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Road vehicles — In-vehicle Ethernet — Part 3: Optical 1-Gbit/s physical entity requirements and conformance test plan

Véhicules routiers — Ethernet embarqué —

*Partie 3: Exigences et plan d'essais de conformité de la couche
physique optique à 1-Gbit/s*

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Contents

Page

Foreword	vi
Introduction	vii
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Abbreviated terms	2
5 Wake-up and synchronised link sleep functionality	4
5.1 General	4
5.2 PHY service interface for a GEPOF entity	5
5.3 Neighbour PHY service interface for a GEPOF entity	7
5.4 Conciliation service interface	9
5.4.1 General	9
5.4.2 CON_WakeUpSleepPacket.request	11
5.4.3 CON_WakeUpSleepPacket.indication	11
5.4.4 CON_WakeUpSleepPacketACK.indication	12
5.4.5 CON_SignalDetected.indication	12
5.4.6 CON_OAMActive.indication	12
5.5 FFME service interface	13
5.5.1 General	13
5.5.2 FFME_PowerDownStatus.request	15
5.5.3 FFME_PowerDownStatus.indication	15
5.5.4 FFME_WakeUp.indication	15
5.6 802-3bv service interface	16
5.6.1 General	16
5.6.2 802-3bv_PowerDownStatus.request	18
5.6.3 802-3bv_RXDETECT.indication	18
5.7 WUSME Sublayer	18
5.7.1 General	18
5.7.2 WUSME wake-up functionality	18
5.7.3 WUSME synchronised link sleep functionality	21
5.7.4 PHY_SleepStatus.indication generation	23
5.8 FFME sublayer	23
5.8.1 General	23
5.8.2 FFME power state functionality	23
5.9 Conciliation sublayer	26
5.9.1 General	26
5.9.2 Conciliation sublayer variables	26
5.9.3 CRC16 computation	26
5.9.4 Generating ISO/IEC/IEEE 8802-3:2017/Amd 9:2018, Clause 45 stimuli from CON_WakeUpSleepPacket.request	27
5.9.5 Generating CON_WakeUpSleepPacket.indication from ISO/IEC/IEEE 8802-3:2017/Amd 9:2018, Clause 45 stimuli	27
5.9.6 Generating CON_WakeUpSleepPacketACK.indication from ISO/IEC/IEEE 8802-3:2017/Amd 9:2018, Clause 45 stimuli	28
5.9.7 Generating CON_SignalDetected.indication from ISO/IEC/IEEE 8802-3:2017/Amd 9:2018, Clause 45 stimuli	28
5.9.8 Conciliation sublayer constants	28
6 PICS proforma	29
6.1 General	29
6.2 Major capabilities/options	29
6.3 Wake-up and synchronised link sleep PICS items	29
7 Test plan	30

7.1	Test plan scope.....	30
7.2	Test plan architecture	30
7.3	Test plan organization	32
7.4	Test case sections.....	32
7.5	Test case reference tables.....	33
7.5.1	Block 1: test mode and loopback test cases	33
7.5.2	Block 2: PCS, PMA, PMD and MDI test cases	34
7.5.3	Block 3: EEE, OAM and wake-up and synchronised link sleep test cases	37
7.6	Test setups.....	38
7.6.1	General.....	38
7.6.2	Test setup 1: TS_BASE	42
7.6.3	Test setup 2: TS_EXTEND	43
7.6.4	Test setup 3: TS_SIGPOW	44
7.6.5	Test setup 4: TS_AOPTX	44
7.6.6	Test setup 5: TS_ER.....	44
7.6.7	Test setup 6: TS_CW	44
7.6.8	Test setup 7: TS_SW.....	44
7.6.9	Test setup 8: TS_RT_FT.....	44
7.6.10	Test setup 9: TS_OS.....	44
7.6.11	Test setup 10: TS_NOD_POD	44
7.6.12	Test setup 11: TS_DIST	45
7.6.13	Test setup 12: TS_RIN.....	45
7.6.14	Test setup 13: TS_MPD.....	45
7.6.15	Test setup 14: TS_TJ	45
7.6.16	Test setup 15: TS_2LP.....	45
7.6.17	Test setup 16: TS_AOPRX.....	45
7.6.18	Test setup 17: TS_LOOP.....	46
7.7	Block 1 test cases: test modes and loopbacks.....	47
7.7.1	General.....	47
7.7.2	LBT_1: Loopback control.....	47
7.7.3	LBT_2: GMII loopback.....	48
7.7.4	LBT_3: PMD loopback.....	50
7.7.5	TMT_1: Test mode configuration general.....	52
7.7.6	TMT_2: Test mode 1 transmission.....	53
7.7.7	TMT_4: Test mode 2 transmission.....	55
7.7.8	TMT_5: Test mode 3 transmission.....	56
7.7.9	TMT_6: Test mode 4 transmission.....	57
7.7.10	TMT_7: Test mode 5 transmission.....	58
7.7.11	TMT_8: Test mode 6 transmission.....	59
7.7.12	TMT_3: Test mode 1 reception	60
7.7.13	LBT_4: Line loopback.....	62
7.8	Block 2 test cases: Mandatory functionality.....	64
7.8.1	General.....	64
7.8.2	PCST_1: PCS transmission signalling.....	64
7.8.3	PCST_2: PCS transmission PHD.....	65
7.8.4	PCST_3: Transmission PCS payload data.....	69
7.8.5	PCST_4: PCS reception header and payload data.....	72
7.8.6	PCST_5: PCS transmission alignment.....	73
7.8.7	PCST_6: PCS reception alignment.....	75
7.8.8	PMAT_1: Transmission PMA power scaling test.....	77
7.8.9	PMAT_2: THP transmission.....	80
7.8.10	PMAT_3: State diagrams – Transmit PHD commit point.....	82
7.8.11	PMAT_4: State diagrams – Receive PHD commit point.....	84
7.8.12	PMAT_5: State diagrams – TX control.....	86
7.8.13	PMAT_6: State diagrams – RX control.....	88
7.8.14	PMAT_7: State diagrams – Link monitor.....	92
7.8.15	PMAT_8: State diagrams – PHD monitor.....	96
7.8.16	PMAT_9: State diagrams – Adaptive THP TX.....	100

7.8.17	PMAT_10: State diagrams – Adaptive THP request	103
7.8.18	PMAT_11: State diagrams – Quality monitor state diagram	106
7.8.19	PMAT_12: Synchronisation	110
7.8.20	PMAT_13: Equalization and BER measurement	112
7.8.21	PMDT_1: PMD transmit function – Electrical to optical	114
7.8.22	PMDT_2: PMD transmit function – Power control	116
7.8.23	PMDT_3: PMD receive function – Optical to electrical	117
7.8.24	PMDT_4: PMD signal detect function	119
7.8.25	PMD_MDIT_1: Transmitter optical specifications – AOP	120
7.8.26	PMD_MDIT_2: Transmitter optical specifications – ER	121
7.8.27	PMD_MDIT_3: Transmitter optical specifications – Centre wavelength	122
7.8.28	PMD_MDIT_4: Transmitter optical specifications – Spectral width	123
7.8.29	PMD_MDIT_5: Transmitter optical specifications – Rise time	123
7.8.30	PMD_MDIT_6: Transmitter optical specifications – Fall time	124
7.8.31	PMD_MDIT_7: Transmitter optical specifications – Signal overshoot	125
7.8.32	PMD_MDIT_8: Transmitter optical specifications – Positive output droop	126
7.8.33	PMD_MDIT_9: Transmitter optical specifications – Negative output droop	127
7.8.34	PMD_MDIT_10: Transmitter optical specifications – Signal distortion	127
7.8.35	PMD_MDIT_11: Transmitter optical specifications – Relative intensity noise	128
7.8.36	PMD_MDIT_12: Transmitter optical specifications – Transmitter off transition time	129
7.8.37	PMD_MDIT_13: Transmitter optical specifications – Transmitter on transition time	132
7.8.38	PMD_MDIT_14: Transmitter optical specifications – Modal power distribution	134
7.8.39	PMD_MDIT_15: Transmitter optical specifications – Timing jitter	135
7.8.40	PMD_MDIT_16: Receiver optical specifications – AOP for a minimum BER	136
7.8.41	PMD_MDIT_17: Receiver optical specifications – Damage threshold power	137
7.8.42	DLYT_1: Transmission plus reception delay	138
7.9	Block 3 test cases: Optional functionality	139
7.9.1	General	139
7.9.2	EEET_1: Enter to LPI mode transmit operation	140
7.9.3	EEET_2: EEE capability exchange	143
7.9.4	EEET_3: Loop test for LPI mode	145
7.9.5	EEET_4: Resume from LPI mode transmit operation	148
7.9.6	OAMT_1: State diagrams – OAM transmit control	150
7.9.7	OAMT_2: State diagrams – OAM receive control	155
7.9.8	OAMT_3: Loop test for OAMPDU transmission and reception	159
7.9.9	WUST_1: WUSME synchronised link sleep state diagram – Synchronised link sleep ACK	165
7.9.10	WUST_2: WUSME synchronised link sleep state diagram – SLEEP_ACK packet reception	169
7.9.11	WUST_3: WUSME synchronised link sleep state diagram – SLEEP packet reception	173
7.9.12	WUST_4: WUSME synchronised link sleep state diagram – Sleep rejection	176
7.9.13	WUST_5: WUSME wake-up state diagram	182
	Bibliography	186

Foreword

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This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 31, *Data communication*.

A list of all parts in the ISO 21111 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The ISO 21111 series includes in-vehicle Ethernet requirements and test plans that are disseminated in other International Standards and complements them with additional test methods and requirements. The resulting requirement and test plans are structured in different documents following the Open Systems Interconnection (OSI) reference model and grouping the documents that depend on the physical media and bit rate used.

In general, the Ethernet requirements are specified in ISO/IEC/IEEE 8802-3. The ISO 21111 series provides supplemental specifications (e.g. wake-up, I/O functionality), which are required for in-vehicle Ethernet applications. In road vehicles, Ethernet networks are used for different purposes requiring different bit-rates. Currently, the ISO 21111 series specifies the 1-Gbit/s optical and 100-Mbit/s electrical physical layer.

The ISO 21111 series contains requirement specifications and test methods related to the in-vehicle Ethernet. This includes requirement specifications for physical layer entity (e.g. connectors, physical layer implementations) providers, device (e.g. electronic control units, gateway units) suppliers, and system (e.g. network systems) designers. Additionally, there are test methods specified for conformance testing and for interoperability testing.

Safety (electrical safety, protection, fire, etc.) and electromagnetic compatibility (EMC) requirements are out of the scope of the ISO 21111 series.

The structure of the specifications given in the ISO 21111 series complies with the Open Systems Interconnection (OSI) reference model specified in ISO/IEC 7498-1^[1] and ISO/IEC 10731^[5].

ISO 21111-1 defines the terms which are used in this series of standards and provides an overview of the standards for in-vehicle Ethernet including the complementary relations to ISO/IEC/IEEE 8802-3, the document structure, type of physical entities, in-vehicle Ethernet specific functionalities and so on.

ISO 21111-2 specifies the interface between reconciliation sublayer and physical entity including reduced gigabit media independent interface (RGMII), and the common physical entity wake-up and synchronized link sleep functionalities, independent from physical media and bit rate.

This document specifies supplemental requirements to a physical layer capable of transmitting 1-Gbit/s over plastic optical fibre compliant with ISO/IEC/IEEE 8802-3, with specific application to communications inside road vehicles, and a test plan for physical entity conformance testing.

ISO 21111-4 specifies the optical components requirements and test methods for 1-Gbit/s optical in-vehicle Ethernet.

ISO 21111-5 specifies, for 1-Gbit/s optical in-vehicle Ethernet, requirements on the physical layer at system level, requirements on the interoperability test set-ups, the interoperability test plan that checks the requirements for the physical layer at system level, requirements on the device-level physical layer conformance test set-ups, and device-level physical layer conformance test plan that checks a set of requirements for the OSI physical layer that are relevant for device vendors.

ISO 21111-6 specifies advanced features of an ISO/IEC/IEEE 8802-3 in-vehicle Ethernet physical layer (often also called transceiver), e.g. for diagnostic purposes for in-vehicle Ethernet physical layers. It specifies advanced physical layer features, wake-up and sleep features, physical layer test suite, physical layer control requirements and conformance test plan, physical sublayers test suite and physical sublayers requirements and conformance test plan.

ISO 21111-7 specifies the implementation for ISO/IEC/IEEE 8802-3:2017/Amd 1:2017, which defines the interface implementation for automotive applications together with requirements on components used to realize this Bus Interface Network (BIN). ISO 21111-7 also defines further testing and system requirements for systems implemented according to the system specification. In addition, ISO 21111-7 defines the channels for tests of transceivers with a test wiring harness that simulates various electrical communication channels.

ISO 21111-8 specifies the transmission media, the channel performance and the tests for ISO/IEC/IEEE 8802-3 in-vehicle Ethernet.

ISO 21111-9 specifies the data link layer requirements and conformance test plan. It specifies the requirements and test plan for devices and systems with bridge functionality.

ISO 21111-10 specifies the application to network layer requirements and test plan. It specifies the requirements and test plan for devices and systems that include functionality related with OSI layers from 3 to 7.

Figure 1 shows the parts of the ISO 21111 series and the document structure.

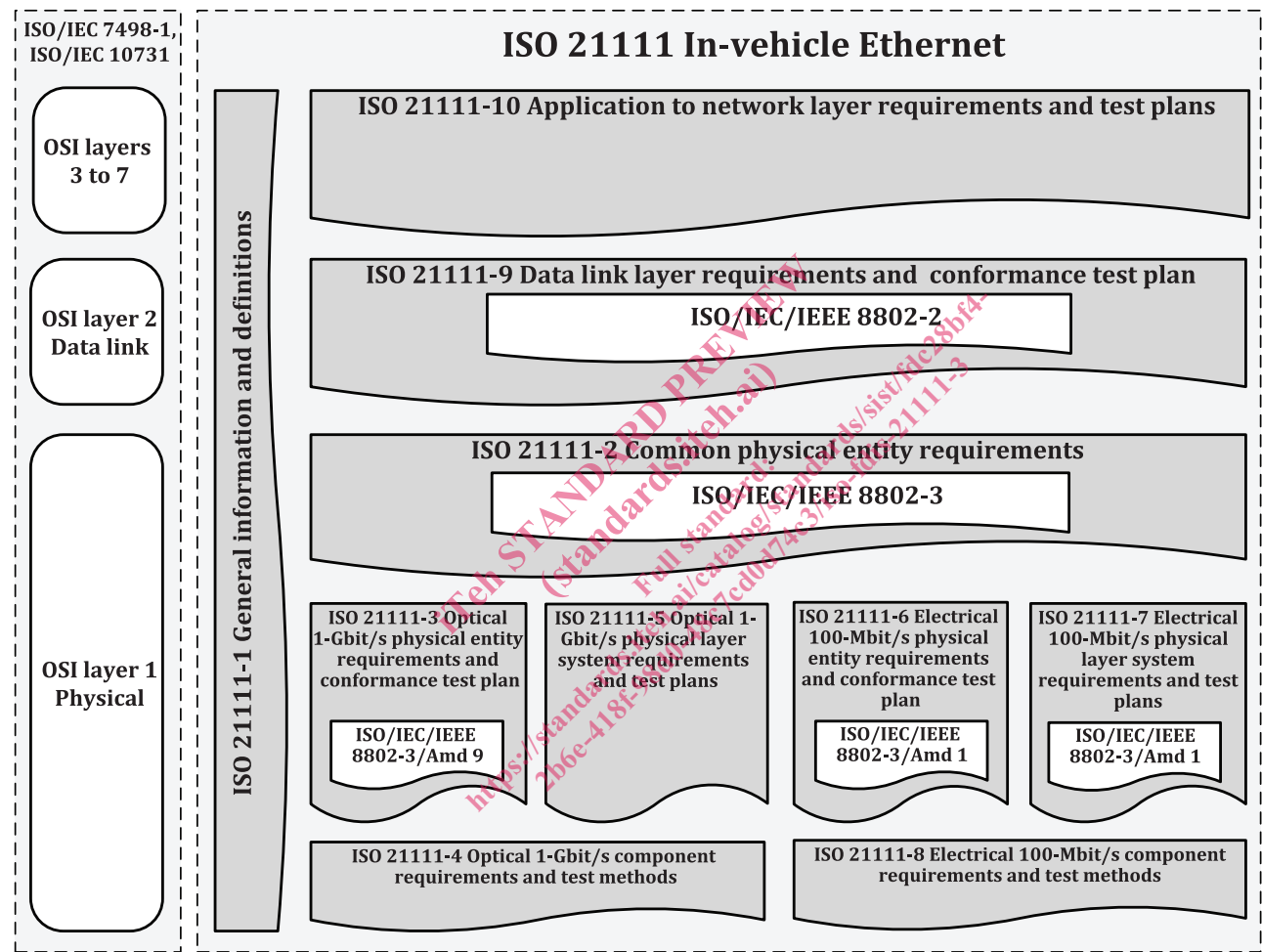


Figure 1 — In-vehicle Ethernet document reference according to the OSI model

Road vehicles — In-vehicle Ethernet —

Part 3:

Optical 1-Gbit/s physical entity requirements and conformance test plan

1 Scope

This document provides supplemental specifications to a physical layer capable of transmitting 1 Gbit/s over plastic optical fibre compliant with ISO/IEC/IEEE 8802-3:2017/Amd 9:2018, with specific application to communications inside road vehicles.

Additionally, there is a test plan specified for conformance testing. The test plan includes test cases to assure compliance of an IUT with the functionality specified in this document.

ISO/IEC/IEEE 8802-3:2017/Amd 9:2018 is considered indispensable for the application of this document.

The supplemental specifications include wake-up and synchronised link sleep functionality. The specification includes the sublayers, service interfaces, and state diagrams that support the functionality. The supplemental specifications are collected in protocol implementation conformance statement (PICS).

The requirements specified in ISO/IEC/IEEE 8802-3:2017/Amd 9:2018 and in this document constitute the complete PICS that specifies the GEPOF physical entity functionality.

The optical component requirements and test methods for optical 1-Gbit/s transmission of in-vehicle Ethernet are not within the scope of this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 21111-1¹⁾, *Road vehicle — In-vehicle Ethernet — Part 1: General information and definitions*

ISO 21111-2:—²⁾, *Road vehicles — In-vehicle Ethernet — Part 2: Common medium-independent interface specifications*

ISO/IEC/IEEE 8802-3:2017, *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements — Part 3: Standard for Ethernet*

ISO/IEC/IEEE 8802-3:2017/Amd 9:2018, *Physical layer specifications and management parameters for 1000 Mb/s operation over plastic optical fiber*

1) Under preparation. Stage at the time of publication: ISO/DIS 21111-1:2020.

2) Under preparation. Stage at the time of publication: ISO/DIS 21111-2:2020.

3 Terms and definitions

For the purposes of this document, the terms and definitions in ISO/IEC/IEEE 8802-3, ISO 21111-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

neighbour GEPOF entities

two or more GEPOF entities embedded in the same device

3.2

GEPOF link partners

two GEPOF entities connected bi-directionally through POF

3.3

IEEE 802.3bv physical layer

physical layer compliant with 1000BASE-RHC

Note 1 to entry: 1000BASE-RHC is specified in ISO/IEC/IEEE 8802-3:2017/Amd 9:2018, 1.4.26c.

3.4

symbol

smallest unit of data transmission on the medium

Note 1 to entry: Symbols are specified in ISO/IEC/IEEE 8802-3:2017, 1.4.393 and in ISO/IEC/IEEE 8802-3:2017/Amd 9:2018, 115.2.

3.5

transmit block

sequence of a fixed number of *symbols* (3.4) that encodes data from MAC layer and control information

Note 1 to entry: The transmit block is specified in ISO/IEC/IEEE 8802-3:2017/Amd 9:2018, 115.2.1.

3.6

transmit block generator

instrument that transmits and generates a *transmit block* (3.5) with controlled content

3.7

transmit block analyser

instrument that receives a *transmit block* (3.5) and processes the information contained in it

3.8

payload data sub-block

part of a *transmit block* (3.5) that encodes data from MAC layer

Note 1 to entry: The payload data sub-block is specified in ISO/IEC/IEEE 8802-3:2017/Amd 9:2018, 115.2.1.

4 Abbreviated terms

ACK	acknowledgement
AOP	average optical power
BCH	Bose, Ray-Chaudhuri, Hocquenghem
BER	bit error rate

CID	company identifier
CRC	cyclic check redundancy
EEE	energy-efficient Ethernet
ER	extinction ratio
FFME	fast forward management entity
GEPOF	gigabit Ethernet over plastic optical fibre
GMII	gigabit media independent interface
IUT	implementation under test
LPI	low power idle
LSB	least significant bit
LT	lower tester
MAC	medium access control
MDI	medium dependent interface
MDIO	management data input/output
MSB	most significant bit
OAM	operations, administration, and maintenance
OAMPDU	OAM protocol data unit
PCS	physical coding sublayer
PHD	physical header data
PHS	physical header sub-frame
PICS	protocol implementation conformance statement
PMA	physical medium attachment
PMD	physical medium dependent
POF	plastic optical fibre
RIN	reference input noise
RX	receiver
TX	transmitter
UT	upper tester
WUSME	wake-up and synchronised link sleep management entity

5 Wake-up and synchronised link sleep functionality

5.1 General

Figure 2 shows the functional block diagram of the GEPOF entity.

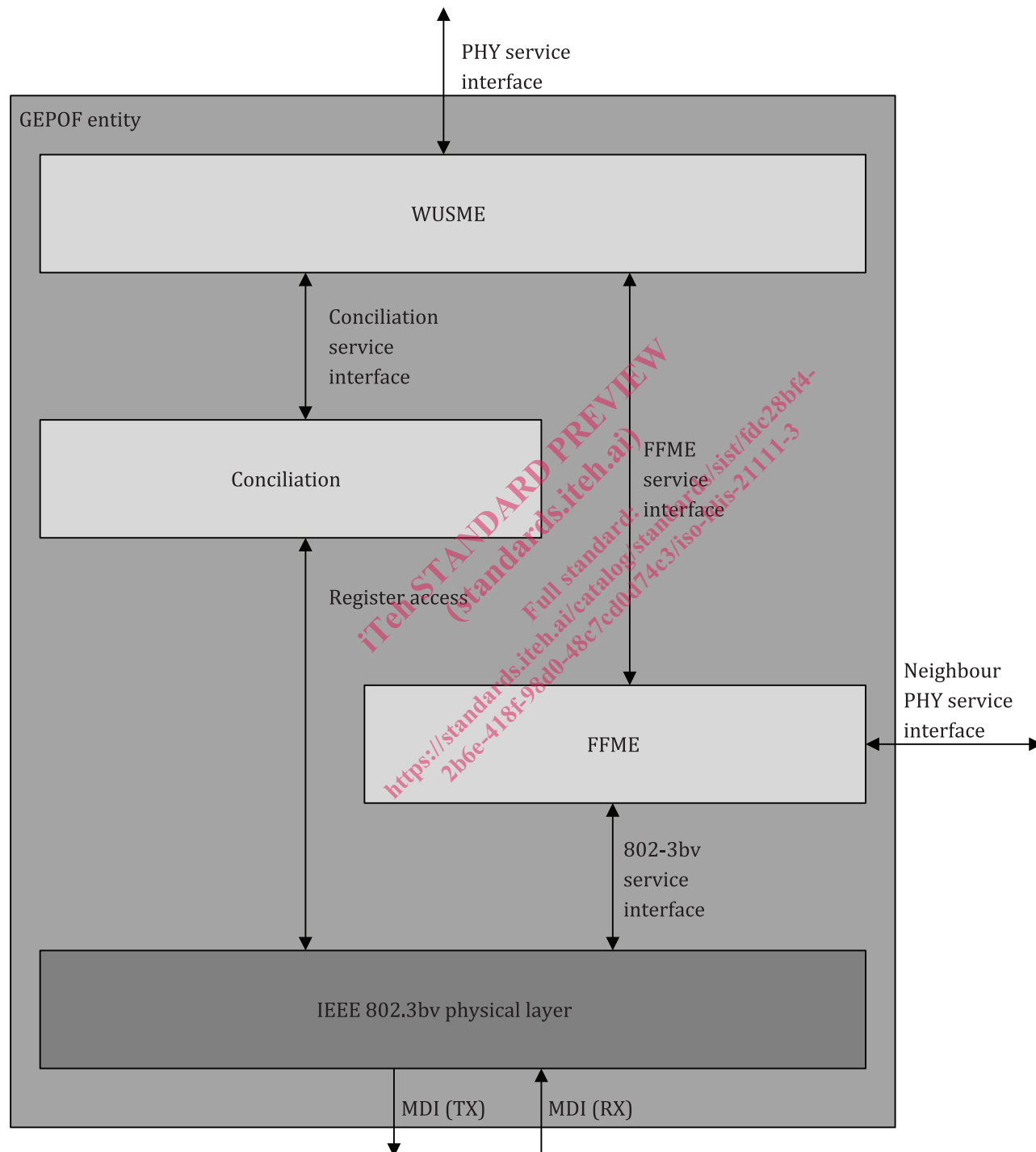


Figure 2 — GEPOF entity functional block diagram

WUSME sublayer shall communicate with the MAC layer over the PHY service interface specified in 5.2 and in ISO 21111-2:—, 6.8.

WUSME sublayer shall contain wake-up and synchronised link sleep algorithms as specified in ISO 21111-2:—, 6.4 and 6.5. This specification includes exchange of events that shall be encoded by using message exchange over the 1000BASE-H OAM channel specified in ISO/IEC/IEEE 8802-3:2017/Amd 9:2018, 115.9 and the state diagrams specified in 5.7.

WUSME sublayer shall communicate with the conciliation sublayer over the conciliation service interface specified in 5.2.

WUSME sublayer shall communicate with FFME sublayer over the FFME service interface specified in 5.5.

FFME sublayer shall behave as the state diagram that controls the power state of the GEPOF entity specified in 5.8 and ISO 21111-2:—, 6.2.

FFME shall communicate with another FFME located inside neighbour GEPOF entity over the neighbour PHY service interface specified in 5.3 and in ISO 21111-2:—, 6.9.

FFME shall communicate with the IEEE 802.3bv physical layer over the 802-3bv service interface specified in 5.6.

The conciliation sublayer shall include the functions described in 5.9 that translate each of the conciliation service primitives into transactions over MDIO registers.

Bit naming and MDIO register numbering are specified in ISO/IEC/IEEE 8802-3:2017/Amd 9:2018, Clause 45. CID is specified in ISO/IEC/IEEE 8802-A:2015, 1.4.162.

The high logic level and low logic level for the MDIO registers are specified in ISO/IEC/IEEE 8802-3:2017, 22.4.

The value of the service primitive parameters follows a positive logic. TRUE corresponds to a high logic level and FALSE corresponds to a low logic level.

State diagrams in this document follow the notation specified in ISO/IEC/IEEE 8802-3:2017, 1.2.

5.2 PHY service interface for a GEPOF entity

The following specifies the mandatory service primitives of the PHY service interface as given in ISO 21111-2 that are required by a GEPOF entity.

Figure 3 shows the service primitives of the PHY service interface and the relationship with the GEPOF entity sublayers.