

# **IEEE Standard for Layer 2 Transport Protocol for Time-Sensitive Applications in Bridged Local Area Networks**

**Microprocessor Standards Committee**

of the

**IEEE Computer Society**

Approved 10 February 2011

**IEEE-SA Standards Board**

**Abstract:** The protocol, data encapsulations, and presentation time procedures used to ensure interoperability between audio- and video-based end stations that use standard networking services provided by all IEEE 802 networks meeting quality-of-service requirements for time-sensitive applications by leveraging concepts of IEC 61883 are specified in this standard.

**Keywords:** bridged LAN, IEC 61883, IEEE 802.1 AVB protocols, IEEE 802.1AS, IEEE 802.1BA, IEEE 802.1Qat, IEEE 802.1Qav, IEEE 1722, local area network (LAN), quality of service, time-sensitive media streaming, time synchronization

---

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

Copyright © 2011 by the Institute of Electrical and Electronics Engineers, Inc.  
All rights reserved. Published 6 May 2011. Printed in the United States of America.

Bluetooth is a registered trademark in the U.S. Patent & Trademark Office, owned by Bluetooth SIG, Inc.

IEEE and 802 are registered trademarks in the U.S. Patent & Trademark Office, owned by the Institute of Electrical and Electronics Engineers, Incorporated.

**PDF:** ISBN 978-0-7381-6549-3      STD97076  
**Print:** ISBN 978-0-7381-6550-9      STDPD97076

*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.*

**IEEE Standards** documents are developed within the IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (IEEE-SA) Standards Board. The IEEE develops its standards through a consensus development process, approved by the American National Standards Institute, which brings together volunteers representing varied viewpoints and interests to achieve the final product. Volunteers are not necessarily members of the Institute and serve without compensation. While the IEEE administers the process and establishes rules to promote fairness in the consensus development process, the 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.

Use of an IEEE Standard is wholly voluntary. The IEEE disclaims liability for any personal injury, property or other damage, of any nature whatsoever, whether special, indirect, consequential, or compensatory, directly or indirectly resulting from the publication, use of, or reliance upon this, or any other IEEE Standard document.

The IEEE does not warrant or represent the accuracy or content of the material contained herein, and expressly disclaims any express or implied warranty, including any implied warranty of merchantability or fitness for a specific purpose, or that the use of the material contained herein is free from patent infringement. IEEE Standards documents are supplied “**AS IS.**”

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. Every IEEE Standard is subjected to review at least every five years for revision or reaffirmation, or every ten years for stabilization. When a document is more than five years old and has not been reaffirmed, or more than ten years old and has not been stabilized, 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 publishing and making this document available, the IEEE is not suggesting or rendering professional or other services for, or on behalf of, any person or entity. Nor is the IEEE undertaking to perform any duty owed by any other person or entity to another. Any person utilizing this, and any other IEEE Standards document, should rely upon his or her 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.

Interpretations: Occasionally questions may arise regarding the meaning of portions of standards as they relate to specific applications. When the need for interpretations is brought to the attention of IEEE, the Institute will initiate action to prepare appropriate responses. Since IEEE Standards represent a consensus of concerned interests, it is important to ensure that any interpretation has also received 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 interpretation requests except in those cases where the matter has previously received formal consideration. A statement, written or oral, that is not processed in accordance with the IEEE-SA Standards Board Operations Manual shall not be considered the official position of IEEE or any of its committees and shall not be considered to be, nor be relied upon as, a formal interpretation of the 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, explanation, or interpretation of the IEEE.

Comments for revision of IEEE Standards are welcome from any interested party, regardless of membership affiliation with IEEE. Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments. Recommendations to change the status of a stabilized standard should include a rationale as to why a revision or withdrawal is required. Comments and recommendations on standards, and requests for interpretations should be addressed to:

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

Authorization to photocopy portions of any individual standard for internal or personal use is granted by The Institute of Electrical and Electronics Engineers, Inc., provided that the appropriate fee is paid to Copyright Clearance Center. To arrange for payment of licensing fee, 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.

## Introduction

This introduction is not part of IEEE Std 1722-2011, IEEE Standard for Layer 2 Transport Protocol for Time-Sensitive Applications in Bridged Local Area Networks.

Increasingly, entertainment media are digitally transported. Streaming audio/video and interactive applications over local area networks is becoming more common.

This standard builds on the work done by the IEEE 802.1 AVB task group by providing a common audio/video transport protocol capable of supporting the needs of both consumer and professional audio/video applications.

## Notice to users

### Laws and regulations

Users of these documents should consult all applicable laws and regulations. Compliance with the provisions of this standard 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

This document is copyrighted by the IEEE. It is made available 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 this document available for use and adoption by public authorities and private users, the IEEE does not waive any rights in copyright to this document.

### Updating of IEEE documents

Users of IEEE standards 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. 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 Standards Association web site at <http://ieeexplore.ieee.org/xpl/standards.jsp>, or contact the IEEE at the address listed previously.

For more information about the IEEE Standards Association or the IEEE standards development process, visit the IEEE-SA web site at <http://standards.ieee.org>.

### Errata

Errata, if any, for this and all other standards can be accessed at the following URL: <http://standards.ieee.org/reading/ieee/updates/errata/index.html>. Users are encouraged to check this URL for errata periodically.

## **Interpretations**

Current interpretations can be accessed at the following URL: <http://standards.ieee.org/reading/ieee/interp/index.html>.

## **Patents**

Attention is called to the possibility that implementation of standard may require use of subject matter covered by patent rights. By publication of this standard, no position is taken with respect to the existence or validity of any patent rights in connection therewith. 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 Audio/Visual Bridging Layer2 Transport Working Group had the following membership:

**Robert Boatright**, *Chair*  
**Matthew Xavier Mora**, *Vice Chair*  
**Don Pannell**, *Secretary*  
**David Olsen and Don Pannell**, *Editors*  
**Alan K. Bartky**, *Initial Editor*

Torrey Atcitty  
Alex Beliaev  
Alexander Busch  
Ashley Butterworth  
Debin Chen  
George Claseman  
William Dai  
Guy Fedorkow  
John Nels Fuller  
Duncan Gray

Kevin Gross  
Craig Gunther  
Chuck Harrison  
Joern Henneberg  
Girault Jones  
Tom Kennedy  
Max Kicherer  
Jeff Koftinoff  
Raghu Kondapalli  
Rick Kreifeldt

Thomas Mathey  
Lee Minich  
Suman Sharma  
Rob Silfvast  
Kevin B. Stanton  
Michael Johas Teener  
Fred Tuck  
Ganesh Venkatesan  
Niel Warren  
Andy Yanowitz

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

Thomas Alexander  
Mark Anderson  
Butch Anton  
Danilo Antonelli  
Lee Armstrong  
Hugh Barrass  
Georgios Bertos  
Martin J. Bishop  
Robert Boatright  
Tomo Bogataj  
Juan Carreon  
Keith Chow  
Charles Cook  
Thomas Dineen  
Sourav Dutta  
Richard Eckard  
Yukihiro Fujimoto  
John Nels Fuller  
Randall Groves  
Craig Gunther  
Joseph Gwinn  
Stephen Haddock  
David Hunter

C. Huntley  
Akio Iso  
Atsushi Ito  
Anthony Jeffree  
Girault Jones  
Piotr Karocki  
Stuart J. Kerry  
Max Kicherer  
Yongbum Kim  
Bruce Kraemer  
Geoff Ladwig  
Paul Lambert  
Richard Lancaster  
Jeremy Landt  
Greg Luri  
Elvis Maculuba  
Peter Martini  
Matthew Xavier Mora  
Michael S. Newman  
David Olsen  
Glenn Parsons  
Subburajan Ponnuswamy  
Robert Robinson  
Benjamin Rolfe

Randall Safier  
John Sauer  
Peter Saunderson  
Bartien Sayogo  
Stephen Schwarm  
Shusaku Shimada  
Gil Shultz  
Kapil Sood  
Amjad Soomro  
Kevin B. Stanton  
Thomas Starai  
Walter Struppler  
Masahiro Takagi  
William Taylor  
Michael Johas Teener  
David Thompson  
Mark-Rene Uchida  
Prabodh Varshney  
Colin Whitby-Stevens  
Kunpeng Wu  
Oren Yuen  
Janusz Zalewski  
Zhen Zhou

When the IEEE-SA Standards Board approved this standard on 10 February 2011, it had the following membership:

**Robert M. Grow**, *Chair*  
**Richard H. Hulett**, *Vice Chair*  
**Steve M. Mills**, *Past Chair*  
**Judith Gorman**, *Secretary*

Karen Bartleson  
Victor Berman  
Ted Burse  
Clint Chaplin  
Andy Drozd  
Alexander Gelman  
Jim Hughes

Young Kyun Kim  
Joseph L. Koepfinger\*  
John Kulick  
David J. Law  
Hung Ling  
Oleg Logvinov  
Ted Olsen

Ronald C. Petersen  
Thomas Prevost  
Jon Walter Rosdahl  
Sam Sciacca  
Mike Seavey  
Curtis Siller  
Don Wright

\*Member Emeritus

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

Satish Aggarwal, *NRC Representative*  
Richard DeBlasio, *DOE Representative*  
Michael Janezic, *NIST Representative*

Don Messina  
*IEEE Standards Program Manager, Document Development*

Malia Zaman  
*IEEE Standards Program Manager, Technical Program Development*

## Contents

1. Overview .....	1
1.1 Scope .....	1
1.2 Purpose .....	2
2. Normative references.....	2
3. Terms, definitions, and notation .....	3
3.1 Conformance levels .....	3
3.2 Definitions .....	3
3.3 Reserved fields .....	4
3.4 Numerical values .....	4
3.5 Notation of fields and values taken from other documents.....	4
4. Abbreviations and acronyms .....	6
5. Audio Video Transport Protocol (AVTP) base protocol .....	7
5.1 Overview .....	7
5.2 AVTPDU common header format .....	8
5.3 AVTPDU common control header format.....	10
5.4 AVTP common stream data AVTPDU header format .....	11
5.5 Timing and synchronization .....	14
6. IEC 61883/IIDC over AVTP.....	17
6.1 Overview .....	17
6.2 Common IEC 61883/IIDC Stream data encapsulation .....	17
6.3 IEC 61883 control AVTPDU format.....	22
6.4 Timing and synchronization .....	22
7. MMA Payload Format over AVTP .....	29
7.1 Overview .....	29
7.2 AVTP stream data AVTPDU format for MMA_SUBTYPE.....	29
Annex A (informative) Bibliography .....	30
Annex B (normative) MAC Address Acquisition Protocol.....	31
Annex C (informative) IEEE 802.3-2008 media specific encapsulation.....	42

## Figures

Figure 3.1—Bit ordering within an octet.....	5
Figure 3.2—Octet ordering within a quadlet.....	5
Figure 3.3—Example 32 bit field diagram.....	5
Figure 5.1—AVTPDU common header fields.....	8
Figure 5.2—Control AVTPDU common fields.....	10
Figure 5.3—AVTP common stream header format (cd field set to zero (0)).....	11
Figure 5.4—Presentation time measurement point.....	16
Figure 6.3—CIP header and data fields, tag = 1, SPH = 0.....	20
Figure 6.4—CIP header and data fields, tag = 1, SPH = 1.....	20
Figure 7.1—AVTP stream data AVTPDU format for MMA_SUBTYPE.....	29
Figure B.1—IEEE 802.3-2008 MAAP PDU format.....	32
Figure C.1— AVTP control or stream data frame in an IEEE 802.3-2008 frame with an IEEE 802.1Q-2005 Tag field.....	43
Figure C.2—AVTP control frame in an IEEE 802.3-2008 frame without an IEEE 802.1Q-2005 Tag field.....	43

## Tables

Table 5.1—AVTP Ethertype .....	8
Table 5.2—AVTP subtype values .....	9
Table 5.3—AVTP default Max Transit Time.....	14
Table 5.4—AVTP Max Timing Uncertainty.....	17
Table B.1—MAC Address Acquisition Protocol message types .....	33
Table B.2—MAAP State machine .....	37
Table B.3—MAAP Probe Constant Values .....	38
Table B.4—MAAP Multicast Addresses .....	41
Table B.5—Reserved Multicast MAAP MAC Addresses.....	41

# IEEE Standard for Layer 2 Transport Protocol for Time-Sensitive Applications in Bridged Local Area Networks

*IMPORTANT NOTICE: This standard is not intended to ensure safety, security, health, or environmental protection. Implementers of the standard are responsible for determining appropriate safety, security, environmental, and health practices or regulatory requirements.*

*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

Increasingly, entertainment media are digitally transported. Streaming audio/video and interactive applications over bridged local area networks (LANs) need to have comparable real-time performance with legacy analog distribution. There is significant end-user and vendor interest in defining a simple yet common method for handling real-time audio/video suitable for consumer electronics, professional audio/video applications, etc. Technologies such as IEEE Std 1394<sup>TM</sup>-2008, Bluetooth<sup>®</sup>, and USB exist today, but each has their own encapsulation, protocols, timing control, etc., such that building interworking functions is difficult. The use of a common audio/video transport over multiple IEEE 802<sup>®</sup> network types will realize operational and equipment cost benefits. By ensuring that all IEEE 802 wired and wireless devices share a common set of transport mechanisms for time-sensitive audio/video streams, we lessen the effort of producing interworking units between IEEE 802 and other digital networks.

### 1.1 Scope

This standard specifies the protocol, data encapsulations, and presentation time procedures used to ensure interoperability between audio- and video-based end stations that use standard networking services provided by all IEEE 802 networks meeting quality-of-service requirements for time-sensitive applications by leveraging the concepts of IEC 61883.

## 1.2 Purpose

This standard will facilitate interoperability between stations that stream time-sensitive audio and/or video across LANs providing time synchronization and latency/bandwidth services by defining the packet format protocols and synchronization mechanisms.

## 2. Normative references

The following referenced documents and URLs are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

IEC 61883-1:2003, Consumer Audio/Video Equipment—Digital Interface—Part 1: General.<sup>1</sup>

IEC 61883-2:2004, Consumer Audio/Video Equipment—Digital Interface—Part 2: SD-DVCR Data Transmission.

IEC 61883-4:2004, Consumer Audio/Video Equipment—Digital Interface—Part 4: MPEG2-TS Data Transmission.

IEC 61883-6:2005, Consumer Audio/Video Equipment—Digital Interface—Part 6: Audio and Music Data Transmission Protocol.

IEC 61883-7:2003, Consumer Audio/Video Equipment—Digital Interface—Part 7: Transmission of ITU-R BO.1294 System B.

IEC 61883-8:2008, Consumer Audio/Video Equipment—Digital Interface—Part 8: Transmission of ITU-R Bt.601 Style Digital Video Data.

IEEE P802.1AS™/D7.2 (Mar. 2010), Draft Standard for Local and Metropolitan Area Networks: Timing and Synchronization for Time-Sensitive Applications in Bridged Local Area Networks.<sup>2,3,4</sup>

IEEE Std 1394™-2008, IEEE Standard for High-Performance Serial Bus.

IEEE Std 802.1Q™-2005, IEEE Standard for Local and Metropolitan Area Networks—Virtual Bridged Local Area Networks.

IEEE Std 802.1Qat™, IEEE Standard for Local and Metropolitan Area Networks: Virtual Bridged Local Area Networks—Amendment 14: Stream Reservation Protocol.

IEEE Std 802.1Qav™, IEEE Standard for Local and Metropolitan Area Networks: Virtual Bridged Local Area Networks—Amendment 11: Forwarding and Queuing for Time-Sensitive Streams.

---

<sup>1</sup> IEC publications are available from the Sales Department of the International Electrotechnical Commission, Case Postale 131, 3 rue de Varembe, CH-1211, Genève 20, Switzerland/Suisse (<http://www.iec.ch/>). IEC publications are also available in the United States from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA.

<sup>2</sup> IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, Piscataway, NJ 08854, USA (<http://standards.ieee.org/>).

<sup>3</sup> The IEEE standards or products referred to in this clause are trademarks owned by the Institute of Electrical and Electronics Engineers, Incorporated.

<sup>4</sup> This IEEE standards project was not approved by the IEEE-SA Standards Board at the time this publication went to press. For information about obtaining a draft, contact the IEEE.