IEEE STANDARDS ASSOCIATION IEEE

IEEE Standard for Conformance Test Procedures for Service Interoperability in Ethernet Passive Optical Networks, IEEE Std 1904.1™ Package B

Version 001.001

IEEE Communications Society

Sponsored by the
Standards Development Board

IEEE
3 Park Avenue
New York, NY 10016-5997
USA

IEEE Std 1904.1™/Conformance02-2014
(Conformance to
IEEE Std 1904.1-2013)

IEEE Std 1904.1™/Conformance02-2014
(Conformance to
IEEE Std 1904.1-2013)

IEEE Standard for Conformance Test Procedures for Service Interoperability in Ethernet Passive Optical Networks, IEEE Std 1904.1™ Package B

Version 001.001

Sponsor

Standards Development Board
of the
IEEE Communications Society

Approved 3 November 2014

IEEE-SA Standards Board

Abstract: This standard specifies a suite of conformance tests for system-level requirements of Ethernet Passive Optical Network (EPON) equipment, defined in IEEE 1904.1 Package B.

Keywords: 1G-EPON, 10G-EPON, conformance, Conformance02, EPON, Ethernet Passive Optical Network, IEEE 1904.1™, Package B, SIEPON

The Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York, NY 10016-5997, USA

Copyright © 2015 by The Institute of Electrical and Electronics Engineers, Inc.
All rights reserved. Published 16 February 2015. Printed in the United States of America.

IEEE is a registered trademark in the U.S. Patent & Trademark Office, owned by The Institute of Electrical and Electronics Engineers, Incorporated.

PDF: ISBN 978-0-7381-9427-1 STD20040
Print: ISBN 978-0-7381-9428-8 STDPD20040

IEEE prohibits discrimination, harassment and bullying.
For more information, visit http://www.ieee.org/web/aboutus/whatis/policies/p9-26.html.
No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher.

Important Notices and Disclaimers Concerning IEEE Standards Documents

IEEE documents are made available for use subject to important notices and legal disclaimers. These notices and disclaimers, or a reference to this page, appear in all standards and may be found under the heading "Important Notice" or "Important Notices and Disclaimers Concerning IEEE Standards Documents."

Notice and Disclaimer of Liability Concerning the Use of IEEE Standards Documents

IEEE Standards documents (standards, recommended practices, and guides), both full-use and trial-use, are developed within IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association ("IEEE-SA") Standards Board. IEEE ("the Institute") develops its standards through a consensus development process, approved by the American National Standards Institute ("ANSI"), which brings together volunteers representing varied viewpoints and interests to achieve the final product. Volunteers are not necessarily members of the Institute and participate without compensation from IEEE. While IEEE administers the process and establishes rules to promote fairness in the consensus development process, IEEE does not independently evaluate, test, or verify the accuracy of any of the information or the soundness of any judgments contained in its standards.

IEEE does not warrant or represent the accuracy or content of the material contained in its standards, and expressly disclaims all warranties (express, implied and statutory) not included in this or any other document relating to the standard, including, but not limited to, the warranties of: merchantability; fitness for a particular purpose; non-infringement; and quality, accuracy, effectiveness, currency, or completeness of material. In addition, IEEE disclaims any and all conditions relating to: results; and workmanlike effort. IEEE standards documents are supplied "AS IS" and "WITH ALL FAULTS."

Use of an IEEE standard is wholly voluntary. The existence of an IEEE standard does not imply that there are no other ways to produce, test, measure, purchase, market, or provide other goods and services related to the scope of the IEEE standard. Furthermore, the viewpoint expressed at the time a standard is approved and issued is subject to change brought about through developments in the state of the art and comments received from users of the standard.

In publishing and making its standards available, IEEE is not suggesting or rendering professional or other services for, or on behalf of, any person or entity nor is IEEE undertaking to perform any duty owed by any other person or entity to another. Any person utilizing any IEEE Standards document, should rely upon his or her own independent judgment in the exercise of reasonable care in any given circumstances or, as appropriate, seek the advice of a competent professional in determining the appropriateness of a given IEEE standard.

IN NO EVENT SHALL IEEE BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO: PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE PUBLICATION, USE OF, OR RELIANCE UPON ANY STANDARD, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE AND REGARDLESS OF WHETHER SUCH DAMAGE WAS FORESEEABLE.

Translations

The IEEE consensus development process involves the review of documents in English only. In the event that an IEEE standard is translated, only the English version published by IEEE should be considered the approved IEEE standard.

Official statements

A statement, written or oral, that is not processed in accordance with the IEEE-SA Standards Board Operations Manual shall not be considered or inferred to be the official position of IEEE or any of its committees and shall not be considered to be, or be relied upon as, a formal position of IEEE. At lectures, symposia, seminars, or educational courses, an individual presenting information on IEEE standards shall make it clear that his or her views should be considered the personal views of that individual rather than the formal position of IEEE.

Comments on standards

Comments for revision of IEEE Standards documents are welcome from any interested party, regardless of membership affiliation with IEEE. However, IEEE does not provide consulting information or advice pertaining to IEEE Standards documents. Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments. Since IEEE standards represent a consensus of concerned interests, it is important that any responses to comments and questions also receive the concurrence of a balance of interests. For this reason, IEEE and the members of its societies and Standards Coordinating Committees are not able to provide an instant response to comments or questions except in those cases where the matter has previously been addressed. For the same reason, IEEE does not respond to interpretation requests. Any person who would like to participate in revisions to an IEEE standard is welcome to join the relevant IEEE working group.

Comments on standards should be submitted to the following address:

Secretary, IEEE-SA Standards Board
445 Hoes Lane
Piscataway, NJ 08854 USA

Laws and regulations

Users of IEEE Standards documents should consult all applicable laws and regulations. Compliance with the provisions of any IEEE Standards document does not imply compliance to any applicable regulatory requirements. Implementers of the standard are responsible for observing or referring to the applicable regulatory requirements. IEEE does not, by the publication of its standards, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

Copyrights

IEEE draft and approved standards are copyrighted by IEEE under U.S. and international copyright laws. They are made available by IEEE and are adopted for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of engineering practices and methods. By making these documents available for use and adoption by public authorities and private users, IEEE does not waive any rights in copyright to the documents.

Photocopies

Subject to payment of the appropriate fee, IEEE will grant users a limited, non-exclusive license to photocopy portions of any individual standard for company or organizational internal use or individual, non-commercial use only. To arrange for payment of licensing fees, please contact Copyright Clearance Center, Customer Service, 222 Rosewood Drive, Danvers, MA 01923 USA; +1 978 750 8400. Permission to photocopy portions of any individual standard for educational classroom use can also be obtained through the Copyright Clearance Center.

Updating of IEEE Standards documents

Users of IEEE Standards documents should be aware that these documents may be superseded at any time by the issuance of new editions or may be amended from time to time through the issuance of amendments, corrigenda, or errata. An official IEEE document at any point in time consists of the current edition of the document together with any amendments, corrigenda, or errata then in effect.

Every IEEE standard is subjected to review at least every ten years. When a document is more than ten years old and has not undergone a revision process, it is reasonable to conclude that its contents, although still of some value, do not wholly reflect the present state of the art. Users are cautioned to check to determine that they have the latest edition of any IEEE standard.

In order to determine whether a given document is the current edition and whether it has been amended through the issuance of amendments, corrigenda, or errata, visit the IEEE-SA Website at http://ieeexplore.ieee.org/xpl/standards.jsp or contact IEEE at the address listed previously. For more information about the IEEE-SA or IEEE's standards development process, visit the IEEE-SA Website at http://standards.ieee.org.

Errata

Errata, if any, for all IEEE standards can be accessed on the IEEE-SA Website at the following URL: http://standards.ieee.org/findstds/errata/index.html. Users are encouraged to check this URL for errata periodically.

Patents

Attention is called to the possibility that implementation of this standard may require use of subject matter covered by patent rights. By publication of this standard, no position is taken by the IEEE with respect to the existence or validity of any patent rights in connection therewith. If a patent holder or patent applicant has filed a statement of assurance via an Accepted Letter of Assurance, then the statement is listed on the IEEE-SA Website at http://standards.ieee.org/about/sasb/patcom/patents.html. Letters of Assurance may indicate whether the Submitter is willing or unwilling to grant licenses under patent rights without compensation or under reasonable rates, with reasonable terms and conditions that are demonstrably free of any unfair discrimination to applicants desiring to obtain such licenses.

Essential Patent Claims may exist for which a Letter of Assurance has not been received. The IEEE is not responsible for identifying Essential Patent Claims for which a license may be required, for conducting inquiries into the legal validity or scope of Patents Claims, or determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance, if any, or in any licensing agreements are reasonable or non-discriminatory. Users of this standard are expressly advised that determination of the validity of any patent rights, and the risk of infringement of such rights, is entirely their own responsibility. Further information may be obtained from the IEEE Standards Association.

Participants

At the time this standard was submitted to the IEEE-SA Standards Board for approval, the SIEPON Working Group had the following membership:

Glen Kramer, *Working Group Chair*
Ken-Ichi Suzuki, *Working Group Vice Chair*
Zhou Zhen, *Executive Secretary*

Toshihiko Kusano, *Conformance Test Procedures Task Force Chair*
Motoyuki Takizawa, *Conformance Test Procedures Task Force Editor*

The following individuals submitted technical contributions or commented on the standard at various stages of the project development:

James Chen, Hitachi, Ltd
Raziel Gabe, PMC Sierra
Marek Hajduczenia, Bright House Networks (formerly with ZTE Corporation)
Lior Khermosh, PMC Sierra
Curtis Knittle, CableLabs
Shinichi Kouyama, Sumitomo Electric Industries, Ltd.
Glen Kramer, Broadcom Corporation
Toshihiko Kusano, Oliver Solutions Ltd.
Edwin Mallette, Bright House Networks
Makoto Matsuoka, Hitachi, Ltd
Daisuke Murayama, NTT Corporation
Susumu Nishihara, NTT Corporation
Sadaichiro Ogushi, NEC
Kazumi Onishi, Oki Electric Industry Co., Ltd.
Hiroshi Ou, NTT Corporation
Liu Qian, RITT, CATR
Takeshi Suehiro, Mitsubishi Electric Corporation
Ken-Ichi Suzuki, NTT Corporation
Masashi Tadokoro, NTT Corporation
Motoyuki Takizawa, Fujitsu Telecom Networks
Lu Yang, RITT, CATR
Zhou Zhen, FiberHome Technologies

The following members of the entity balloting committee voted on this standard. Balloters may have voted for approval, disapproval, or abstention:

Bright House Networks
Broadcom Corporation
Cable Television Laboratories, Inc. (CableLabs)
FiberHome Technologies Group
Fujitsu Telecom Networks
Hitachi, Ltd.
Huawei Technologies Co., Ltd.
ISB Corporation
Marvell Semiconductor, Inc.
Oki Electric Industry Co., Ltd.
Oliver Solutions, Ltd.
PMC-Sierra, Inc.
Research Institute of Telecommunications Transmission of Ministry of Industry and Information Technology (RITT)
Sumitomo Electric Industries, Ltd.

Copyright © 2015 IEEE. All rights reserved.

When the IEEE-SA Standards Board approved this standard on 3 November 2014, it had the following membership:

John Kulick, *Chair*
Jon Walter Rosdahl, *Vice-chair*
Richard H. Hulett, *Past Chair*
Konstantinos Karachalios, *Secretary*

Peter Balma
Farooq Bari
Ted Burse
Clint Chaplain
Stephen Dukes
Jean-Phillippe Faure
Gary Hoffman
Michael Janezic
Jeffrey Katz
Joseph L. Koepfinger*
David Law
Hung Ling
Oleg Logvinov
T. W. Olsen
Glenn Parsons
Ron Peterson
Adrian Stephens
Peter Sutherland
Yatin Trivedi
Phil Winston
Don Wright
Yu Yuan

*Member Emeritus

Also included are the following nonvoting IEEE-SA Standards Board liaisons:

Richard DeBlasio, *DOE Representative*
Michael Janezic, *NIST Representative*

Don Messina
IEEE-SA Content Production and Management

Soo Kim
IEEE-SA Technical Program Operations

Copyright © 2015 IEEE. All rights reserved.

Introduction

This introduction is not part of IEEE Std 1904.1-Conformance02-2014, IEEE Standard for Conformance Test Procedures for Service Interoperability in Ethernet Passive Optical Networks, IEEE Std 1904.1™ Package B – Version 001.001.

This standard builds upon the IEEE 1904.1 Service Interoperability in Ethernet Passive Optical Networks (SIEPON) and specifies a suite of conformance tests for system-level requirements of Ethernet Passive Optical Network (EPON) equipment, defined in IEEE 1904.1 Package B. This standard supplements IEEE Std 1904.1 by providing test cases to verify key requirements for proper service establishment across the Optical Line Terminal (OLT) and Optical Network Units (ONUs) from different manufacturers. Interoperability between the OLT and ONUs is verified indirectly, by assessing conformance of individual devices to IEEE 1904.1 Package B requirements.

Copyright © 2015 IEEE. All rights reserved.

Contents

1. Overview 1

1.1 Scope 1
1.2 Purpose 1
1.3 Mandatory and optional requirements 2
1.4 Test suite version and conformance test identifier 2
1.4.1 Major and minor conformance test suite versions 2
1.4.2 Conformance test identifier 2
1.4.3 Updating conformance test identifier and test suite version 2
1.5 Overview of clauses 3

2. Normative references 4

3. Definitions, acronyms, and abbreviations 5

3.1 Definitions 5
3.2 Acronyms and abbreviations 5
3.3 Package B organizationally unique identifier (OUI) value 6

4. Test equipment and test configuration 7

4.1 Functional requirements for test equipment 7
4.1.1 Introduction 7
4.1.2 Packet Analyzer 7
4.1.3 PON Protocol Analyzer 7
4.1.4 Packet Generator 8
4.1.4.1 Size of Ethernet frame 8
4.1.5 ODN 8
4.1.6 OLT Emulator 8
4.1.7 ONU Emulator 9
4.2 Test equipment configurations 9
4.2.1 Introduction 9
4.2.2 ONU under test, without Packet Generator/Analyzer 9
4.2.3 OLT under test, without Packet Generator/Analyzer 10
4.2.4 ONU under test, with Packet Generator/Analyzer 10
4.2.5 OLT under test, with Packet Generator/Analyzer 11
4.3 Frame flow configurations 12

5. Conformance map 14

5.1 Introduction 14
5.2 Mapping between IEEE 1904.1 Package B PICS for ONU and test cases 14
5.3 Mapping between IEEE 1904.1 Package B PICS for OLT and test cases 15

6. Common messages 16

6.1 Message and TLV primitives 16
6.1.1 `Set_Request( TLV1,…, TLVn )` primitive 16
6.1.2 `TLV_ObjectID( type, instance )` primitive 16
6.2 Group AU messages 17
6.2.1 `EAPOL( ProtocolVersion, PacketType, EAP )` primitive 17
6.2.2 `EAP( Code, Data )` primitive 17
6.2.3 `EAP_Identity()` primitive 18
6.2.4 `EAP_MD5()` primitive 18
6.2.5 `EAP_GPSK( OPCode )` primitive 18

Copyright © 2015 IEEE. All rights reserved.

6.3 Group DCD messages 19
6.3.1 Information_Local (Flags, Ver) primitive 19
6.3.2 Information_Remote(Flags, Ver) primitive 19
6.4 Group RF messages 20
6.4.1 MPCP_GATE() primitive 20
6.4.2 MPCP_REPORT() primitive 21
6.5 Group UVM/TVM messages 21
6.5.1 TLV_VLAN_Mode(VLANmode) primitive 21
6.5.2 TLV_PON_VID(ponVID) primitive 22
6.5.3 TLV_ToS/CoS_Conversion_Table(PCPmap0, PCPmap1, PCPmap2, PCPmap3, PCPmap4, PCPmap5, PCPmap6, PCPmap7) primitive 22
6.5.4 TLV_MAC_Address_Learning(Learning) primitive 22
6.5.5 TLV_ONU_Restart(Restart) primitive 23

7. ONU tests 24

7.1 Introduction 24
7.2 Common ONU requirements 24
7.3 Group AU: Authentication 24
7.3.1 BU-AU4b-01, Test case for ONU authentication for 1G-EPON ONU 24
7.3.1.1 Test description 24
7.3.1.2 Required equipment and test configuration 24
7.3.1.3 Test procedure and expected results 25
7.3.2 BU-AU6b-01, Test case for ONU authentication for 10G-EPON ONU 26
7.3.2.1 Test description 26
7.3.2.2 Required equipment and test configuration 26
7.3.2.3 Test procedure and expected results 27
7.4 Group DCD: Device and capability discovery 29
7.4.1 BU-DCD1-01, Test case for eOAM and capability discovery process, successful discovery 29
7.4.1.1 Test description 29
7.4.1.2 Required equipment and test configuration 29
7.4.1.3 Test procedure and expected results 29
7.5 Group DE: Data encryption 30
7.5.1 BU-DE1-01, Test case for data encryption, successful IEEE 802.1ae-2006 encryption 30
7.5.1.1 Test description 30
7.5.1.2 Required equipment and test configuration 30
7.5.1.3 Test procedure and expected results 31
7.6 Group RF: *REPORT* MPCPDU format 32
7.6.1 BU-RF1-01, Test case for *REPORT* MPCPDU format for ONU 32
7.6.1.1 Test description 32
7.6.1.2 Required equipment and test configuration 33
7.6.1.3 Test procedure and expected results 33
7.7 Group UVM: ONU VLAN modes 34
7.7.1 BU-UVM2-01, Test case for Transparent VLAN mode, upstream and downstream directions 34
7.7.1.1 Test description 34
7.7.1.2 Required equipment and test configuration 34
7.7.1.3 Test procedure and expected results 34
7.7.2 BU-UVM3-01, Test case for Tagging VLAN mode, upstream and downstream directions 37
7.7.2.1 Test description 37
7.7.2.2 Required equipment and test configuration 37
7.7.2.3 Test procedure and expected results 37
7.7.3 BU-UVM4-01, Test case for ToS/CoS Conversion VLAN mode, upstream and downstream directions 40
7.7.3.1 Test description 40
7.7.3.2 Required equipment and test configuration 40
7.7.3.3 Test procedure and expected results 40

Copyright © 2015 IEEE. All rights reserved.

8. OLT tests 44
8.1 Introduction 44
8.2 Group AU: Authentication 44
8.2.1 BT-AU4b-01, Test case for ONU authentication for 1G-EPON OLT 44
8.2.1.1 Test description 44
8.2.1.2 Required equipment and test configuration 44
8.2.1.3 Test procedure and expected results 44
8.2.2 BT-AU6b-01, Test case for ONU authentication for 10G-EPON OLT 46
8.2.2.1 Test description 46
8.2.2.2 Required equipment and test configuration 46
8.2.2.3 Test procedure and expected results 46
8.3 Group DCD: Device and capability discovery 48
8.3.1 BT-DCD1-01, Test case for eOAM discovery process, successful discovery 48
8.3.1.1 Test description 48
8.3.1.2 Required equipment and test configuration 49
8.3.1.3 Test procedure and expected results 49
8.3.2 BT-DCD1-02, Test case for eOAM discovery process, discovery failure due to unacceptable version 50
8.3.2.1 Test description 50
8.3.2.2 Required equipment and test configuration 50
8.3.2.3 Test procedure and expected results 50
8.4 Group DE: Data encryption 51
8.4.1 BT-DE1-01, Test case for data encryption, successful IEEE 802.1ae-2006 encryption 51
8.4.1.1 Test description 51
8.4.1.2 Required equipment and test configuration 51
8.4.1.3 Test procedure and expected results 51
8.5 Group TVM: OLT VLAN modes 53
8.5.1 BT-TVM2-01, Test case for Transparent VLAN mode, upstream and downstream directions 53
8.5.1.1 Test description 53
8.5.1.2 Required equipment and test configuration 53
8.5.1.3 Test procedure and expected results 54
8.5.2 BT-TVM3-01, Test case for Tagging VLAN mode, upstream and downstream directions 56
8.5.2.1 Test description 56
8.5.2.2 Required equipment and test configuration 56
8.5.2.3 Test procedure and expected results 56
8.5.3 BT-TVM4-01, Test case for Translation VLAN mode, upstream and downstream directions 58
8.5.3.1 Test description 58
8.5.3.2 Required equipment and test configuration 58
8.5.3.3 Test procedure and expected results 58

Copyright © 2015 IEEE. All rights reserved.

IEEE Standard for Conformance Test Procedures for Service Interoperability in Ethernet Passive Optical Networks, IEEE Std 1904.1™ Package B

Version 001.001

IMPORTANT NOTICE: IEEE Standards documents are not intended to ensure safety, security, health, or environmental protection, or ensure against interference with or from other devices or networks. Implementers of IEEE Standards documents are responsible for determining and complying with all appropriate safety, security, environmental, health, and interference protection practices and all applicable laws and regulations.

This IEEE document is made available for use subject to important notices and legal disclaimers. These notices and disclaimers appear in all publications containing this document and may be found under the heading "Important Notice" or "Important Notices and Disclaimers Concerning IEEE Documents." They can also be obtained on request from IEEE or viewed at http://standards.ieee.org/IPR/disclaimers.html.

1. Overview

1.1 Scope

This standard specifies a suite of conformance tests for system-level requirements of Ethernet Passive Optical Network (EPON) equipment, defined in IEEE 1904.1 Package B.

1.2 Purpose

The purpose of this standard is to build upon the IEEE 1904.1 Package B EPON system-level interoperability standard and create a suite of conformance tests. Defining the exact test procedures will allow vendors, network operators, and independent testing facilities to achieve consistent results when testing EPON equipment for conformance with IEEE 1904.1 Package B.

Copyright © 2015 IEEE. All rights reserved.