mode where it consumes maximum power to take the measurement
- The PD must know when the PSE has concluded the measurement and it may move on to a different power state

PHILIPS

Autoclass procedure

A few Autoclass field bits can be used by the PD to request the PSE to perform Autoclass. Two bits are required: `request_autoclass` and `completed_autoclass`, default value 0. The sequence of events is:

1. (Optional) PD uses LLDP to negotiate for higher power if desired power level > current allocated power
2. PD switches to a mode where maximum power is consumed
3. PD sends LLDP frame with `request_autoclass=1` set
4. PSE sees the frame with `request_autoclass=1` and performs the measurement and budget reduction
5. PSE sends LLDP frame with `completed_autoclass=1` set
6. PD receives LLDP frame with `completed_autoclass=1` and sets `request_autoclass=0`
7. PSE receives LLDP frame with `request_autoclass=0` and sets `completed_autoclass=0`

PHILIPS

Autoclass LLDP

Bit	Function	Value/Meaning
7:3	Reserved	Transmit as zero. Ignore on receive.
2	PSE Autoclass support	1 = PSE supports Autoclass 0 = PSE does not support Autoclass
1	Autoclass completed	1 = Autoclass measurement completed 0 = Autoclass idle
0	Autoclass request	1 = PD requests Autoclass measurement 0 = Autoclass idle

Bits 2 and 1 are set and cleared by the PSE. Bit 0 is set and cleared by the PD.

PHILIPS

Power down

Purpose: PDs may want perform a full power cycle, or indicate they no longer need power.

Bit	Function	Value/Meaning
7:0	power down	Value = 0xDD triggers a power down. Any other value is ignored.

A magic number of 8 bits is used here to prevent accidental reboot/power cycles in case of a software bug or transmission error.

PHILIPS

Measurements

Purpose: Exchanging basic measurements allows PSE and PD to learn about link conditions to optimize power management. Exchanged information should include port voltage, port current and energy consumed since power up.

See zhuang_02_0715.pdf and zhuang_03_0715.pdf for current status.

PHILIPS

Measurement - proposed changes

An extension is proposed to add synchronization to these measurements. Without synchronization:

- The PSE and PD would be required to send out a new LLDPU every time any of the measurements change
- The receiving device would not know how old the received measurement is
- Basic synchronization gives a device the chance to learn that a measurement was taken after a request

The current scheme does not support dual-signature PDs, or energy measurement, this is also addressed.

Energy measurement

Having energy measurement data by the PSE is useful for several applications:

- Applications that would use this data to bill for energy consumed
- Allows PSE/PD to learn about its own consumption without needing to transfer continuous measurements

The measurement data is transmitted as a 32 bit integer, expressed in Watt $\cdot$ minutes. This allows sufficient dynamic range:

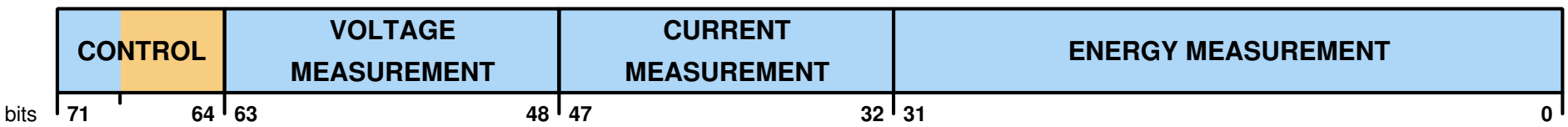
- At 100W continuous consumption, overflow only happens after $2^{32}/(100 \cdot 60 \cdot 24 \cdot 365) = 81.7$ years
- Precision for energy billing is possible at a resolution of $1/60000^{\text{th}}$ of the price of 1 kWh

Energy is measured from the moment power is applied to the PI.

Measurements Overview

PSE Measurements

PD Measurements



Written by PSE Written by PD

There are two measurement fields, one for PD and one for PSE. The control byte of the PSE measurements field is set by the PD to indicate which measurements it wants. The PSE fills out the measurement data in the PSE measurements field. For the PD it is visa versa.

PHILIPS

Measurements definition PSE

Bit	Function	Value/Meaning
71	Voltage support	1 = PSE supports voltage measurement 0 = PSE does not support voltage measurement
70	Current support	1 = PSE supports current measurement 0 = PSE does not support current measurement
69	Energy support	1 = PSE supports energy measurement 0 = PSE does not support energy measurement
68:67	Measurement source	Determine where the measurement is to be taken. 0 0 = No request 0 1 = Pairset Alternative A 1 0 = Pairset Alternative B 1 1 = Port total
66	Voltage request	Request voltage measurement
65	Current request	Request current measurement
64	Energy request	Request energy measurement

PHILIPS

Measurements definition PSE (2)

Bit	Function	Value/Meaning
63:48	Voltage measurement	V_{Port_PSE} = (decimal value of bits) mV. Valid values for these bits are decimal 0 through 57000.
47:32	Current measurement	I_{Port} or $I_{Port\text{-}2P}$ = 0.1 × (decimal value of bits) mA. Valid values for these bits are decimal 0 through 20000.
31:0	Energy measurement	Total energy delivered to the port or pairset = (decimal value of bits) in W · minutes since power on.

Measurement values (voltage, current or energy) are to be set to 0 in case the corresponding request bit is 0. If a device does not support a measurement, the corresponding measurement value must always be set to 0.

PHILIPS

Measurements definition PD

Bit	Function	Value/Meaning
71	Voltage support	1 = PD supports voltage measurement 0 = PD does not support voltage measurement
70	Current support	1 = PD supports current measurement 0 = PD does not support current measurement
69	Energy support	1 = PD supports energy measurement 0 = PD does not support energy measurement
68:67	Measurement source	Determine where the measurement is to be taken. 0 0 = No request 0 1 = Pairset Alternative A 1 0 = Pairset Alternative B 1 1 = Port total
66	Voltage request	Request voltage measurement
65	Current request	Request current measurement
64	Energy request	Request energy measurement

PHILIPS

Measurements definition PD (2)

Bit	Function	Value/Meaning
63:48	Voltage measurement	V_{Port_PD} = (decimal value of bits) mV. Valid values for these bits are decimal 0 through 57000.
47:32	Current measurement	I_{Port} or $I_{Port\text{-}2P}$ = 0.1 × (decimal value of bits) mA. Valid values for these bits are decimal 0 through 20000.
31:0	Energy measurement	Total energy consumed at the port or pairset = (decimal value of bits) in W · minutes since power on.

Measurement values (voltage, current or energy) are to be set to 0 in case the corresponding request bit is 0. If a device does not support a measurement, the corresponding measurement value must always be set to 0.

PHILIPS

Dual Signature with Unequal Classes

Replace Figure 79-3 with the following:

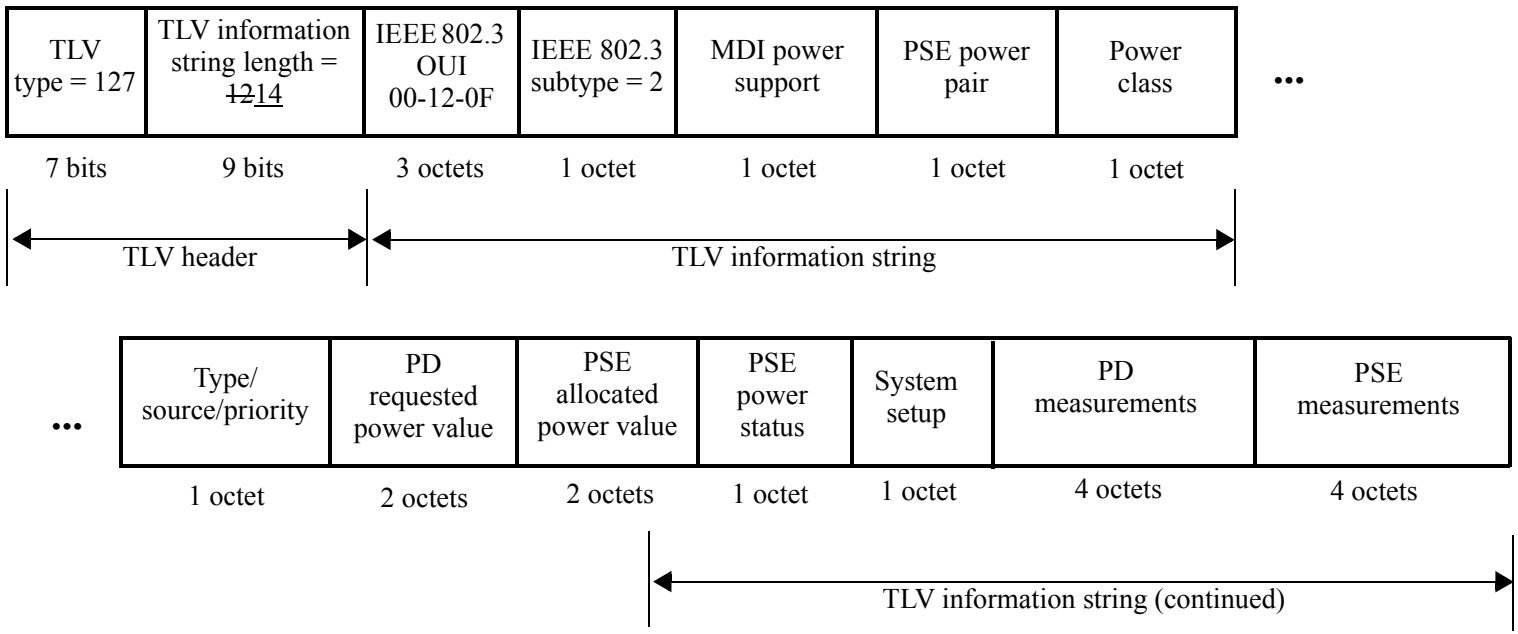
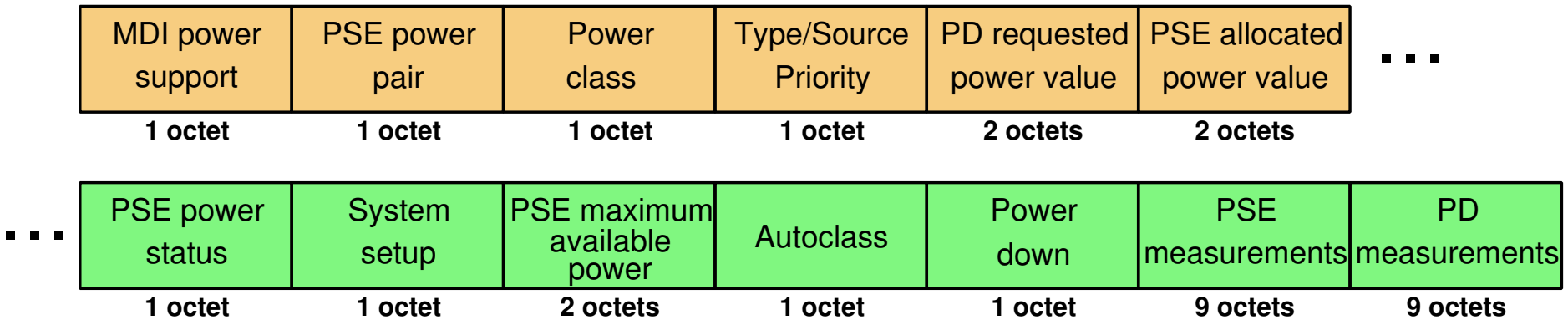


Figure 79–3—Power Via MDI TLV format

This is the current (Draft 1.2) LLDP format. It does not support Dual-Signature PDs with unequal classes on each pairset.

PHILIPS

Overview



This diagram shows the `Power via MDI fields' in the order in which they occur. The new Type 3/4 fields are appended after the legacy Type 1/2 fields.

PHILIPS


PHILIPS