FINAL
DRAFT

INTERNATIONAL
STANDARD

**ISO/FDIS
21111-3**

ISO/TC **22**/SC **31**

Secretariat: DIN

Voting begins on:
2020-04-03

Voting terminates on:
2020-05-29

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

Reference number
ISO/FDIS 21111-3:2020(E)

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Published in Switzerland

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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.

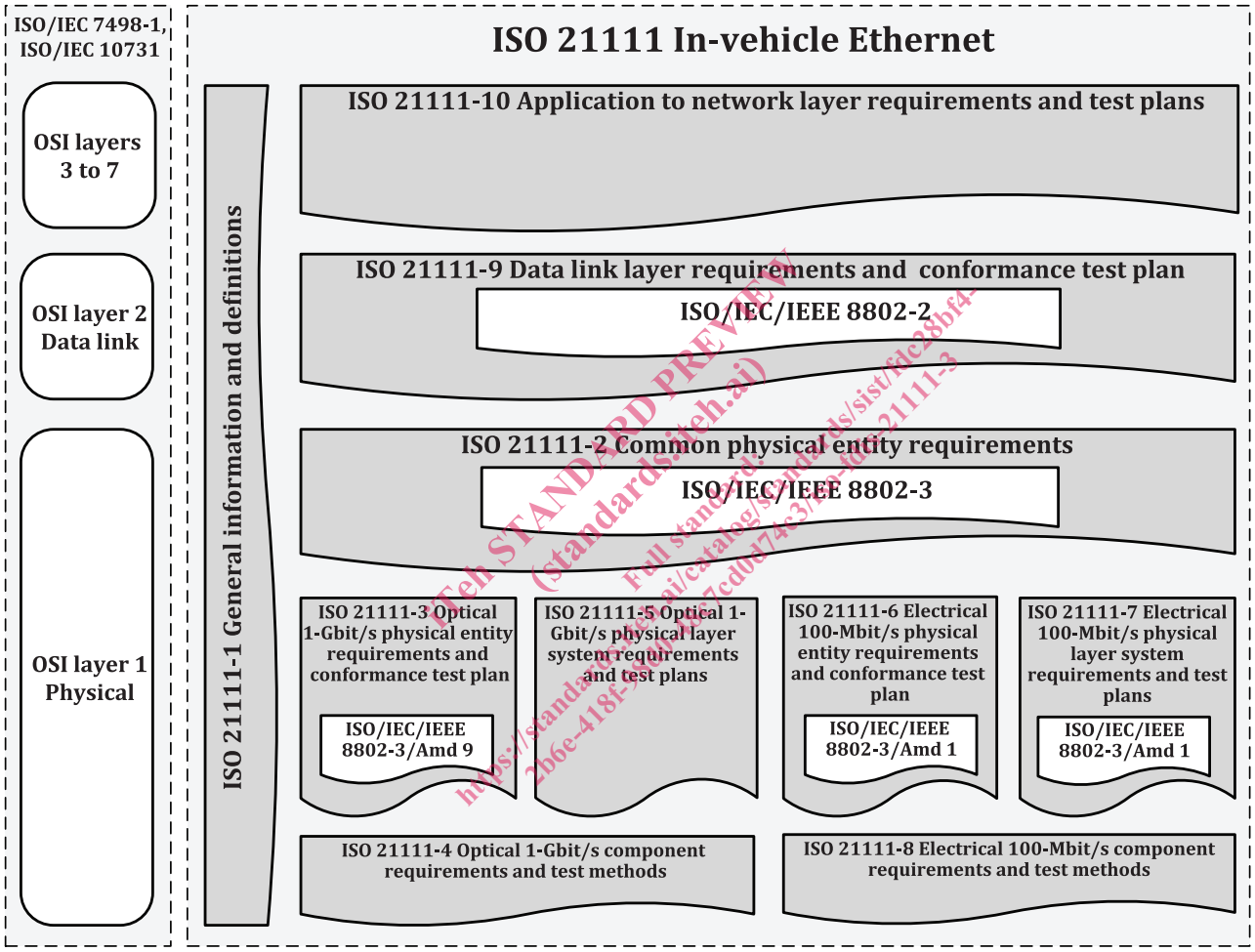

Figure 1 — In-vehicle Ethernet document reference according to the OSI model

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 21111-1[1)], *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.

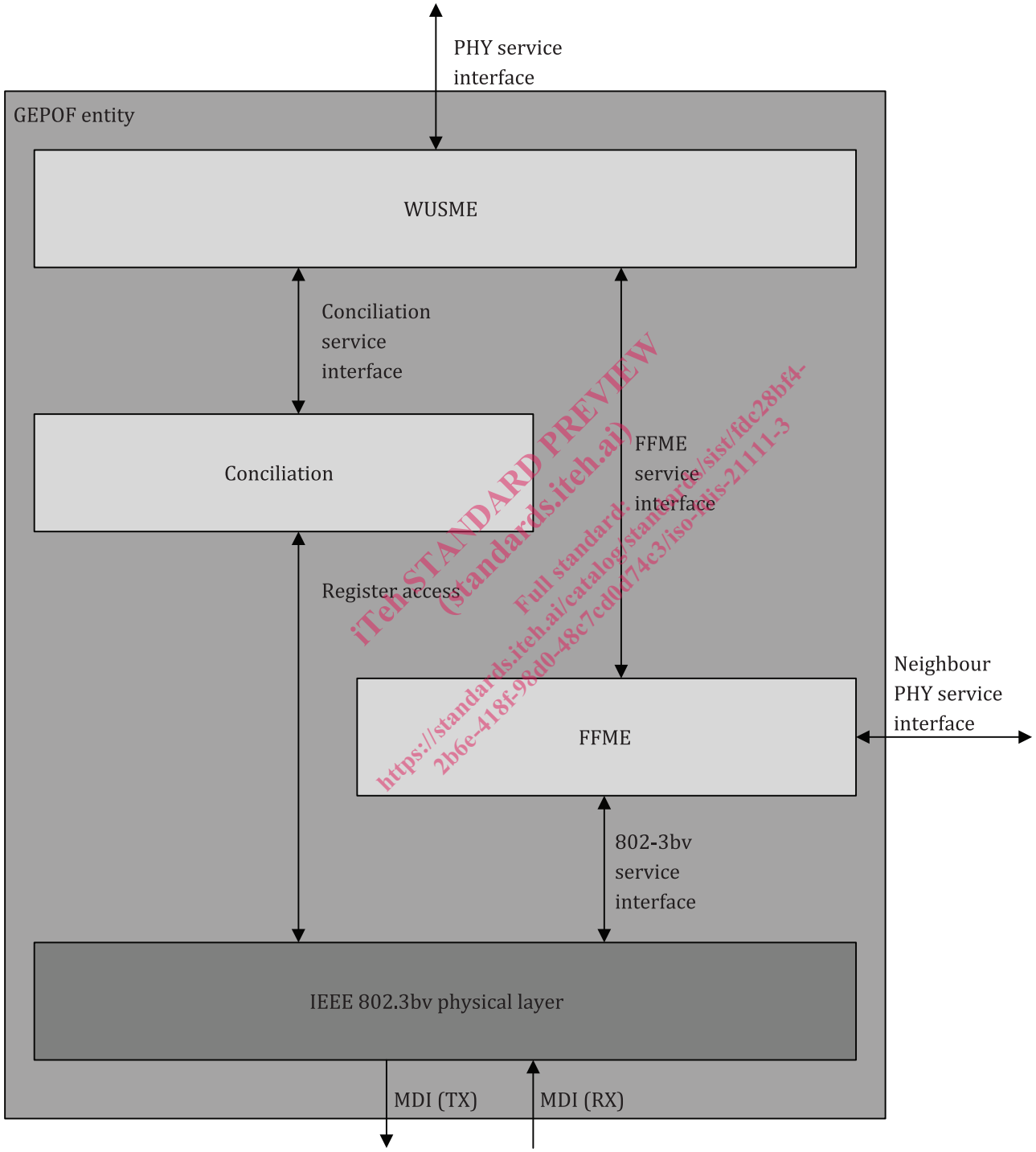

Figure 2 — GEPOF entity functional block diagram

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.