



**IEEE Standard for
Information technology—
Telecommunications and information
exchange between systems—
Local and metropolitan area networks—
Specific requirements**

**Part 3: Carrier Sense Multiple Access with
Collision Detection (CSMA/CD) Access Method
and Physical Layer Specifications**

**Amendment 3: Data Terminal Equipment (DTE)
Power via the Media Dependent Interface (MDI)
Enhancements**

IEEE Computer Society

Sponsored by the
LAN/MAN Standards Committee

IEEE
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IEEE Std 802.3atTM-2009
(Amendment to
IEEE Std 802.3TM-2008)

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of the
IEEE Computer Society**

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Abstract: This amendment includes changes to IEEE Std 802.3-2008 to augment the capabilities of IEEE Std 802.3 with higher power levels and improved power management information.

Keywords: Data Link Layer classification, MPS, PD, PI, POE+, power, Power over Ethernet plus, PSE, Type 1, Type 2

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Introduction

This introduction is not part of IEEE Std 802.3at-2009, IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements, Part 3: CSMA/CD Access Method and Physical Layer Specifications, Amendment 3: Data Terminal Equipment (DTE) Power via the Media Dependent Interface (MDI) Enhancements.

IEEE Std 802.3™ was first published in 1985. Since the initial publication, many projects have added functionality or provided maintenance updates to the specifications and text included in the standard. Each IEEE 802.3 project/amendment is identified with a suffix (e.g., IEEE Std 802.3at-2009).

The Media Access Control (MAC) protocol specified in IEEE Std 802.3 is Carrier Sense Multiple Access with Collision Detection (CSMA/CD). This MAC protocol was included in the experimental Ethernet developed at Xerox Palo Alto Research Center. While the experimental Ethernet had a 2.94 Mb/s data rate, IEEE Std 802.3-1985 specified operation at 10 Mb/s. Since 1985 new media options, new speeds of operation, and new capabilities have been added to IEEE Std 802.3.

Some of the major additions to IEEE Std 802.3 are identified in the marketplace with their project number. This is most common for projects adding higher speeds of operation or new protocols. For example, IEEE Std 802.3u™ added 100 Mb/s operation (also called Fast Ethernet), IEEE Std 802.3x™ specified full duplex operation and a flow control protocol, IEEE Std 802.3z™ added 1000 Mb/s operation (also called Gigabit Ethernet), IEEE Std 802.3ae™ added 10 Gb/s operation (also called 10 Gigabit Ethernet) and IEEE Std 802.3ah™ specified access network Ethernet (also called Ethernet in the First Mile). These major additions are all now included in, and are superseded by, IEEE Std 802.3-2008 and are not maintained as separate documents.

At the date of IEEE Std 802.3at-2009 publication, IEEE Std 802.3 is comprised of the following documents:

IEEE Std 802.3-2008

Section One—Includes Clause 1 through Clause 20 and Annex A through Annex H and Annex 4A. Section One includes the specifications for 10 Mb/s operation and the MAC, frame formats and service interfaces used for all speeds of operation.

Section Two—Includes Clause 21 through Clause 33 and Annex 22A through Annex 33E. Section Two includes management attributes for multiple protocols and speed of operation as well as specifications for providing power over twisted pair cabling for multiple operational speeds. It also includes general information on 100 Mb/s operation as well as most of the 100 Mb/s Physical Layer specifications.

Section Three—Includes Clause 34 through Clause 43 and Annex 36A through Annex 43C. Section Three includes general information on 1000 Mb/s operation as well as most of the 1000 Mb/s Physical Layer specifications.

Section Four—Includes Clause 44 through Clause 55 and Annex 44A through Annex 55B. Section Four includes general information on 10 Gb/s operation as well as most of the 10 Gb/s Physical Layer specifications.

Section Five—Includes Clause 56 through Clause 74 and Annex 57A through Annex 74A. Clause 56 through Clause 67 and associated annexes specify subscriber access and other Physical Layers and sublayers for operation from 512 kb/s to 1000 Mb/s, and defines services and protocol elements that enable the exchange of IEEE Std 802.3 format frames between stations in a subscriber access network.

Clause 68 specifies a 10 Gb/s Physical Layer specification. Clause 69 through Clause 74 and associated annexes specify Ethernet operation over electrical backplanes at speeds of 1000 Mb/s and 10 Gb/s.

IEEE Std 802.3av™-2009

This amendment includes changes to IEEE Std 802.3-2008 and adds Clause 75 through Clause 77 and Annex 75A through Annex 76A. This amendment adds new Physical Layers for 10 Gb/s operation on point-to-multipoint passive optical networks.

IEEE Std 802.3bc™-2009

This amendment includes changes to IEEE Std 802.3-2008 and adds Clause 79. This amendment moves the Ethernet Organizationally Specific Type, Length, Value (TLV) information elements that were specified in IEEE Std 802.1AB to IEEE Std 802.3.

IEEE Std 802.3at-2009

This amendment includes changes to IEEE Std 802.3-2008. This amendment augments the capabilities of IEEE Std 802.3-2008 with higher power levels and improved power management information.

IEEE Std 802.3 will continue to evolve. New Ethernet capabilities are anticipated to be added within the next few years as amendments to this standard.

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Special symbols and operators

Printed character	Meaning	Font
*	Boolean AND	Symbol
+	Boolean OR, arithmetic addition	Symbol
^	Boolean XOR	Times New Roman
!	Boolean NOT	Symbol
×	Multiplication	Symbol
<	Less than	Symbol
≤	Less than or equal to	Symbol
>	Greater than	Symbol
≥	Greater than or equal to	Symbol
=	Equal to	Symbol
≠	Not equal to	Symbol
←	Assignment operator	Symbol
∈	Indicates membership	Symbol
∉	Indicates nonmembership	Symbol
±	Plus or minus (a tolerance)	Symbol
°	Degrees	Symbol
Σ	Summation	Symbol
√	Square root	Symbol
—	Big dash (em dash)	Times New Roman
–	Little dash (en dash), subtraction	Times New Roman
	Vertical bar	Times New Roman
†	Dagger	Times New Roman
‡	Double dagger	Times New Roman
α	Lower case alpha	Symbol
β	Lower case beta	Symbol
γ	Lower case gamma	Symbol
δ	Lower case delta	Symbol
ε	Lower case epsilon	Symbol
λ	Lambda	Symbol
μ	Micro	Times New Roman
Ω	Omega	Symbol

Contents

1.	Introduction.....	2
1.3	Normative references.....	2
1.4	Definitions	2
25.	Physical Medium Dependent (PMD) sublayer and baseband medium, type 100BASE-TX.....	3
25.4	Specific requirements and exceptions.....	3
25.4.4a	Change to 9.1.7, “Worst case droop of transformer”.....	3
25.4.4a.1	Equivalent system time constant.....	3
25.4.5a	Addition to 10.1, “Receiver”	4
25.5	Protocol implementation conformance statement (PICS) proforma for Clause 25, Physical Medium Dependent (PMD) sublayer and baseband medium, type 100BASE-TX5	
25.5.3	Major capabilities/options.....	5
25.5.3.1	DTE Power via MDI major capabilities/options	5
25.5.4	PICS proforma tables for the Physical Medium Dependent (PMD) sublayer and baseband medium, type 100BASE-TX5	
25.5.4.4	DTE Power via MDI compliance	5
30.	Management.....	7
30.2	Managed objects	7
30.2.2	Overview of managed objects.....	7
30.2.2.1	Text description of managed objects	7
30.2.3	Containment.....	7
30.2.5	Capabilities	9
30.9	Management for DTE Power via MDI Sourcing Equipment (PSE).....	13
30.9.2	PD managed object class	14
30.9.2.1	PD attributes	14
30.9.2.1.1	aPDID	14
30.12.2	LLDP Local System Group managed object class	14
30.12.2.1	LLDP Local System Group attributes	14
30.12.2.1.14a	LldpXdot3LocPowerType	14
30.12.2.1.15a	LldpXdot3LocPowerSource.....	14
30.12.2.1.16a	LldpXdot3LocPowerPriority	14
30.12.2.1.17a	LldpXdot3LocPDRequestedPowerValue	15
30.12.2.1.18a	LldpXdot3LocPSEAllocatedPowerValue.....	15
30.12.2.1.19a	LldpXdot3LocResponseTime	15
30.12.2.1.20a	LldpXdot3LocReady.....	16
30.12.2.1.21a	LldpXdot3LocReducedOperationPowerValue	16
30.12.3	LLDP Remote System Group managed object class	16
30.12.3.1	LLDP Remote System Group attributes	16
30.12.3.1.14a	LldpXdot3RemPowerType	16
30.12.3.1.15a	LldpXdot3RemPowerSource	16
30.12.3.1.16a	LldpXdot3RemPowerPriority	17
30.12.3.1.17a	LldpXdot3RemPDRequestedPowerValue	17
30.12.3.1.18a	LldpXdot3RemPSEAllocatedPowerValue	17
33.	Data Terminal Equipment (DTE) Power via Media Dependent Interface (MDI).....	19
33.1	Overview.....	19

33.1.1	Objectives	19
33.1.2	Compatibility considerations	20
33.1.3	Relationship of DTE Power via MDI to the IEEE 802.3 Architecture.....	20
33.1.4	Type 1 and Type 2 system parameters.....	21
33.1.4.1	Type 2 cabling requirement	22
33.1.4.2	Type 1 and Type 2 channel requirement	22
33.2	Power sourcing equipment (PSE)	22
33.2.1	PSE location.....	22
33.2.2	Midspan PSE types	23
33.2.3	PI pin assignments	28
33.2.4	PSE state diagrams.....	29
33.2.4.1	Overview	29
33.2.4.2	Conventions	29
33.2.4.3	Constants.....	29
33.2.4.4	Variables	29
33.2.4.5	Timers	33
33.2.4.6	Functions.....	33
33.2.4.7	State diagrams	35
33.2.5	PSE detection of PDs.....	37
33.2.5.1	PSE detection validation circuit.....	37
33.2.5.2	Detection probe requirements	39
33.2.5.3	Detection criteria.....	39
33.2.5.4	Rejection criteria.....	40
33.2.5.5	Open circuit criteria	40
33.2.6	PSE classification of PDs and mutual identification	40
33.2.6.1	PSE 1-Event Physical Layer classification	42
33.2.6.2	PSE 2-Event Physical Layer classification	43
33.2.7	Power supply output	45
33.2.7.1	Output voltage in the POWER_ON state	46
33.2.7.2	Voltage transients	46
33.2.7.3	Power feeding ripple and noise.....	47
33.2.7.4	Continuous output current capability in the POWER_ON state.....	47
33.2.7.5	Output current in POWER_UP mode.....	47
33.2.7.6	Overload current	48
33.2.7.7	Output current—at short circuit condition.....	48
33.2.7.8	Turn off time	50
33.2.7.9	Turn off voltage	50
33.2.7.10	Continuous output power capability in POWER_ON state.....	50
33.2.7.11	Current unbalance	50
33.2.7.12	Power turn on time.....	51
33.2.7.13	PSE stability.....	51
33.2.8	Power supply allocation.....	51
33.2.9	PSE power removal	51
33.2.9.1	PSE Maintain Power Signature (MPS) requirements	51
33.2.9.1.1	PSE AC MPS component requirements	51
33.2.9.1.2	PSE DC MPS component requirements	52
33.3	Powered devices (PDs)	53
33.3.1	PD PI.....	53
33.3.2	PD type descriptions	54
33.3.3	PD state diagram	54
33.3.3.1	Conventions	54
33.3.3.2	Constants.....	55
33.3.3.3	Variables	55
33.3.3.4	Timers	56

33.3.3.5	State diagrams	57
33.3.4	PD valid and non-valid detection signatures	58
33.3.5	PD classifications.....	60
33.3.5.1	PD 1-Event class signature	60
33.3.5.2	PD 2-Event class signature	61
33.3.5.2.1	Mark Event behavior	61
33.3.6	PSE Type identification	61
33.3.7	PD power	62
33.3.7.1	Input voltage	63
33.3.7.2	Input average power.....	63
33.3.7.2.1	System stability test conditions during startup and steady state operation.....	63
33.3.7.3	Input inrush current.....	64
33.3.7.4	Peak operating power.....	64
33.3.7.5	Peak transient current.....	65
33.3.7.6	PD behavior during transients at the PSE PI	66
33.3.7.7	Ripple and noise.....	66
33.3.7.8	PD classification stability time	67
33.3.7.9	Backfeed voltage.....	67
33.3.8	PD Maintain Power Signature	67
33.4	Additional electrical specifications.....	67
33.4.1	Isolation	68
33.4.1.1	Electrical isolation environments.....	68
33.4.1.1.1	Environment A requirements.....	68
33.4.1.1.2	Environment B requirements	68
33.4.2	Fault tolerance.....	69
33.4.3	Impedance balance.....	69
33.4.4	Common-mode output voltage	70
33.4.5	Pair-to-pair output noise voltage.....	72
33.4.6	Differential noise voltage.....	73
33.4.7	Return loss	73
33.4.8	100BASE-TX transformer droop.....	73
33.4.9	Midspan PSE device additional requirements	74
33.4.9.1	“Connector” or “telecom outlet” Midspan PSE device transmission requirements	76
33.4.9.1.1	Near End Crosstalk (NEXT).....	76
33.4.9.1.2	Insertion loss	76
33.4.9.1.3	Return loss	76
33.4.9.1.4	Work area or equipment cable Midspan PSE	77
33.4.9.2	Midspan signal path requirements	77
33.4.9.2.1	Alternative A Midspan PSE signal path transfer function	77
33.5	Management function requirements	78
33.5.1	PSE registers	78
33.5.1.1	PSE Control register (Register 11) (R/W)	78
33.5.1.1.1	Reserved bits (11.15:6)	79
33.5.1.1.2	Data Link Layer Classification Capability (11.5).....	79
33.5.1.1.3	Enable Physical Layer Classification (11.4).....	79
33.5.1.1.4	Pair Control (11.3:2).....	80
33.5.1.1.5	PSE enable (11.1:0)	80
33.5.1.2	PSE Status register (Register 12) (R/W).....	80
33.5.1.2.1	PSE Type Electrical Parameters (12.15).....	81
33.5.1.2.2	Data Link Layer Classification Enabled (12.14)	81
33.5.1.2.3	Physical Layer Classification Supported (12.13)	82

	33.5.1.2.4	Power Denied or Removed (12.12)	82
	33.5.1.2.5	Valid Signature (12.11)	82
	33.5.1.2.6	Invalid Signature (12.10)	82
	33.5.1.2.7	Short Circuit (12.9)	82
	33.5.1.2.8	Overload (12.8)	82
	33.5.1.2.9	MPS Absent (12.7)	82
	33.5.1.2.10	PD Class (12.6:4)	83
	33.5.1.2.11	PSE Status (12.3:1)	83
	33.5.1.2.12	Pair Control Ability (12.0)	83
33.6		Data Link Layer classification	83
33.6.1		TLV frame definition	83
33.6.2		Data Link Layer classification timing requirements	83
33.6.3		Power control state diagrams	84
	33.6.3.1	Conventions	84
	33.6.3.2	Constants	84
	33.6.3.3	Variables	85
	33.6.3.4	Functions	87
	33.6.3.5	State diagrams	88
33.6.4		State change procedure across a link	89
	33.6.4.1	PSE state change procedure across a link	90
	33.6.4.2	PD state change procedure across a link	90
33.7		Environmental	91
33.7.1		General safety	91
33.7.2		Network safety	91
33.7.3		Installation and maintenance guidelines	91
33.7.4		Patch panel considerations	91
33.7.5		Telephony voltages	91
33.7.6		Electromagnetic emissions	92
33.7.7		Temperature and humidity	92
33.7.8		Labeling	92
33.8		Protocol implementation conformance statement (PICS) proforma for Clause 33, DTE Power via MDI	93
33.8.1		Introduction	93
33.8.2		Identification	93
	33.8.2.1	Implementation identification	93
	33.8.2.2	Protocol summary	93
	33.8.2.3	PD Major capabilities/options	94
	33.8.2.4	PSE Major capabilities/options	95
33.8.3		PICS proforma tables for DTE Power via MDI	96
	33.8.3.1	Common device features	96
	33.8.3.2	Power sourcing equipment	96
	33.8.3.3	Powered devices	101
	33.8.3.4	Electrical specifications applicable to the PSE and PD	104
	33.8.3.5	Electrical specifications applicable to the PSE	105
	33.8.3.6	Electrical specifications applicable to the PD	106
	33.8.3.7	Management function requirements	107
	33.8.3.8	Data Link Layer classification requirements	110
	33.8.3.9	Environmental specifications applicable to PSEs and PDs	111
	33.8.3.10	Environmental specifications applicable to the PSE	111
79.		IEEE 802.3 Organizationally Specific Link Layer Discovery Protocol (LLDP) type, length, and values (TLV) information elements	113
79.2		Requirements of the IEEE 802.3 Organizationally Specific TLV set	113

79.3	IEEE 802.3 Organizationally Specific TLVs	113
79.3.2	Power via MDI TLV	113
79.3.2.4	Requested power type/source/priority	114
79.3.2.4.1	Power type	114
79.3.2.4.2	Power source	114
79.3.2.4.3	Power priority	115
79.3.2.5	PD requested power value	115
79.3.2.6	PSE allocated power value	115
79.4	IEEE 802.3 Organizationally Specific TLV selection management	116
79.4.2	IEEE 802.3 Organizationally Specific TLV/LLDP Local and Remote System group managed object class cross references	116
79.5	Protocol implementation conformance statement (PICS) proforma for IEEE 802.3 Organizationally Specific Link Layer Discovery Protocol (LLDP) type, length, and values (TLV) information elements	118
79.5.6	Power via MDI TLV	118
Annex A (informative) Bibliography		119
Annex 33A (informative) PSE-PD stability		121
33A.1	Recommended PSE design guidelines and test setup	121
33A.2	Recommended PD design guidelines	123

IEEE Standard for Information technology— Telecommunications and information exchange between systems— Local and metropolitan area networks— Specific requirements

Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications

Amendment 3: Data Terminal Equipment (DTE) Power via the Media Dependent Interface (MDI) Enhancements

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[This amendment is based on IEEE Std 802.3-2008.]

NOTE—The editing instructions contained in this amendment define how to merge the material contained therein into the existing base standard and its amendments to form the comprehensive standard. When the source of the base text is other than IEEE Std 802.3-2008, the source is indicated in the change instruction.

The editing instructions are shown in ***bold italic***. Four editing instructions are used: change, delete, insert, and replace. ***Change*** is used to make corrections in existing text or tables. The editing instruction specifies the location of the change and describes what is being changed by using ~~striketrough~~ (to remove old material) and underscore (to add new material). ***Delete*** removes existing material. ***Insert*** adds new material without disturbing the existing material. Insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. ***Replace*** is used to make changes in figures or equations by removing the existing figure or equation and replacing it with a new one. Editing instructions, change markings, and this NOTE will not be carried over into future editions because the changes will be incorporated into the base standard.¹

¹Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

1. Introduction

1.3 Normative references

Insert the following new references in alphanumerical order:

ANSI/TIA-568-C.0—Generic Telecommunications Cabling.

ANSI/TIA-568-C.2—Copper Cabling Components.

1.4 Definitions

Insert the following definitions alphabetically and renumber as required:

1.4.x 1-Event class signature: The response of the PD to 1-Event classification (see IEEE 802.3, Clause 33).

1.4.x 1-Event classification: The application of a single class event during PI probing (see IEEE 802.3, Clause 33, 33.2.6).

1.4.x 2-Event class signature: The response of the PD to 2-Event classification (see IEEE 802.3, Clause 33).

1.4.x 2-Event classification: The application of two class events during PI probing (see IEEE 802.3, Clause 33, 33.2.6).

1.4.x I_{Port}: The total power-pair current going into the PI (see IEEE 802.3, Clause 33).

1.4.x Midspan PSE, 1000BASE-T: A Midspan PSE that results in a link that can support 10BASE-T, 100BASE-TX, and 1000BASE-T operation (see IEEE 802.3, Clause 33).

1.4.x Midspan PSE, 10BASE-T/100BASE-TX: A Midspan PSE that results in a link that can only support 10BASE-T and 100BASE-TX operation (see IEEE 802.3, Clause 33).

1.4.x TP-PMD: Twisted Pair, Physical Medium Dependent (ANSI X3.263-1995).

1.4.x Type 1 PD: A PD that does not provide a Class 4 signature during Physical Layer classification (see IEEE 802.3, Clause 33).

1.4.x Type 1 PSE: A PSE that supports only a Type 1 PD (see IEEE 802.3, Clause 33).

1.4.x Type 2 PD: A PD that provides a Class 4 signature during Physical Layer classification, understands 2-Event classification, and is capable of Data Link Layer classification (see IEEE 802.3, Clause 33).

1.4.x Type 2 PSE: A PSE that supports both a Type 1 and a Type 2 PD (see IEEE 802.3, Clause 33).

1.4.x V_{PD}: The voltage at the PD PI measured between any conductor of one power pair and any conductor of the other power pair (see IEEE 802.3, Clause 33).

1.4.x V_{PSE}: The voltage at the PSE PI measured between any conductor of one power pair and any conductor of the other power pair (see IEEE 802.3, Clause 33).

25. Physical Medium Dependent (PMD) sublayer and baseband medium, type 100BASE-TX

25.4 Specific requirements and exceptions

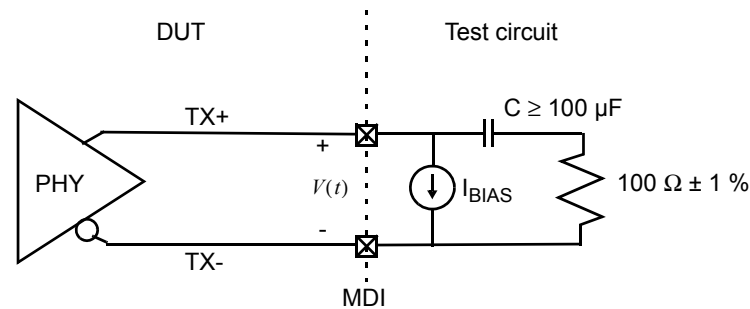
Insert new subclause 25.4.4a after 25.4.4 as follows:

25.4.4a Change to 9.1.7, “Worst case droop of transformer”

A receiver in a Type 2 Endpoint PSE or Type 2 PD (see Clause 33) shall meet the requirements of 25.4.5a. A transmitter in a Type 2 Endpoint PSE or Type 2 PD delivering or accepting more than 13.0 W average power shall meet either the Open Circuit Inductance (OCL) requirement in 9.1.7 of TP-PMD, or meet the requirements of 25.4.4a.1.

25.4.4a.1 Equivalent system time constant

While transmitting the Data Dependent Jitter (DDJ) packet of TP-PMD A.2, using the test circuit shown in Figure 25–1, the equivalent system time constant, τ , shall be greater than 2.4 μs when calculated using measurement points A and C as shown in Figure 25–2.



DUT = Device under test

NOTE— I_{BIAS} is the current $I_{\text{unb}} / 2$ defined in Clause 33.

Figure 25–1—Type 2 system time constant test circuit

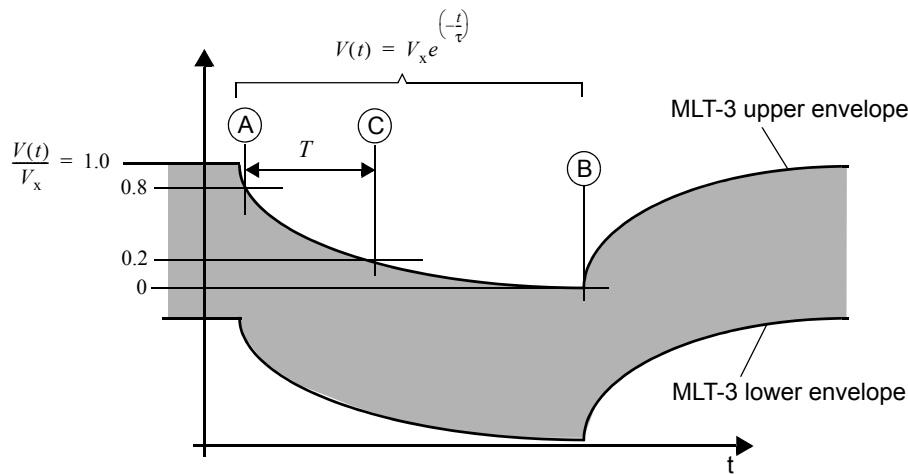


Figure 25-2—Type 2 system time constant measurement

Point B is the point of maximum baseline wander droop, and is the zero point for the vertical axis. Point A, with MDI voltage V_A , is earlier in time from B, with a magnitude that is 80 % of the MLT-3 upper envelope value. Point C, with MDI voltage V_C , is between A and B, with a magnitude that is 20 % of the MLT-3 upper envelope value. The time between A and C is T .

These measurements are to be made for the transmitter pair, observing the differential signal output at the MDI with intervening cable, meeting or exceeding the requirements of 25.4.7, less than 1 m long.

The time constant of the transmitter MDI connected to the test circuit of Figure 25-1 is given by Equation (25-1).

$$\left\{ \tau = \frac{T}{\ln\left(\frac{V_A}{V_C}\right)} = \frac{2L}{R} \right\}_s \quad (25-1)$$

where

τ	is the effective time constant of the transmitter
T	is the time in seconds from point A to point C as shown in Figure 25-2
V_A	is the MDI voltage at point A
V_C	is the MDI voltage at point C
L	is the open-circuit inductance of the Ethernet isolation transformer
R	is the 100 Ω termination impedance

Insert new subclause 25.4.5a after 25.4.5 as follows:

25.4.5a Addition to 10.1, “Receiver”

Differential voltage signals generated by a remote transmitter that meets the specifications of Clause 25; passed through a link specified in 25.4.6; and received at the MDI of a 100BASE-TX PMD in a Type 2 Endpoint PSE or a Type 2 PD shall be translated into one of the PMD_UNITDATA.indicate messages with a bit error ratio less than 10^{-9} after link reset completion.

25.5 Protocol implementation conformance statement (PICS) proforma for Clause 25, Physical Medium Dependent (PMD) sublayer and baseband medium, type 100BASE-TX²

25.5.3 Major capabilities/options

Add new subclause, 25.5.3.1, as follows:

25.5.3.1 DTE Power via MDI major capabilities/options

Item	Feature	Subclause	Status	Support	Value/Comment
*PSET2	Type 2 PSE implementation	33.1.4	O	Yes [] No []	Optional
*PDT2	Type 2 PD implementation	33.3.2	O	Yes [] No []	Optional

25.5.4 PICS proforma tables for the Physical Medium Dependent (PMD) sublayer and baseband medium, type 100BASE-TX

Add new subclause, 25.5.4.4, after 25.5.4.3 as follows:

25.5.4.4 DTE Power via MDI compliance

Item	Feature	Subclause	Status	Support	Value/Comment
DTEP1	Type 2 PD receiver worst-case droop transformer	25.4.4a	PDT2:M	Yes [] No []	Meet requirements of 25.4.5a: differential voltage signals translated into one of the PMD_UNITDATA.indicate messages with a bit error ratio less than 10^{-9} after link reset completion
DTEP2	Type 2 Endpoint PSE receiver worst-case droop transformer	25.4.4a	PSET2:M	Yes [] No []	Meet requirements of 25.4.5a: differential voltage signals translated into one of the PMD_UNITDATA.indicate messages with a bit error ratio less than 10^{-9} after link reset completion

²Copyright release for PICS proformas: Users of this standard may freely reproduce the PICS proforma in this subclause so that it can be used for its intended purpose and may further publish the completed PICS.

Item	Feature	Subclause	Status	Support	Value/Comment
DTEP3	Type 2 PD transmitter worst-case droop transformer while accepting more than 13 W average power	25.4.4a	PDT2:M	Yes [] No []	Meet OCL requirements of 9.1.7 or requirements in 25.4.4a.1
DTEP4	Type 2 Endpoint PSE transmitter worst-case droop transformer while delivering more than 13 W average power	25.4.4a	PSET2:M	Yes [] No []	Meet OCL requirements in 9.1.7 or requirements in 25.4.4a.1
DTEP5	Equivalent system time constant	25.4.4a.1	M	Yes [] N/A []	Greater than 2.4 μ s when calculated using measurement points A and C in Figure 25–2

30. Management

30.2 Managed objects

30.2.2 Overview of managed objects

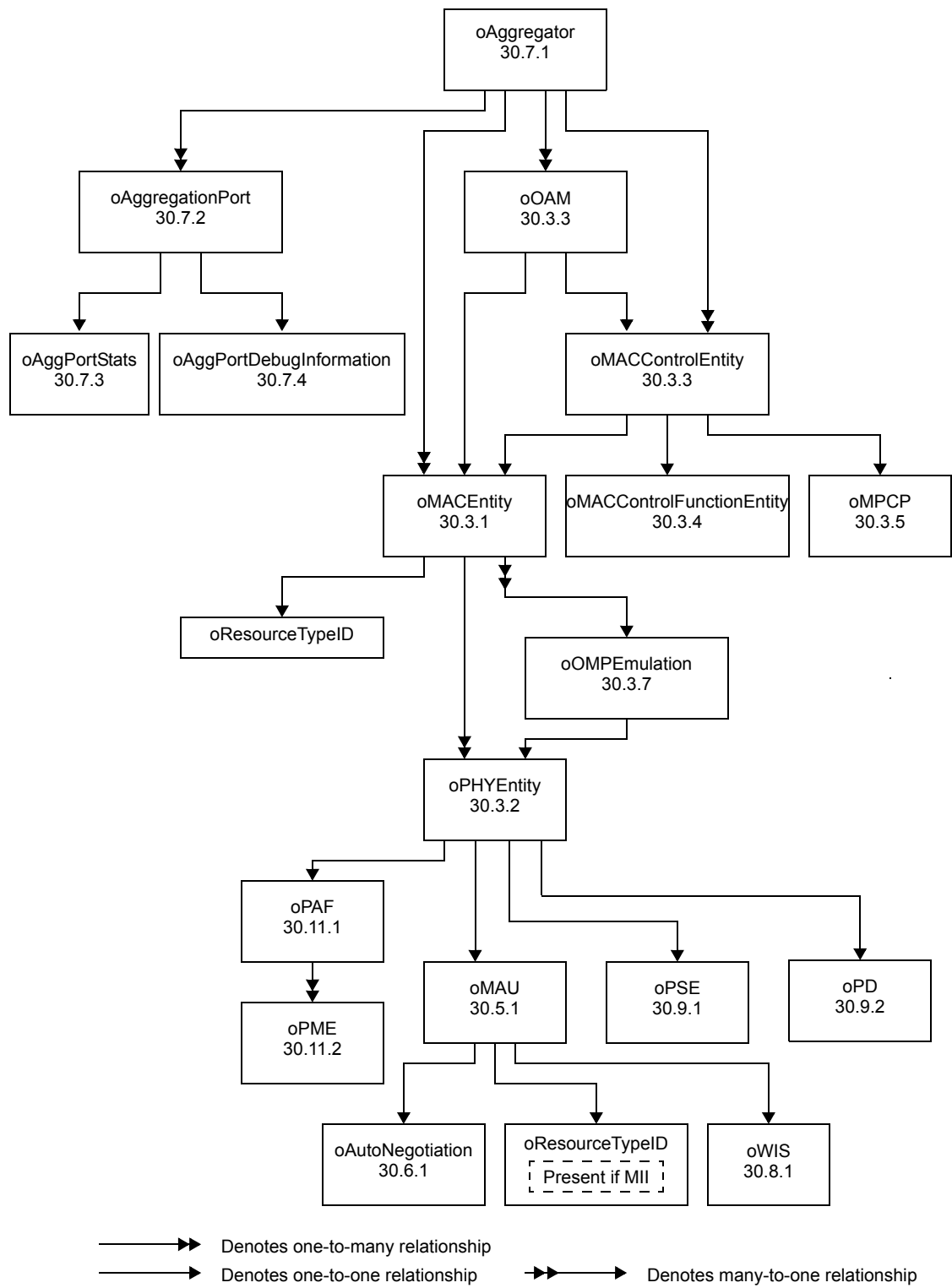
30.2.2.1 Text description of managed objects

Change the following paragraphs as shown:

oPAF	The oPAF managed object class provides the management controls necessary to allow an instance of a PME aggregation function (PAF) to be managed. The PAF managed object class also provides a view of a collection of PMEs.
<u>oPD</u>	<u>The managed object of that portion of the containment trees shown in Figure 30–3, Figure 30–4, and Figure 30–5. This managed object class provides the attributes, actions, and notifications required for management by a PSE system.</u>
oPME	The oPME managed object class provides the management controls necessary to allow an instance of a PME to be managed. The oPAF managed object contains the PME managed object in a DTE.
oPSE	The managed object of that portion of the containment trees shown in Figure 30–3, Figure 30–4, and Figure 30–5. <u>This managed object class provides the attributes, actions, and notifications defined in this subclause are contained within the oPSE managed object required for management of a PD system.</u>
oPSEGroup	The PSE Group managed object class is a view of a collection of PSEs.

30.2.3 Containment

Replace Figure 30–3 and Figure 30–4 with the following:



NOTE—The objects oAggregator, oAggregationPort, oAggPortStats, and oAggPortDebugInformation are deprecated by IEEE Std 802.1AX-2008.

Figure 30–3—DTE System entity relationship diagram

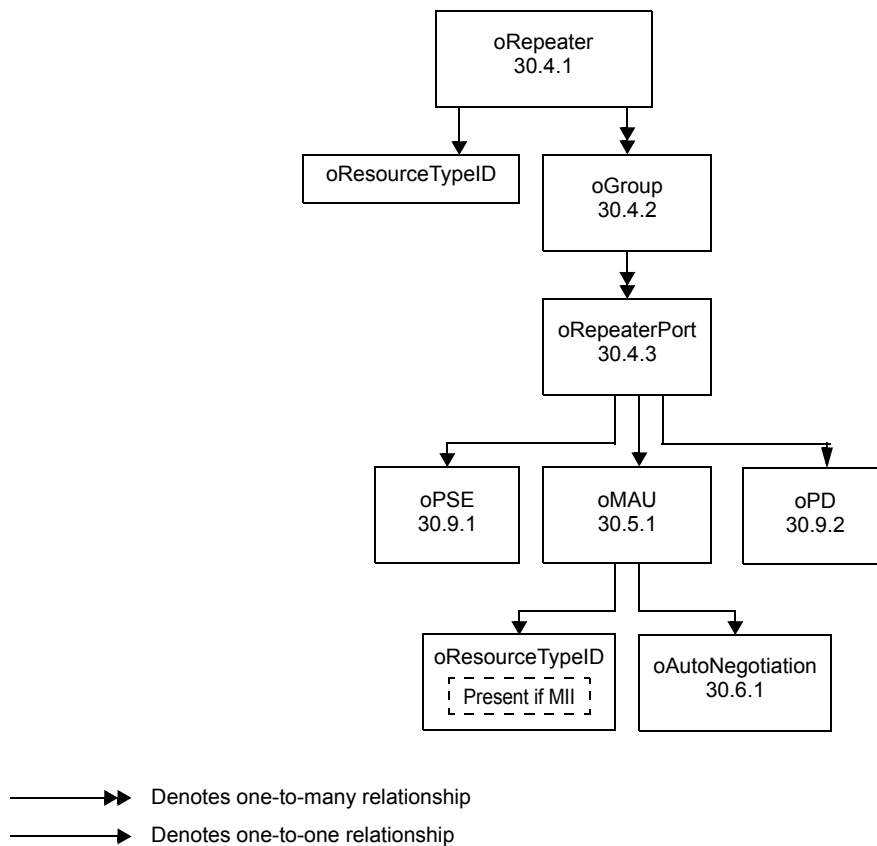


Figure 30-4—Repeater entity relationship diagram

30.2.5 Capabilities

Change the following paragraphs as shown (30.2.5 previously changed by IEEE Std 802.3bc-2009):

The 1000 Mb/s Burst Monitor Capability provides additional attributes that relate only to 1000 Mb/s operation, while the 100 Mb/s Monitor Capability has attributes that apply to a mixed 100 and 1000 Mb/s operation. These attributes are provided to complement the counter attributes of the optional packages and capabilities that apply to 10 Mb/s and mixed 10, 100, and 1000 Mb/s implementations. It is recommended that when the 100/1000 Mb/s Monitor Capability or 1000 Mb/s Burst Monitor Capability is implemented, the appropriate complementary counter packages and capabilities are also implemented.

For managed PSEs, the PSE Basic Package is mandatory and the PSE Recommended Package is optional. For managed PDs, the PD Basic Package is mandatory. For a managed PSE to be conformant to this standard, it shall fully implement the PSE Basic Package. For a managed PD to be conformant to this standard, it shall fully implement the PD Basic Package. For a managed PSE to be conformant to the optional Recommended Package it shall implement that entire package. PSE and PD management is optional with respect to all other CSMA/CD management.

For managed Midspans, the Midspan managed object class shall be implemented in its entirety. All attributes and notifications are mandatory. Midspan management is optional with respect to all other CSMA/CD management.

~~For LLDP management, the LLDP Basic Package is mandatory, the LLDP Local Package and LLDP Remote Package are conditional on the LLDP operating mode (see IEEE Std 802.1AB-20XX Clause 10). The LLDP Local Package is mandatory for LLDP transmit only mode and LLDP transmit and receive mode. The LLDP Remote Package is mandatory for LLDP receive only mode and LLDP transmit and receive mode.~~

For LLDP management, the LLDP Basic Package is mandatory. All other LLDP packages are conditional on the IEEE 802.3 Organizationally Specific TLVs supported and the LLDP operating mode (see IEEE Std 802.1AB, Clause 10).

LLDP MAC/PHY Configuration/Status Local Package is mandatory for managed entities that support IEEE 802.3 Organizationally Specific TLV named “MAC/PHY Configuration/Status” and are either in LLDP transmit only mode or in LLDP transmit and receive mode. LLDP MAC/PHY Config/Status Remote Package is mandatory for managed entities that support IEEE 802.3 Organizationally Specific TLV named “MAC/PHY Configuration/Status” and are either in LLDP receive only mode or in LLDP transmit and receive mode.

LLDP Power via MDI Local Package is mandatory for managed entities that support IEEE 802.3 Organizationally Specific TLV named “Power via MDI” and are either in LLDP transmit only mode or in LLDP transmit and receive mode. LLDP Power via MDI Remote Package is mandatory for managed entities that support IEEE 802.3 Organizationally Specific TLV named “Power via MDI” and are either in LLDP receive only mode or in LLDP transmit and receive mode.

LLDP Link Aggregation Local Package is mandatory for managed entities that support IEEE 802.3 Organizationally Specific TLV named “Link Aggregation” and are either in LLDP transmit only mode or in LLDP transmit and receive mode. LLDP Link Aggregation Remote Package is mandatory for managed entities that support IEEE 802.3 Organizationally Specific TLV named “Link Aggregation” and are either in LLDP receive only mode or in LLDP transmit and receive mode.

LLDP Max Frame Size Local Package is mandatory for managed entities that support IEEE 802.3 Organizationally Specific TLV named “Max Frame Size” and are either in LLDP transmit only mode or in LLDP transmit and receive mode. LLDP Max Frame Size Remote Package is mandatory for managed entities that support IEEE 802.3 Organizationally Specific TLV named “Max Frame Size” and are either in LLDP receive only mode or in LLDP transmit and receive mode.

Replace Table 30–4 with the following:

Table 30-4—DTE Power via MDI capabilities

[illegible]

Replace Table 30–5 with the following (Table 30-5 inserted by IEEE Std 802.3bc-2009):

Table 30–5—LLDP capabilities

				LLDP Basic Package (mandatory)	LLDP MAC/PHY Configuration/Status Local Package (conditional)	LLDP MAC/PHY Configuration/Status Remote Package (conditional)	LLDP Power via MDI Local Package (conditional)	LLDP Power via MDI Remote Package (conditional)	LLDP Link Aggregation Local Package (conditional)	LLDP Link Aggregation Remote Package (conditional)	LLDP Maximum Frame Size Local Package (conditional)	LLDP Maximum Frame Size Remote Package (conditional)
oLldpXdot3Config managed object class (30.12.1)												
aLldpXdot3PortConfigTLVsTxEnable	ATTRIBUTE	GET-SET	X									
oLldpXdot3LocSystemsGroup managed object class (30.12.2)												
aLldpXdot3LocPortAutoNegSupported	ATTRIBUTE	GET	X									
aLldpXdot3LocPortAutoNegEnabled	ATTRIBUTE	GET	X									
aLldpXdot3LocPortAutoNegAdvertisedCap	ATTRIBUTE	GET	X									
aLldpXdot3LocPortOperMauType	ATTRIBUTE	GET	X									
aLldpXdot3LocPowerPortClass	ATTRIBUTE	GET			X							
aLldpXdot3LocPowerMDISupported	ATTRIBUTE	GET			X							
aLldpXdot3LocPowerMDIEnabled	ATTRIBUTE	GET			X							
aLldpXdot3LocPowerPairControlable	ATTRIBUTE	GET			X							
aLldpXdot3LocPowerPairs	ATTRIBUTE	GET			X							
aLldpXdot3LocPowerClass	ATTRIBUTE	GET			X							
aLldpXdot3LocLinkAggStatus	ATTRIBUTE	GET						X				
aLldpXdot3LocLinkAggPortId	ATTRIBUTE	GET						X				
aLldpXdot3LocMaxFrameSize	ATTRIBUTE	GET									X	
aLldpXdot3LocPowerType	ATTRIBUTE	GET			X							
aLldpXdot3LocPowerSource	ATTRIBUTE	GET			X							
aLldpXdot3LocPowerPriority	ATTRIBUTE	GET-SET			X							
aLldpXdot3LocPDRequestedPowerValue	ATTRIBUTE	GET			X							
aLldpXdot3LocPSEAllocatedPowerValue	ATTRIBUTE	GET			X							
aLldpXdot3LocResponseTime	ATTRIBUTE	GET			X							
aLldpXdot3LocReady	ATTRIBUTE	GET			X							
aLldpXdot3LocReducedOperationPowerValue	ATTRIBUTE	GET			X							

Table 30–5—LLDP capabilities (continued)

			LLDP Basic Package (mandatory)	LLDP MAC/PHY Configuration/Status Local Package (conditional)	LLDP MAC/PHY Configuration/Status Remote Package (conditional)	LLDP Power via MDI Local Package (conditional)	LLDP Power via MDI Remote Package (conditional)	LLDP Link Aggregation Local Package (conditional)	LLDP Link Aggregation Remote Package (conditional)	LLDP Maximum Frame Size Local Package (conditional)	LLDP Maximum Frame Size Remote Package (conditional)
oLldpXdot3RemSystemsGroup managed object class (30.12.3)											
aLldpXdot3RemPortAutoNegSupported	ATTRIBUTE	GET		X							
aLldpXdot3RemPortAutoNegEnabled	ATTRIBUTE	GET		X							
aLldpXdot3RemPortAutoNegAdvertisedCap	ATTRIBUTE	GET		X							
aLldpXdot3RemPortOperMauType	ATTRIBUTE	GET		X							
aLldpXdot3RemPowerPortClass	ATTRIBUTE	GET				X					
aLldpXdot3RemPowerMDISupported	ATTRIBUTE	GET				X					
aLldpXdot3RemPowerMDIEnabled	ATTRIBUTE	GET				X					
aLldpXdot3RemPowerPairControlable	ATTRIBUTE	GET				X					
aLldpXdot3RemPowerPairs	ATTRIBUTE	GET				X					
aLldpXdot3RemPowerClass	ATTRIBUTE	GET				X					
aLldpXdot3RemLinkAggStatus	ATTRIBUTE	GET						X			
aLldpXdot3RemLinkAggPortId	ATTRIBUTE	GET						X			
aLldpXdot3RemMaxFrameSize	ATTRIBUTE	GET									X
aLldpXdot3RemPowerType	ATTRIBUTE	GET				X					
aLldpXdot3RemPowerSource	ATTRIBUTE	GET				X					
aLldpXdot3RemPowerPriority	ATTRIBUTE	GET				X					
aLldpXdot3RemPDRRequestedPowerValue	ATTRIBUTE	GET				X					
aLldpXdot3RemPSEAllocatedPowerValue	ATTRIBUTE	GET				X					

Change the title of 30.9 as follows:

30.9 Management for DTE Power via MDI-Sourcing Equipment (PSE)

Insert new subclause 30.9.2 after 30.9.1 as follows:

30.9.2 PD managed object class

This subclause formally defines the behaviours for the oPD managed object class attributes.

30.9.2.1 PD attributes

30.9.2.1.1 aPDID

ATTRIBUTE

APPROPRIATE SYNTAX:

INTEGER

BEHAVIOUR DEFINED AS:

The value of aPDID is assigned so as to uniquely identify a PD Power via MDI classification local system among the subordinate managed objects of the containing object.;

30.12.2 LLDP Local System Group managed object class

30.12.2.1 LLDP Local System Group attributes

Insert new subclauses 30.12.2.1.14 through 30.12.2.1.21 after 30.12.2.1.13 (30.12.2 inserted by IEEE Std 802.3bc-2009):

30.12.2.1.14 aLldpXdot3LocPowerType

ATTRIBUTE

APPROPRIATE SYNTAX:

BIT STRING [SIZE (2)]

BEHAVIOUR DEFINED AS:

A GET attribute that returns a bit string indicating whether the local system is a PSE or a PD and whether it is Type 1 or Type 2. The first bit indicates Type 1 or Type 2. The second bit indicates PSE or PD. A PSE shall set this bit to indicate a PSE. A PD shall set this bit to indicate a PD.;

30.12.2.1.15 aLldpXdot3LocPowerSource

ATTRIBUTE

APPROPRIATE SYNTAX:

BIT STRING [SIZE (2)]

BEHAVIOUR DEFINED AS:

A GET attribute that returns a bit string indicating the power sources of the local system. A PSE indicates whether it is being powered by a primary power source; a backup power source; or unknown. A PD indicates whether it is being powered by a PSE and locally; by a PSE only; or unknown.;

30.12.2.1.16 aLldpXdot3LocPowerPriority

ATTRIBUTE

APPROPRIATE SYNTAX:

An ENUMERATED value list that has the following entries:

low	low priority PD
high	high priority PD
critical	critical priority PD
unknown	priority unknown

BEHAVIOUR DEFINED AS:

A GET attribute that returns the priority of a PD system. For a PSE, this is the priority that the PSE assigns to the PD. For a PD, this is the priority that the PD requests from the PSE.

A SET operation changes the priority of the PD system to the indicated value.;

30.12.2.1.17 aLdpXdot3LocPDRequestedPowerValue**ATTRIBUTE****APPROPRIATE SYNTAX:**

INTEGER

BEHAVIOUR DEFINED AS:

A GET attribute that returns the PD requested power value. For a PD, it is the power value that the PD has currently requested from the remote system. PD requested power value is the maximum input average power the PD ever draws under this power allocation if accepted. For a PSE, it is the power value that the PSE mirrors back to the remote system. This is the PD requested power value that was used by the PSE to compute the power it has currently allocated to the remote system. The PD requested power value is encoded according to Equation (79–1), where X is the decimal value of aLdpXdot3LocPDRequestedPowerValue.;

30.12.2.1.18 aLdpXdot3LocPSEAllocatedPowerValue**ATTRIBUTE****APPROPRIATE SYNTAX:**

INTEGER

BEHAVIOUR DEFINED AS:

A GET attribute that returns the PSE allocated power value. For a PSE, it is the power value that the PSE has currently allocated to the remote system. The PSE allocated power value is the maximum input average power that the PSE wants the PD to ever draw under this allocation if it is accepted. For a PD, it is the power value that the PD mirrors back to the remote system. This is the PSE allocated power value that was used by the PD to compute the power that it has currently requested from the remote system. The PSE allocated power value is encoded according to Equation (79–2), where X is the decimal value of aLdpXdot3LocPSEAllocatedPowerValue.;

30.12.2.1.19 aLdpXdot3LocResponseTime**ATTRIBUTE****APPROPRIATE SYNTAX:**

INTEGER

BEHAVIOUR DEFINED AS:

A GET attribute that returns the response time in seconds of the local system. For a PD, it is the maximum time required to update the value of attribute aLdpXdot3LocPDRequestedPowerValue when the remote system requests the PD to change its max power draw. For a PSE, it is the maximum time required to update the value of attribute aLdpXdot3LocPDRequestedPowerValue when the remote system requests of the PSE a new power value.;

30.12.2.1.20 aLldpXdot3LocReady

ATTRIBUTE

APPROPRIATE SYNTAX:

A BOOLEAN value:

FALSE: Local system has not completed initialization of the Data Link Layer classification engine and is not ready to receive/transmit an LLDPDU containing a Power via MDI TLV.

TRUE: Local system has initialized the Data Link Layer classification engine and is ready to receive/transmit an LLDPDU containing a Power via MDI TLV.

BEHAVIOUR DEFINED AS:

A GET operation returns the initialization status of the Data Link Layer classification engine on the local system.;

30.12.2.1.21 aLldpXdot3LocReducedOperationPowerValue

ATTRIBUTE

APPROPRIATE SYNTAX:

INTEGER

BEHAVIOUR DEFINED AS:

A GET attribute that returns the reduced operation power value. For a PD, it is a power value that is lower than the currently requested power value. This reduced operation power value represents a power state in which the PD could continue to operate, but with less functionality than at the current PD requested power value. The PSE could optionally use this information in the event that the PSE subsequently requests a lower PD power value than the PD requested power value. For a PSE, it is a power value that the PSE could ask the PD to move to if the PSE wants the PD to move to a lower power state. The definition and encoding of PD requested power value is the same as described in aLldpXdot3LocPDRequestedPowerValue (30.12.2.1.17). The default value for this field is the hexadecimal value FFFF.;

30.12.3 LLDP Remote System Group managed object class**30.12.3.1 LLDP Remote System Group attributes**

Insert new subclauses 30.12.3.1.14 through 30.12.3.1.18 after 30.12.3.1.13 (30.12.3 inserted by IEEE Std 802.3bc-2009):

30.12.3.1.14 aLldpXdot3RemPowerType

ATTRIBUTE

APPROPRIATE SYNTAX:

BIT STRING [SIZE (2)]

BEHAVIOUR DEFINED AS:

A GET attribute that returns a bit string indicating whether the remote system is a PSE or a PD and whether it is Type 1 or Type 2. The first bit indicates Type 1 or Type 2. The second bit indicates PSE or PD.;

30.12.3.1.15 aLldpXdot3RemPowerSource

ATTRIBUTE

APPROPRIATE SYNTAX:

BIT STRING [SIZE (2)]

BEHAVIOUR DEFINED AS:

A GET attribute that returns a bit string indicating the power sources of the remote system. When the remote system is a PSE, it indicates whether it is being powered by a primary power source; a backup power source; or unknown. When the remote system is a PD, it indicates whether it is being powered by a PSE and locally; locally only; by a PSE only; or unknown.;

30.12.3.1.16 aLdpXdot3RemPowerPriority

ATTRIBUTE

APPROPRIATE SYNTAX:

An ENUMERATED value list that has the following entries:

low	low priority PD
high	high priority PD
critical	critical priority PD
unknown	priority unknown

BEHAVIOUR DEFINED AS:

A GET operation returns the priority of the PD system received from the remote system. For a PSE, this is the priority that the remote system requests from the PSE. For a PD, this is the priority that the remote system has assigned to the PD.;

30.12.3.1.17 aLdpXdot3RemPDRequestedPowerValue

ATTRIBUTE

APPROPRIATE SYNTAX:

INTEGER

BEHAVIOUR DEFINED AS:

A GET attribute that returns the PD requested power value that was used by the remote system to compute the power value that is has currently allocated to the PD. For a PSE, it is the PD requested power value received from the remote system. The definition and encoding of PD requested power value is the same as described in aLdpXdot3LocPDRequestedPowerValue (30.12.2.1.17).;

30.12.3.1.18 aLdpXdot3RemPSEAllocatedPowerValue

ATTRIBUTE

APPROPRIATE SYNTAX:

INTEGER

BEHAVIOUR DEFINED AS:

A GET attribute that returns the PSE allocated power value received from the remote system. For a PSE, it is the PSE allocated power value that was used by the remote system to compute the power value that it has currently requested from the PSE. For a PD, it is the PSE allocated power value received from the remote system. The definition and encoding of PSE allocated power value is the same as described in aLdpXdot3LocPSEAllocatedPowerValue (30.12.2.1.18).;

Replace Clause 33 with the following:

33. Data Terminal Equipment (DTE) Power via Media Dependent Interface (MDI)

33.1 Overview

This clause defines the functional and electrical characteristics 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 and Clause 40. These entities allow devices to draw/supply power using the same generic cabling as is used for data transmission.

DTE powering is intended to provide a 10BASE-T, 100BASE-TX, or 1000BASE-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 to add power to the 100 Ω balanced cabling system
- b) The characteristics of a powered device's load on the power source and the structured cabling
- c) A protocol allowing the detection of a device that requests power from a PSE
- d) Methods to classify devices based on their power needs
- e) A method for powered devices and power sourcing equipment 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

The importance of item c) above should not be overlooked. Given the large number of legacy devices (both IEEE 802.3 and other types of devices) that could be connected to a 100 Ω balanced cabling system, and the possible consequences of applying power to such devices, the protocol to distinguish compatible devices and non-compatible devices is important to prevent damage to non-compatible devices.

The detection and powering algorithms are likely to be compromised by cabling that is not point-to-point, resulting in unpredictable performance and possibly damaged equipment.

This clause differentiates between the two ends of the powered portion of the link, defining the PSE and the PD as separate but related devices.

33.1.1 Objectives

The following are objectives of Power via MDI:

- a) *Power*—A PD designed to the standard, and within its range of available power, can obtain both power and data for operation through the MDI and therefore needs no additional connections.
- b) *Safety*—A PSE designed to the standard does not introduce non-SELV (Safety Extra Low Voltage) power into the wiring plant.
- c) *Compatibility*—Clause 33 utilizes the MDIs of 10BASE-T, 100BASE-TX, and 1000BASE-T without modification. Type 1 operation adds no significant requirements to the cabling. Type 2 operation requires ISO/IEC 11801:1995 Class D or better cabling and a derating of the cabling maximum ambient operating temperature. The clause does not address the operation of 10GBASE-T. For 10GBASE-T operation, the channel model specified in Clause 55 needs to be met without regard to DTE Power via MDI presence or operation.

- d) *Simplicity*—The powering system described here is no more burdensome on the end users than the requirements of 10BASE-T, 100BASE-TX, or 1000BASE-T.

33.1.2 Compatibility considerations

All implementations of PD and PSE systems shall be compatible at their respective Power Interfaces (PIs) when used in accordance with the restrictions of Clause 33 where appropriate. Designers are free to implement circuitry within the PD and PSE in an application-dependent manner provided that the respective PI specifications are satisfied.

33.1.3 Relationship of DTE Power via MDI to the IEEE 802.3 Architecture

DTE Power via MDI comprises an optional non-data entity. As a non-data entity, it does not appear in a depiction of the OSI Reference Model. Figure 33–1 depicts the positioning of DTE Power via MDI in the case of the PD.

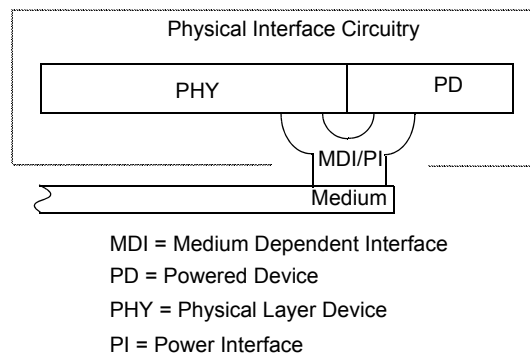


Figure 33–1—DTE Power via MDI powered device relationship to the physical interface circuitry and the IEEE 802.3 CSMA/CD LAN model

Figure 33–2 and Figure 33–3 depict the positioning of DTE Power via MDI in the cases of the Endpoint PSE and the Midspan PSE, respectively.

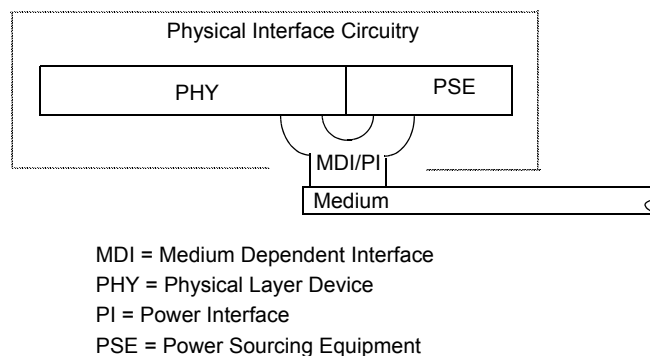


Figure 33–2—DTE Power via MDI Endpoint power sourcing equipment relationship to the physical interface circuitry and the IEEE 802.3 CSMA/CD LAN model

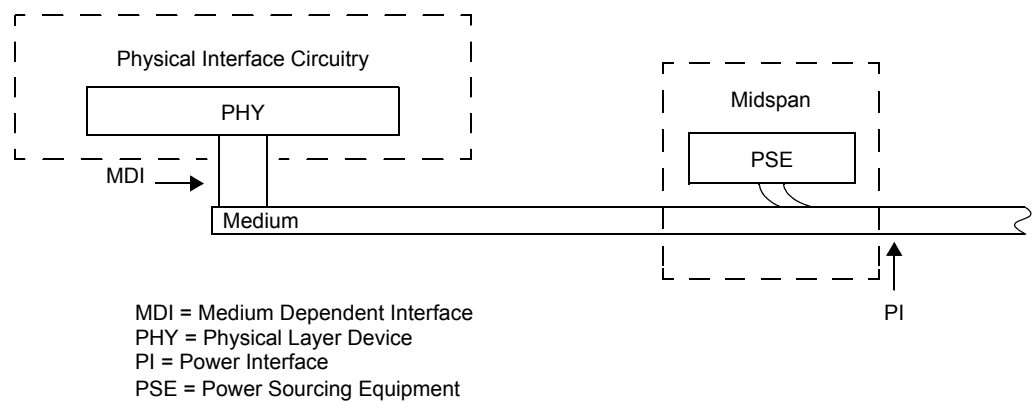


Figure 33–3—DTE Power via MDI Midspan power sourcing equipment relationship to the physical interface circuitry and the IEEE 802.3 CSMA/CD LAN model

The Power Interface (PI) is the generic term that refers to the mechanical and electrical interface between the PSE or PD and the transmission medium.

In an Endpoint PSE and in a PD, the PI is encompassed within the MDI.

PSE power interface specifications that are defined at the MDI apply to an Endpoint PSE. They may or may not apply to a Midspan PSE PI.

33.1.4 Type 1 and Type 2 system parameters

A power system, consisting of a single PSE, link segment, and a single PD, defined as either Type 1 or Type 2, has certain basic parameters defined according to Table 33–1. 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 33.2 and 33.3.

Table 33–1—Type 1 and Type 2 system parameters

Parameter	Symbol	Units	Type 1 value	Type 2 value	Additional information
Nominal highest DC current per pair	I_{Cable}	A	0.350	0.600	
Channel maximum DC pair loop resistance	R_{Ch}	Ω	20.0	12.5	
Minimum cable type			UTP per 14.4 and 14.5 ^a	Class D	See 33.1.4.1, 33.1.4.2

^aClass D recommended.

I_{Cable} is the current on one twisted pair in the multi-twisted pair cable. Two twisted pairs are required to source I_{Cable} —one carrying (+ I_{Cable}) and one carrying (– I_{Cable}), from the perspective of the PI.

It should be noted that the cable references use “DC loop resistance,” which refers to a single conductor. This clause uses “DC pair loop resistance,” which refers to a pair of conductors in parallel. Therefore, R_{Ch} is related to, but not equivalent to, the “DC loop resistance” called out in the cable references.

33.1.4.1 Type 2 cabling requirement

Type 2 operation requires Class D, or better, cabling as specified in ISO/IEC 11801:1995 with the additional requirement that channel DC loop resistance shall be 25 Ω or less. These requirements are also met by Category 5e or better cable and components as specified in ANSI/TIA/EIA-568-B.2, ANSI/TIA/EIA-568-B.2-1, and ANSI/TIA/EIA-568-B.2-10; or Category 5 cable and components as specified in ANSI/TIA/EIA-568-A-1995.

Under worst-case conditions, Type 2 operation requires a 10 °C reduction in the maximum ambient operating temperature of the cable when all cable pairs are energized at I_{Cable} (see Table 33–1), or a 5 °C reduction in the maximum ambient operating temperature of the cable when half of the cable pairs are energized at I_{Cable} . Additional cable ambient operating temperature guidelines for Type 2 operation are provided in ISO/IEC TR 29125 [Bxx1]³ and TIA TSB-184 [Bxx2].

33.1.4.2 Type 1 and Type 2 channel requirement

Type 1 and Type 2 operation requires that the resistance unbalance shall be 3 % or less. Resistance unbalance is a measure of the difference between the two conductors of a twisted pair in the 100 Ω balanced cabling system. Resistance unbalance is defined as in Equation (33–1):

$$\left\{ \frac{(R_{\max} - R_{\min})}{(R_{\max} + R_{\min})} \times 100 \right\} \% \quad (33-1)$$

where

$R_{\max}$	is the resistance of the channel conductor with the highest resistance
$R_{\min}$	is the resistance of the channel conductor with the lowest resistance

33.2 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.

33.2.1 PSE location

PSEs may be placed in two locations with respect to the link segment, either coincident with the DTE/Repeater or midspan. A PSE that is coincident with the DTE/Repeater is an “Endpoint PSE.” A PSE that is located within a link segment that is distinctly separate from and between the MDIs is a “Midspan PSE.” The requirements of this document shall apply equally to Endpoint and Midspan PSEs unless the requirement contains an explicit statement that it applies to only one implementation. The location of

³The numbers in brackets correspond to those of the bibliography in Annex A.

Alternative A and Alternative B Endpoint PSEs and Midspan PSEs are illustrated in Figure 33–4, Figure 33–5, Figure 33–6, and Figure 33–7.

PSEs can be compatible with 10BASE-T, 100BASE-TX, and/or 1000BASE-T. PSEs may support either Alternative A, Alternative B, or both.

33.2.2 Midspan PSE types

There are two types of Midspan PSEs defined.

10BASE-T/100BASE-TX Midspan PSE:

A Midspan PSE that results in a link that can support only 10BASE-T and 100BASE-TX operation (see Figure 33–6). Note that this limitation is due to the presence of the Midspan PSE whether it is supplying power or not.

1000BASE-T Midspan PSE:

A Midspan PSE that results in a link that can support 10BASE-T, 100BASE-TX, and 1000BASE-T operation (see Figure 33–7).

NOTE—See 33.4.9.2 for Alternative A Midspan PSEs.

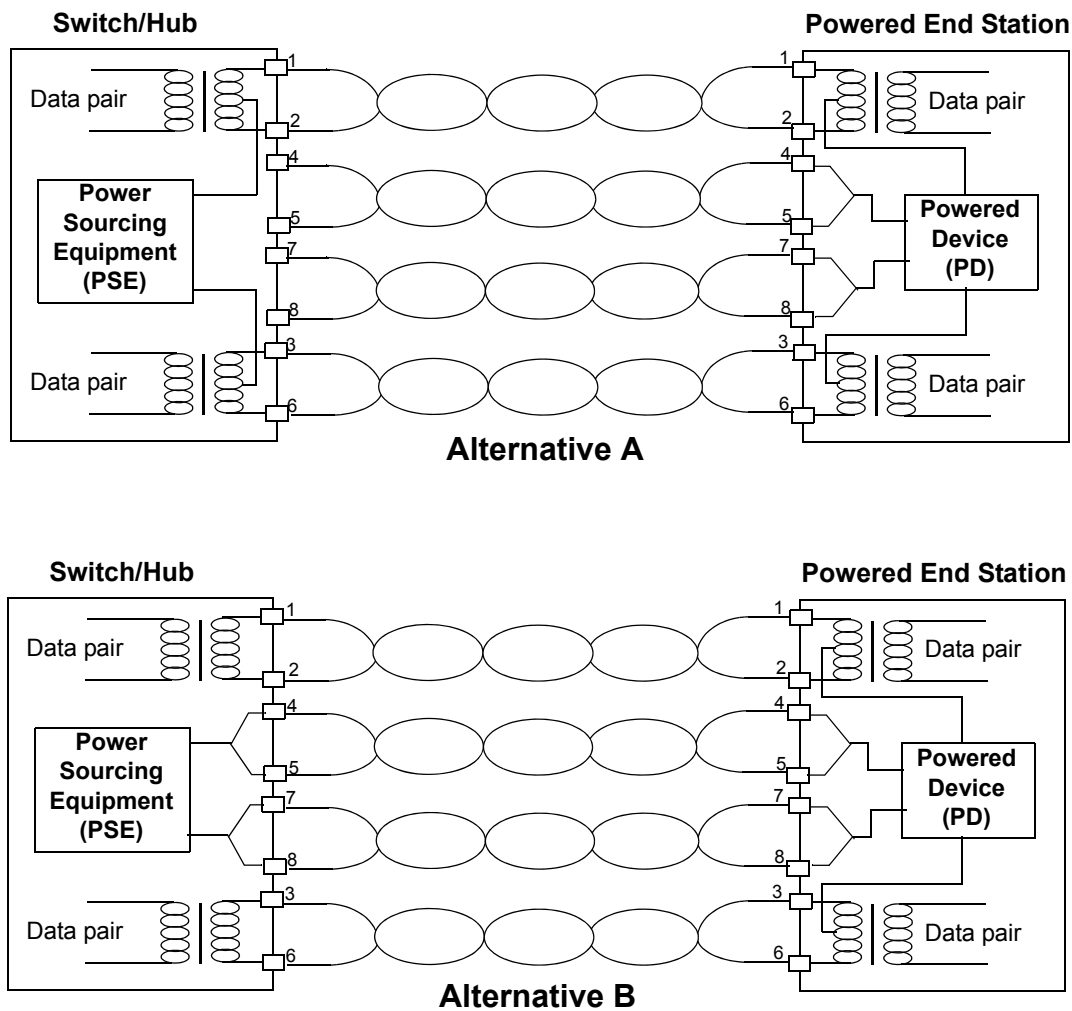


Figure 33-4—10BASE-T/100BASE-TX Endpoint PSE location overview

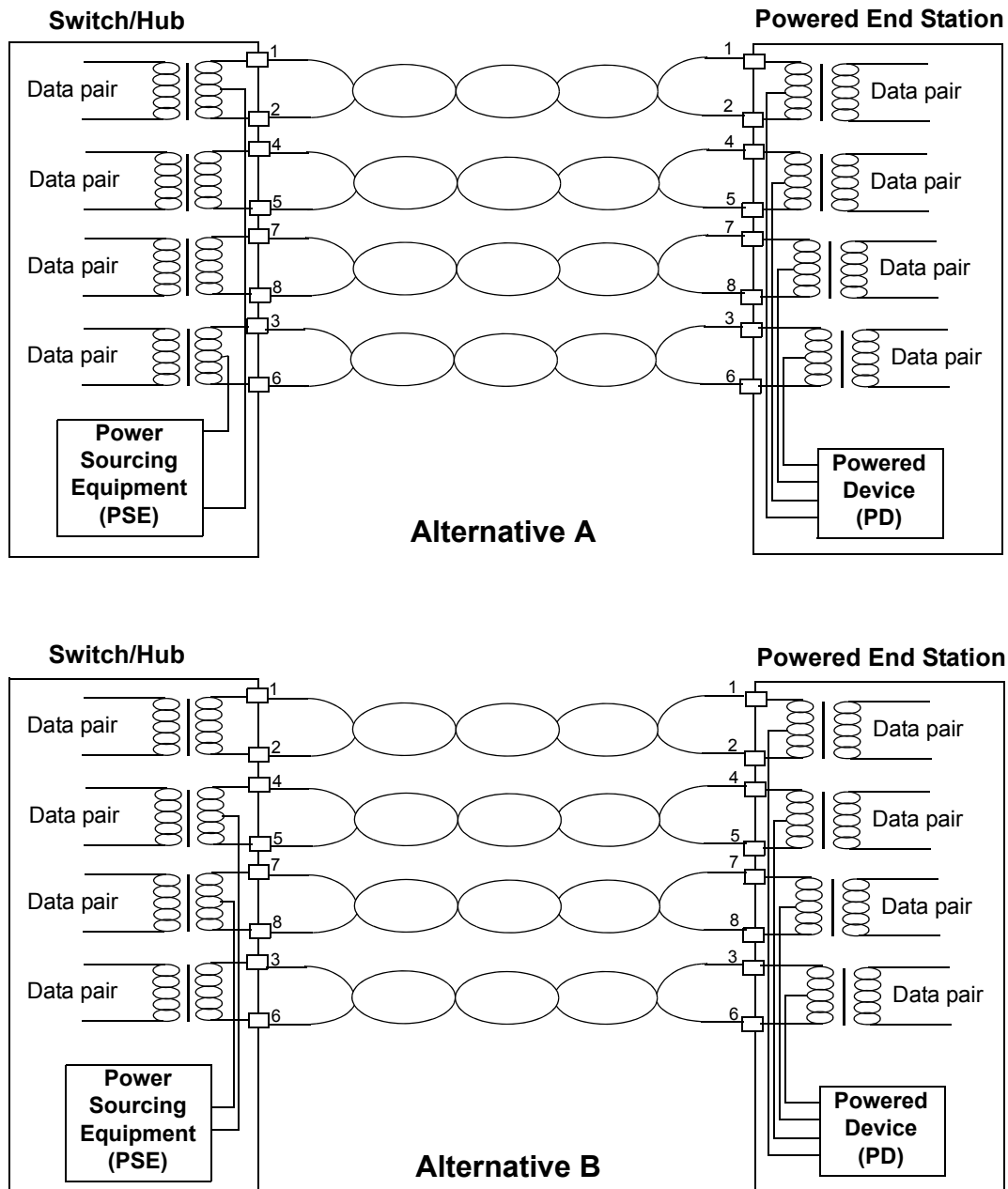


Figure 33-5—1000BASE-T Endpoint PSE location overview