



**IEEE Standard for**

**Local and metropolitan area networks—**

**Virtual Bridged Local Area Networks**

**Amendment 11: Two-Port Media  
Access Control (MAC) Relay**

---

**IEEE Computer Society**

Sponsored by the  
LAN/MAN Standards Committee

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

30 December 2009

**IEEE Std 802.1aj™-2009**  
(Amendment to  
IEEE Std 802.1Q™-2005)

Currently in preview, click buy full version

**IEEE Std 802.1aj™-2009**

(Amendment to  
IEEE Std 802.1Q™-2005)

**IEEE Standard for  
Local and metropolitan area networks—**

**Virtual Bridged Local Area Networks**

**Amendment 11: Two-Port Media  
Access Control (MAC) Relay**

Sponsor

**LAN/MAN Standards Committee  
of the  
IEEE Computer Society**

Approved 9 December 2009

**IEEE-SA Standards Board**

**Abstract:** This amendment to IEEE Std 802.1Q specifies the function of a MAC Relay with two MACs, and the protocols and procedures to support its operation. A MAC Relay is transparent to all frame-based media independent protocols except those explicitly addressed to this device. It is remotely manageable through at least one of its external MACs, and signals a failure of either MAC's LAN through the other MAC.

**Keywords:** MAC Relay, network interface device, Provider Bridged Networks, Virtual Bridged Local Area Networks, Virtual LANs, VLANs

---

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

Copyright © 2009 by the Institute of Electrical and Electronics Engineers, Inc.  
All rights reserved. Published 30 December 2009. Printed in the United States of America.

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 978-0-7381-6139-6 STD96006  
Print: ISBN 978-0-7381-6140-2 STDPD96006

*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 endorsing 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 Standard document, should rely upon the advice of a competent professional in determining the exercise of reasonable care in any given circumstances.

**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 unable 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 802.1aj-2009, IEEE Standard for Local and Metropolitan Area Networks—Virtual Bridged Local Area Networks—Amendment 11: Two-Port Media Access Control (MAC) Relay.

## 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 website 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 website 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 this amendment may require use of subject matter covered by patent rights. By publication of this amendment, 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 amendment 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 amendment was submitted to the IEEE-SA for approval, the IEEE 802.1 Working Group had the following membership:

**Tony Jeffree, Chair**  
**Paul Congdon, Vice Chair**  
**Stephen Haddock, Chair, Interworking Task Group**  
**John Messenger, Editor**  
**Brian Hassink, MIB Editor**

Zehavit Alon  
Siamack Ayandeh  
Jan Bialkowski  
Rob Boatright  
Jean-Michel Bonnamy  
Paul Bottorff  
Rudolf Brandner  
Craig W. Carlson  
Weiyang Cheng  
Rao Cherukuri  
Jin-Seek Choi  
Diego Crupnicoff  
Claudio Desanti  
Zheming Ding  
Linda Dunbar  
Hesham M. Elbakoury  
David Elie-Dit-Cosaque  
Janos Farkas  
Donald Fedyk  
Norman Finn  
Robert Frazier  
John Fuller  
Geoffrey Garner  
Anoop Ghanwani  
Franz Goetz  
Yannick Le Goff  
Eric Gray  
Karanvir Grewal  
Craig Gunther  
Mitch Gusat  
Asif Hazarika  
Charles Hudson

Romain Insler  
Abhay Karandikar  
Prakash Kashyap  
Hal Keen  
Keti Kilcrease  
Doyeon Kim  
Yongbum Kim  
Philippe Klein  
Mike Ko  
Vinod Kumar  
Bruce Kwan  
Kari Laihonen  
Ashvin Lakshmikantha  
Michael Lerer  
Marina Lipshteyn  
Gael Mace  
Ben Mack-Crane  
David Martin  
Alan McGuire  
James McIntosh  
Menucher M. Muechery  
Gabriel Montenegro  
Matthew Mora  
John Morrison  
Erno Murtanen  
Kevin Nolish  
Don O'Connor  
David Olsen  
Donald Pannell  
Glenn Parsons  
Joseph Pelissier  
David Peterson

Hayim Porat  
Max Pritikin  
Karen Randall  
Josef Roese  
Derek J. Ross  
Dan Romascanu  
Jessy V. Rouyer  
Jonathan Sadler  
Ali Sajad  
Panagiotis Saltsidis  
Jeremy Salowey  
Satish Sathe  
John Sauer  
Michael Seaman  
Koichiro Seto  
Himanshu Shah  
Nurit Sprecher  
Kevin B. Stanton  
Robert A. Sultan  
Muneyoshi Suzuki  
Michael Johas Teener  
Patricia Thaler  
Oliver Thorp  
Manoj Wadekar  
Yuehua Wei  
Brian Weis  
Martin White  
Bert Wijnen  
Michael D. Wright  
Chien-Hsien Wu  
Ken Young  
Glen Zorn

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

Butch Anton	Piotr Karocki	Robert Robinson
Khin Mi Mi Aung	Stuart J. Kerry	Benjamin Rolfe
Juan Carreon	Chad Kiger	Jessy V. Rouyer
Keith Chow	Yongbum Kim	Randall Safier
Thomas Dineen	John Lemon	John Sauer
Linda Dunbar	Michael Lerer	Bartien Sayogo
Sourav Dutta	Li Li	Michael Seaman
Donald Fedyk	William Lumpkins	Kapil Sood
C. Fitzgerald	Thomas Mack-Crane	Thomas Starai
Yukihiro Fujimoto	Arthur Marris	Rene Struik
Michael Geipel	David Martin	Walter Struppler
James Gilb	Marco Mascitto	Robert Sultan
Randall Groves	Alan Mcguire	Joseph Tarc
C. Guy	Jonathon Mclendon	William Taylor
Stephen Haddock	John Messenger	Patricia Thaler
John Hawkins	Gary Michel	Geoffrey Thompson
Atsushi Ito	Jose Morales	Prabodh Wershney
Raj Jain	Michael S. Newman	Oren Yuen
Tony Jeffree	Satoshi Obara	
Shinkyu Kaku	Maximilian Riegel	

When the IEEE-SA Standards Board approved this standard on 9 December 2009, it had the following membership:

**Robert M. Grow, Chair**  
**Thomas Prevost, Vice Chair**  
**Steve M. Mills, Past Chair**  
**Judith Gorman, Secretary**

John Barr	Alexander Gelman	David J. Law
Karen Bartleson	Jim Hughes	Ted Olsen
Victor Berman	Richard H. Hulett	Glenn Parsons
Ted Burse	Young Kwon Kim	Ronald C. Petersen
Richard DeBlasio	Joseph Koepfenger*	Narayanan Ramachandran
Andy Drozd	John K. Lick	Jon Walter Rosdahl
Mark Epstein		Sam Sciacca

\*Member Emeritus

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

Howard L. Wolfman, TAB Representative  
Michael Janezic, NIST Representative  
Satish Aggarwal, NRC Representative

Michelle Turner  
*IEEE Standards Program Manager, Document Development*

Kathryn Cush  
*IEEE Standards Program Manager, Technical Program Development*

Currently in preview, click buy full version

# Contents

1. Overview.....	2
1.1 Scope.....	2
2. References.....	3
3. Definitions .....	5
4. Abbreviations.....	7
5. Conformance.....	9
5.2 Conformant components and equipment.....	9
5.11 Backbone Edge Bridge conformance .....	9
5.14 VLAN-unaware Bridge component requirements.....	10
5.15 TPMR component conformance.....	10
5.16 TPMR conformance.....	11
5.17 T-component conformance .....	11
6. Support of the MAC Service in VLANs.....	13
6.5 Quality of service maintenance.....	13
6.10 Support of the ISS/EISS by Provider Instance Ports .....	13
6.20 Support of the ISS with signaled priority .....	14
8. Principles of bridge operation.....	17
8.5 Bridge Port Transmit and Receive.....	17
8.6 The Forwarding Process .....	19
8.13 Addressing .....	22
12. VLAN Bridge Management.....	23
12.19 TPMR managed objects.....	23
17. Management Information Base.....	33
23. MAC status propagation.....	51
23.1 Model of operation.....	53
23.2 MAC status protocol (MSP) overview .....	54
23.3 MAC status protocol state machines .....	58
23.4 State machine timers.....	60
23.5 MSP performance parameters.....	60
23.6 State machine variables .....	61
23.7 State machine procedures .....	63
23.8 Status Transition state machine .....	63
23.9 Status Notification state machine .....	63
23.10 Receive Process .....	63
23.11 Transmit Process.....	64
23.12 Management of MSP .....	64
23.13 MSPDU transmission, addressing, and protocol identification.....	65
23.14 Representation and encoding of octets .....	66
23.15 MSPDU structure.....	66
23.16 Validation of received MSPDUs .....	67

23.17	Other MSP participants.....	67
25.	Support of the MAC Service by Provider Backbone Bridged Networks .....	69
25.2	Customer service interface.....	71
25.11	Transparent service interface .....	71
Annex A	(normative)PICS proforma.....	75
A.5	Major capabilities .....	75
A.5	Major capabilities .....	75
A.5	Major capabilities .....	75
A.7	Relay and filtering of frames .....	77
A.8	Basic Filtering Services .....	77
A.14	Bridge management .....	78
A.24	Management Information Base (MIB) .....	79
A.25	TPMR.....	79
A.26	MSP .....	80
Annex K	(informative) TPMR use cases.....	81
K.1	Use case 1—TPMR as User to Network Interface (UNI) demarcation device .....	81
K.2	Use case 2—TPMRs with aggregated links .....	82
K.3	Use case 3—Multiple TPMRs .....	82
K.4	Special cases .....	83

## Figures

Figure 6-4	Provider Instance Ports .....	14
Figure 6-12	Supporting the ISS with signaled priority .....	15
Figure 8-8	Bridge Port Transmit and Receive .....	17
Figure 8-9	TPMR Port Transmit and Receive .....	18
Figure 23-1	TPMR connecting two Bridge Ports .....	51
Figure 23-2	TPMR chain connecting Bridge Ports .....	51
Figure 23-3	MAC Status Shims and the MAC Status Propagation Entity .....	53
Figure 23-4	Adding connectivity .....	55
Figure 23-5	Losing connectivity .....	56
Figure 23-6	TPMR recovery .....	57
Figure 23-7	Notification from one end of the link to the other .....	58
Figure 23-8	Immediate MAC status notification at the end of a link .....	58
Figure 23-9	MSPE state machine overview .....	59
Figure 23-10	Status Transition state machine .....	63
Figure 23-11	Status Notification state machine .....	64
Figure 23-12	MSPDU structure .....	66
Figure 25-1	Internal organization of the MAC sublayer in a PBBN .....	69
Figure 25-2	Provider Backbone Bridge terminology .....	70
Figure 25-3	Customer service interface types .....	71
Figure 25-15	Transparent service interface .....	72
Figure 25-16	Transparent service interface equipment .....	73
Figure K-1	TPMR as UNI demarcation device .....	81
Figure K-2	TPMRs with aggregated links .....	82
Figure K-3	Multiple TPMRs .....	82
Figure K-4	Recovery at the end of a chain .....	83
Figure K-5	Near simultaneous recoveries .....	84
Figure K-6	Near simultaneous failure and recovery .....	84
Figure K-7	Loss with quick recovery .....	85

## Tables

Table 8-1	C-VLAN component Reserved addresses .....	20
Table 8-3	TPMR component Reserved addresses.....	21
Table 8-2	S-VLAN component Reserved addresses.....	21
Table 17-1	Structure of the MIB modules .....	33
Table 17-14	IEEE8021-TPMR MIB Structure and relationship to this standard .....	33
Table 23-1	Time sequence diagram symbols.....	55
Table 23-2	MSP performance parameters.....	61
Table 23-3	MSPDU group destination address.....	65
Table 23-4	MSP Ethernet Type assignment.....	65
Table 23-5	MSP Packet Types.....	67

# IEEE Standard for Local and metropolitan area networks—

## Virtual Bridged Local Area Networks

### Amendment 11: Two-Port Media Access Control (MAC) Relay

*IMPORTANT NOTICE: This standard is not intended to ensure safety, security, health, or environmental protection in all circumstances. 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>.*

#### Editorial Note

This amendment specifies changes to the forwarding and queuing functions described in IEEE Std 802.1Q™. Changes are applied to the base text of IEEE Std 802.1Q-2005, as modified by those amendments that had been approved, but not incorporated into the base text of the standard, at the time that this amendment was approved, namely (in chronological order) IEEE Std 802.1ad™, IEEE Std 802.1ak™, IEEE Std 802.1ag™, IEEE Std 802.1ah™, IEEE Std 802.1Q-2005/Cor 1, IEEE Std 802.1ap™, IEEE Std 802.1Qaw™, and IEEE Std 802.1Qay™. Text shown in bold italics in this amendment defines the editing instructions necessary to changes to this base text. Three editing instructions are used: ***change***, ***delete***, and ***insert***. ***Change*** is used to make a change to existing material. The editing instruction specifies the location of the change and describes what is being changed. Changes to existing text may be clarified using ~~strikeout~~ markings to indicate removal of old material, and underline markings to indicate addition of new material. ***Delete*** removes existing material. ***Insert*** adds new material without changing the existing material. Insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. Editorial notes will not be carried over into future editions of IEEE Std 802.1Q.

## 1. Overview

### 1.1 Scope

*Insert the following text at the end of this subclause:*

Additionally, this standard specifies the function of a Two-Port MAC Relay (TPMR), along with protocols and procedures that support its operation. A TPMR is a type of bridge that has only two externally accessible Ports, and supports a subset of the functionality of a MAC Bridge. A TPMR is transparent to all frame-based media independent protocols, except those explicitly addressed to it and those that are destined for reserved MAC addresses that the relay function of the TPMR is defined not to forward. It is remotely manageable through at least one of its external MACs, and signals a failure of either MAC's LAN through the other MAC. A TPMR should only be attached to point-to-point LANs. The conformance requirements for a TPMR are stated in 5.15 and 5.16.