145.1 Overview

Info: not part of baseline
This introductory (informative) text creates a link between the PoE system described in Clause 33 and the one described here in Clause 145.

This clause defines the functional and electrical characteristics for providing an enhancement of the Power over Ethernet (PoE) system defined in Clause 33 for deployment over balanced twisted-pair cabling. This includes the capability to provide power over 4 pairs while maintaining compatibility with equipment designed in accordance to Clause 33. The system consists of two optional power (non-data) entities, a Powered Device (PD) and Power Sourcing Equipment (PSE), for use with the MAU defined in Clause 14 and the PHYs defined in Clause 25, Clause 40, Clause 55, and Clause 126. These entities allow devices to draw/supply power using the same generic cabling as is used for data transmission.

Info: not part of baseline
Introduction of PSE and PD types needs to be moved here from 145.1.3. Editorial comment #197 from Fred also addressed. (.. without a Type)

PSEs and PDs are categorized by Type. This Clause specifies Type 3 and Type 4 devices and their interaction with Type 1 and Type 2 devices. References in this clause to PSEs and PDs without a Type qualifier refer exclusively to Type 3 and Type 4 devices. See Clause 33 for the specification of Type 1 and Type 2 devices.

This clause uses several terms defined in 1.4 .

Info: not part of baseline
Lennart's proposal: we need at the beginning of Clause 145 (and possible in Clause 33 as well) something like (right after the second paragraph): *Type 1, Type 2, Type 3, and Type 4 PSEs fully interoperate with Type 1, Type 2, Type 3, and Type 4 PDs. The only limitation being that some PDs may not receive their requested amount of power when connected to a lower Type PSE, they can then optionally operate in a reduced power mode.* My comment: - We also need the symmetrical sentence for the PDs Sentence to be introduced in the PSE section when describing PSE Types: *Type 1, Type 2, Type 3, and Type 4 PSEs interoperate with Type 1, Type 2, Type 3, and Type 4 PDs. The only limitation being that some PDs may not receive their requested amount of power when connected to a lower Type PSE. The PD may then operate in a reduced power mode.* A symmetrical sentence will be introduced in the PD section when describing PD Types

Info: not part of baseline

Waiting for resolution of #408, #409, #22, and #81 *(4-pair) Power over Ethernet* replaces *DTE powering*

PSE replaces *power source*

Power over Ethernet ~~DTE powering~~ is intended to provide a 10BASE-T, 100BASE-TX, 1000BASE-T, 2.5GBASE-T, 5GBASE-T, or 10GBASE-T device with a single interface to both the data it requires and the power to process this data.

This clause specifies the following:

a) A ~~power source~~PSE to add power to the 100 Ω~~□□□~~balanced cabling system

b) The characteristics of a PD's load on the ~~power source~~PSE and the structured cabling

c) A protocol allowing the detection of a PD that requests power from a PSE

d) Methods to classify PDs based on their power needs

e) A method for PDs and PSEs to dynamically negotiate and allocate power

f) A method for scaling supplied power back to the detect level when power is no longer requested or required

Info: not part of baseline

A power system can be made of PSEs and PD of any type, including Type 1 and Type2, so it needs to be stated here.

The sentence *PSEs and PDs are categorized by Type* was moved to 145.1.

145.1.3 System parameters

A power system consists of a single PSE, a single PD, and the link section connecting them. PSEs and PDs may be of a Type defined in Clause 33, Clause 145, or a combination of both. ~~PSEs and PDs are categorized by Type.~~ The power system has certain basic parameters defined according to Table 145–1. These parameters define not only certain performance characteristics of the system, but are also used in calculating the various electrical characteristics of PSEs and PDs as described in 145.2 and 145.3.

145.2 Power sourcing equipment (PSE)

The PSE is the portion of the end station or midspan equipment that provides the power to a single PD. The PSE's main functions are as follows:

— to search the link section for a PD

— to supply power to the detected PD through the link section

— to monitor the power on the link section

— to remove power when no longer requested or required, returning to the searching state.

An unplugged link section is one instance when power is no longer required.

In addition, power classification mechanisms exist to provide the PSE with detailed information regarding the power needs of the PD.

A PSE is electrically specified at the point of the physical connection to the cabling.

Info: not part of baseline

First sentence: see comment #35 from David Abramson. Additionally, PSE Type description is not complete without an informative reference to Type1 and Type2 PSE. The second sentence text addresses interoperability between PSEs and PDs of any Type.

145.2.1 PSE Type descriptions

PSEs can be categorized as ~~either~~ Type 1, Type 2, Type 3, or Type 4 PSEs. See 33.2 for the specification of Type 1 and Type 2 PSEs.,

Type 1, Type 2, Type 3, and Type 4 PSEs interoperate with Type 1, Type 2, Type 3, and Type 4 PDs. The only limitation being that some PDs may not receive their requested amount of power when connected to a lower Type PSE. The PD may then operate in a reduced power mode.

Info: not part of baseline

Type1 and Type 2 PSEs are also permissible, just not described in this clause, so the table needs to be renamed.

See also #335 from Lennart for addition in the footnote. Wait resolution of TFTD comments #219, #171

Table 145–2 summarizes the ~~permissible~~ PSE ~~Types along with~~ supported parameters.

Table 145–2—~~Permissible~~ PSE ~~Types~~ supported parameters

PSE Type	Supports 4-pair power	Range of maximum Class supported[a]	Short MPS support[b]	Physical Layer Classification[a]	Data Link Layer Classification[a]	Autoclass[c]
Type 3	Optional	Class 3 to 4	Yes	Multiple-Event	Optional	Optional
Type 3	Yes	Class 5 to 6	Yes	Multiple-Event	Optional	Optional
Type 4	Yes	Class 8	Yes	Multiple-Event	Optional	Optional

[a]See 145.2.7, Table 145–11 and Table 145-12
[b]See 145.2.10
[c]See 145.2.7.2 and 145.3.6.2

145.2.6.5 Rejection criteria

The PSE shall reject a pairset within a link section as having an invalid signature, when the pairset exhibits any of the following characteristics as specified in Table 145–10:

a) Resistance less than or equal to R_{bad} min, or

b) Resistance greater than or equal to R_{bad} max, or

c) Capacitance greater than or equal to C_{bad} min.

Info: not part of baseline

Detection and rejection criteria are the same for PSEs of any Type. It was certainly true when the clause was one. With the clause split it is a precise choice which ensures interoperability. It deserves to be pointed out.

Heath' comment: *(this note) does not give due attention to the new connection check requirements*. Better text is welcome.

Note: Detection and rejection criteria for Clause 145 remain unchanged from Clause 33, therefore ensuring interoperability with Clause 33 devices (see also 145.2.6.4).

A PSE may accept or reject a signature resistance in the band between R_{good} min and R_{bad} min, and in the band between R_{good} max and R_{bad} max. A PSE may accept or reject a parallel signature capacitance in the band between C_{good} max and C_{bad} min. In instances where the resistance and capacitance meet the detection criteria, but one or both of the offsets are exceeded, the detection behavior of the PSE is undefined.

145.3 Powered devices (PDs)

A PD is the portion of a device that is either drawing power or requesting power by participating in the PD detection algorithm. A device that is capable of becoming a PD may have the ability to draw power from an alternate power source. A PD requiring power from the PI may simultaneously draw power from an alternate power source. PD capable devices that are neither drawing nor requesting power are also covered in this subclause. A PD is specified at the point of the physical connection to the cabling. Characteristics such as the losses due to voltage correction circuits, power supply inefficiencies, separation of internal circuits from external ground or other characteristics induced by circuits after the PI connector are not specified. Limits defined for the PD are specified at the PI, not at any point internal to the PD, unless specifically stated.

Info: not part of baseline
Comment #373 from Lennart: swap the order of 145.3.2 and 145.3.1

~~145.3.1~~ 145.3.2 **PD PI**

PDs shall be capable of accepting power on either pairset and on both pairsets. The two pairsets are named Mode A and Mode B. In each four-wire connection, the two wires associated with a pair are at the same nominal average voltage. Figure 145–12 in conjunction with Table 145–18 illustrates the two power modes.

Info: not part of baseline
Comment #96 from Chris added on either mode Also waiting for resolution of TFTD comment #374

The PD shall be implemented to be insensitive to the polarity of the power supply on either mode. Single-signature PDs with a power demand lower or equal to Class 4 power shall be able to operate per the PD Mode A column and the PD Mode B column in Table 145–18. All other PDs may require being supplied over Mode A and Mode B simultaneously to operate at their nominal power level.

Info: not part of baseline
The following sentence is symmetrical to the one in 143.2 related to PSEs. Here PDs are the subject.

PDs interoperate with Type 1, Type 2, Type 3, and Type 4 PSEs. Depending on the PSE Type and powering capabilities, a PD may not receive its requested amount of power. The PD may operate in a reduced power mode in that case.

Info: not part of baseline

Same as before for the PSE - Type1 and Type 2 PDs are also permissible, just not described in this clause, so the table needs to be renamed . Also waiting for resolution of comments #376, #160,

~~145.3.2~~ 145.3.1 PD Type descriptions

PDs can be categorized as either Type 1, Type 2, Type 3, or Type 4. See 33.3 for the specification of Type 1 and Type 2 PDs. PDs can be constructed as single-signature or dual-signature as defined in 1.4 and 145.3.5 and shown in Table 145–19. Table 145–19 shows the ~~permissible~~ PD ~~Types along with~~ supported parameters.

Table 145–19—~~Permissible~~ PD ~~Types~~ supported parameters

PD Type	Single- or dual-signature	PD Class	4-pair Capable	Short/Long MPS support	Physical Layer Classification	Data Link Layer Classification	Optional Capabilities
Type 3	Single	1 to 3	Mandatory	Both	Multiple-Event	Optional	Autoclass
		4 to 6	Mandatory	Both	Multiple-Event	Mandatory	Autoclass
	Dual	1 to 4	Mandatory	Both	Multiple-Event	Mandatory	—
Type 4	Single	7 to 8	Mandatory	Both	Multiple-Event	Mandatory	Autoclass
	Dual	5	Mandatory	Both	Multiple-Event	Mandatory	—

NOTE—See Table 145–24 and Table 145–25 for the allowed PD power for each Type and Class.