



IEEE Standard for Local and metropolitan area networks

Virtual Bridged Local Area Networks Amendment 4: Provider Bridges

IEEE Computer Society

Sponsored by the
LAN/MAN Standards Committee

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(Amendment to
IEEE Std 802.1Q™-2005)

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

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

Approved 28 March 2006

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Abstract: This amendment enables a service provider to use the architecture and protocols of IEEE Std 802.1Q to offer the equivalent of separate LANs, Bridged Local Area Networks, or Virtual Bridged Local Area Networks to a number of customers, while requiring no cooperation between the customers, and minimal cooperation between each customer and the service provider.

Keywords: Bridged Local Area Networks, local area networks (LANs), MAC Bridges, metropolitan area networks, Multiple Spanning Tree Protocol (MSTP), Rapid Spanning Tree Protocol (RSTP), Virtual Bridged Local Area Networks (virtual LANs)

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IEEE Standard for Local and metropolitan area networks—

Virtual Bridged Local Area Networks Amendment 4: Provider Bridges

[This amendment is based on IEEE Std 802.1Q™-2006.]

NOTE—The editing instructions contained in this amendment define how to merge the material contained therein into the existing base standard and its amendments to form the comprehensive standard.

The editing instructions are shown in ***bold italic***. Four editing instructions are used: change, delete, insert, and replace. ***Change*** is used to make corrections in existing text or tables. The editing instruction specifies the location of the change and describes what is being changed by using ~~striketrough~~ (to remove old material) and underscore (to add new material). ***Delete*** removes existing material. ***Insert*** adds new material without disturbing the existing material. Insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. ***Replace*** is used to make changes in figures or equations by removing the existing figure or equation and replacing it with a new one. Editorial notes will not be carried over into future editions because the changes will be incorporated into the base standard.

1. Overview

Insert the following paragraph after the initial paragraph of Clause 1:

This standard further extends the specification of VLAN-aware MAC Bridges to enable a service provider organization to use a common infrastructure of Bridges and LANs to offer the equivalent of separate LANs, Bridged, or Virtual Bridged Local Area Networks to independent customer organizations.

1.1 Scope

Insert the following text and bullets immediately after bullet m):

To enable a service provider to use a Virtual Bridged Local Area Network to provide separate instances of the IEEE 802® MAC Service, MAC Internal, and Enhanced Internal Sublayer Services¹ to multiple

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independent customers, in a manner that does not require cooperation among the customers and that requires a minimum of cooperation between the customers and the provider of the MAC Service, this standard further specifies the operation of Provider Bridges. To this end it

- n) Differentiates Customer VLANs (C-VLANs) that are under the administrative control of a single customer of a service provider, from the Service VLANs (S-VLANs) that are used by a service provider to support different customers.
- o) Specifies VLAN TAG formats for both C-VLANs and S-VLANs, allowing each to be distinguished and separately applied and administered by customers and by a service provider.
- p) Specifies the functionality of a generic VLAN-aware bridge component within a system and the specific requirements of derived C-VLAN and S-VLAN components.
- q) Specifies a VLAN Bridge as comprising a single C-VLAN component, and a Provider Bridge as encompassing bridges that comprise a single S-VLAN component and no C-VLAN components (S-VLAN Bridge) or a single S-VLAN component and one or more C-VLAN components (Provider Edge Bridge).
- r) Specifies parameters and mappings that allow the Enhanced Internal Sublayer Service to support traffic classes that comprise distinct aggregate flows supporting different QoS characteristics and provide independent guarantees to different customers, through support of priority and drop precedence marking.
- s) Specifies the incorporation of flow metering, transmission queue management, and transmission selection algorithms within the forwarding process of a Bridge.
- t) Positions the support of S-VLANs within the architectural description of the MAC Sublayer and specifies their relationship to media access method dependent functions and to the media independent functions used by customers to administer their networks, including the support of C-VLANs.
- u) Allocates the reserved multicast addresses to media access method dependent, provider network, and customer network functions, specifying the filtering to be applied in each type of VLAN-aware bridge component.
- v) Defines the principles of network operation in terms of the support and preservation of the MAC Service, and the maintenance of Quality of Service for each service instance, including the segregation of data belonging to different organizations.
- w) Specifies customer interfaces to a Provider Bridged Network in terms of the operation and configuration of the VLAN-aware bridge components of Provider Bridges, including interfaces that
 - 1) Provide access to a single service instance through a Bridge Port
 - 2) Allow a customer to select amongst and identify service instances by Customer VLAN Identifier (C-VID)
 - 3) Allow a customer to select amongst and identify service instances by Service VLAN Identifier (S-VID)
 - 4) Support customer signaling of priority information on a frame by frame basis
 - 5) Multiplex service instances over LANs that provide access to a provider network
 - 6) Support fault tolerance through redundant provision of access LANs and equipment.
- x) Describes the functions to be performed within the Provider Bridged Network in order to support and maintain the connectivity provided to customer service instances.
- y) Establishes the requirements for Bridge Management in the Provider Bridged Network, identifying the managed objects and defining the management operations.
- z) Specifies performance requirements, and recommends default values and applicable ranges for the operational parameters of a Provider Bridge.

3. Definitions

Insert the following definitions into Clause 3, in appropriate collating sequence, renumbering existing/new definitions as appropriate:

3.1 C-VLAN component: A VLAN-aware bridge component with each Port supported by an instance of the EISS that can recognize, insert, and remove Customer VLAN tags.

3.2 C-VLAN Bridge: A VLAN Bridge.

3.3 customer: The purchaser of a service instance from a service provider. Often a business.

NOTE—Certain terms in this standard, including customer and service provider, reflect common business relationships that exist among the users of equipment implemented in conformance with IEEE Std 802.1Q. The use of these terms does not imply or impose any requirement on such business relationships.²

3.4 Customer Bridge: A MAC Bridge as specified by IEEE Std 802.1D™ or a VLAN Bridge as specified by IEEE Std 802.1Q.

3.5 Customer Bridged Local Area Network: A network of Customer Bridges.

3.6 Customer Edge Port: A C-VLAN component Port on a Provider Edge Bridge that is connected to customer owned equipment and receives and transmits frames for a single customer.

3.7 customer equipment: The physical embodiment of one or more customer systems.

3.8 Customer Network Port: An S-VLAN component Port on a Provider Bridge or within a Provider Edge Bridge that receives and transmits frame for a single customer.

3.9 customer system: A system attached to Provider Bridged Network but not intended by the service provider to be under the control of the service provider.

3.10 customer tagged frames: Frames that include a C-TAG.

3.11 C-tagged service interface: The interface provided by a Provider Edge Bridge to allow the attached customer to select between and identify service instances using the C-VID associated with transmitted and received frames.

3.12 Customer VLAN: A VLAN identified by an C-VID.

3.13 Customer VLAN ID: A VLAN Identifier conveyed in a C-TAG.

3.14 Customer VLAN tag: A VLAN tag with a Tag Protocol Identification value allocated for “802.1Q Tag Protocol Type”.

3.15 Port-based service interface: The interface provided by a Provider Bridge that associates all customer frames with a single service instance.

3.16 Provider Bridge: An S-VLAN Bridge or a Provider Edge Bridge.

3.17 Provider Bridged Network: A network using Provider Bridges to offer customer protocol transparent connectivity.

²Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

3.18 Provider Edge Bridge: A system comprising a single S-VLAN component and one or more C-VLAN components implemented in accordance with Clause 5 of IEEE Std 802.1Q.

3.19 Provider Edge Port: A C-VLAN component Port within a Provider Edge Bridge that connects to a Customer Network Port and receives and transmits frames for a single customer.

3.20 Provider Network Port: An S-VLAN component Port on a Provider Bridge that can transmit and receive frames for multiple customers.

3.21 service instance: An instance of the MAC Service, providing the service at a number of service access points. The term “service instance” is often used to refer to the service and connectivity provided by a service provider to a customer.

NOTE—In general, a service provider can use a number of technologies to support a service instance; within IEEE Std 802.1Q, a service instance is supported by a single S-VLAN.

3.22 service provider: An organization that contracts to provide one or more service instances to a customer.

3.23 service tagged frames: Frames that include an S-TAG.

3.24 S-tagged service interface: The interface provided by a Provider Bridge to allow the attached customer to select between and identify service instances using the S-VID associated with transmitted and received frames.

3.25 Service VLAN: A VLAN identified by an S-VID.

3.26 Service VLAN ID: A VLAN Identifier conveyed in an S-TAG.

3.27 Service VLAN tag: A VLAN tag with a Tag Protocol Identification value allocated for “802.1Q Service Tag Type.”

3.28 S-VLAN component: A VLAN-aware bridge component with each Port supported by an instance of the EISS that can recognize, insert, and remove Service VLAN tags.

3.29 S-VLAN Bridge: A system comprising a single S-VLAN component implemented in accordance with Clause 5 of IEEE Std 802.1Q.

3.30 VLAN-aware bridge component: The media access method independent functionality supporting an instance of the EISS at each Port that can recognize, insert, and remove VLAN tags, and the functionality that relays frames between Ports.

3.31 VLAN Bridge: A system comprising a single C-VLAN component implemented in accordance with Clause 5 of IEEE Std 802.1Q.

4. Abbreviations

Insert the following abbreviations, in the appropriate collating sequence:

C-TAG	Customer VLAN tag
C-VID	Customer VLAN Identifier
C-VLAN	Customer VLAN
DEI	Drop Eligible Indicator
S-TAG	Service VLAN tag
S-VID	Service VLAN Identifier
S-VLAN	Service VLAN

5. Conformance

Delete 5.2, and replace with the following two new subclauses:

5.2 Conformant components and equipment

This subclause specifies requirements and options for the following core component:

- a) VLAN-aware bridge component (5.4);

for the following two components that use that core functionality:

- b) C-VLAN component (5.5);
- c) S-VLAN component (5.6);

and for the following systems that include instances of either or both of the above two components:

- d) VLAN Bridge (5.7);
- e) S-VLAN Bridge (5.8.1);
- f) Provider Edge Bridge (5.8.2).

NOTE—A VLAN Bridge can also be referred to as a Customer Bridge or a C-VLAN Bridge. Both S-VLAN Bridges and Provider Edge Bridges are types of Provider Bridges.

5.3 Protocol Implementation Conformance Statement (PICS)

A claim of conformance specifies implementation of a C-VLAN component, an S-VLAN component, or a specific system. A component or system can support multiple claims for a range of possible behaviors.

The supplier of an implementation that is claimed to conform to this standard shall provide the information necessary to identify both the supplier and the implementation and shall complete a copy of the PICS proforma provided in Annex A for that specific component or system, together with the further information and completed PICS(s) required to identify subcomponents.

NOTE 1—C-VLAN component and S-VLAN component PICS' both require completion of a PICS for a VLAN-aware bridge component; the VLAN Bridge PICS requires a claim of conformance for a single C-VLAN component; the Provider Edge Bridge requires a claim of conformance for a single S-VLAN component and one or more claims for C-VLAN components.

NOTE 2—The claim of conformance that could be made to IEEE Std 802.1Q for an implementation of a VLAN-aware Bridge is replaced by a claim of conformance to a VLAN Bridge. Although the current and subsequent amendment(s) or revision(s) of this standard has changed the presentation of the information, the technical requirements of conformance remain unchanged.

Renumber the existing 5.3 to 5.4, and change the headings and introductory sentences as follows:

5.4 VLAN-aware Bridge **component** requirements

An implementation of a VLAN-aware Bridge **component** shall

5.4.1 VLAN-aware Bridge **component** options

An implementation of a VLAN-aware Bridge **component** may

Insert the following subclauses 5.5 through 5.8, and renumber the existing subclauses:

5.5 C-VLAN component conformance

A C-VLAN component comprises a VLAN-aware Bridge component with the EISS on all Ports supported by the use of a Customer VLAN tag (C-TAG) (6.6, 9.5).

A conformant implementation of a C-VLAN component shall

- a) Comprise a single conformant VLAN-aware bridge component;
- b) Recognize and use Customer VLAN tags;
- c) Filter the Reserved MAC Addresses specified in Table 8-1;
- d) Use the GVRP Application Address specified in Table 11-1; and

shall not

- e) Use a VID Translation Table (6.7) on any Port;
- f) Use Service VLAN tags except in support of the functionality specified in 6.9.

5.5.1 C-VLAN component options

A conformant C-VLAN component may implement the options specified for a VLAN-aware bridge component whose use is not specifically prohibited by 5.4.1 and may

- a) Support encoding the drop_eligible parameter in the PCP field of the tag header (6.7.3); and
- b) Allow support of the ISS as specified in subclause 6.9 to facilitate priority selection on a Provider Bridged Network; and
- c) Implement RSTP, with the enhancements to support Customer Edge Ports, as specified in 13.38.

5.6 S-VLAN component conformance

An S-VLAN component comprises a VLAN-aware Bridge component with the EISS on all Ports supported by the use of a Service VLAN tag (S-TAG) (6.6, 9.5).

A conformant implementation of an S-VLAN component shall

- a) Comprise a single conformant VLAN-aware bridge component; and
- b) Recognize and use Service VLAN tags;
- c) Support encoding the drop_eligible parameter in the PCP field of the tag header (6.7.3);
- d) Filter the Reserved MAC Addresses specified in Table 8-2;
- e) Use the GVRP Application Address specified in Table 8-1;
- f) Allow the Acceptable Frame Types parameter (6.7) to be set to *Admit All Frames* for each Port;
- g) Allow the Enable Ingress Filtering parameter (8.6.2) to be set for each Port; and

shall not

- h) Recognize or use Customer VLAN tags;
- i) Allow support of the ISS as specified in subclause 6.9 for any of its Ports;

- i) Allow support of the ISS as specified in subclause 6.9 for any of its Ports;
- j) Configure any of the GARP Application Addresses specified in Table 12-1 of IEEE Std 802.1D in the Filtering Database (8.10) or Permanent Database (8.10.10);
- k) Use the GVRP Application Address specified in Table 11-1.

5.6.1 S-VLAN component options

A conformant S-VLAN component may implement any of the options specified for a VLAN-aware Bridge component (5.4.1) and may

- a) Allow translation of VIDs through support of a VID Translation Table (6.6) on each Port.

5.7 VLAN Bridge conformance

A VLAN Bridge shall comprise a single conformant C-VLAN component (5.5).

Each VLAN Bridge Port shall be capable of attaching directly to an IEEE 802 LAN.

5.7.1 VLAN Bridge options

A VLAN Bridge may implement any C-VLAN component option (5.5).

5.8 Provider Bridge conformance

A Provider Bridge shall comprise a single conformant S-VLAN (5.6) component and zero or more C-VLAN components (5.5).

Each Port shall be capable of being configured as one of, and may be capable of being configured as any of

- a) A Provider Network Port;
- b) A Customer Network Port;
- c) A Customer Edge Port;

as specified in Clause 15. Each Port configured as a Provider Network Port or Customer Network Port shall be capable of attaching the S-VLAN component of the Provider Bridge directly to an IEEE 802 LAN. Each Port configured as a Customer Edge Port shall be capable of attaching a C-VLAN component within the Provider Bridge directly to an IEEE 802 LAN.

5.8.1 S-VLAN Bridge conformance

An S-VLAN Bridge shall comprise a single conformant S-VLAN component (5.6). An S-VLAN Bridge does not have any physical interfaces configured as a Customer Edge Port, nor does it include any C-VLAN components.

5.8.2 Provider Edge Bridge conformance

A Provider Edge Bridge is a conformant Provider Bridge with the capability to include one or more C-VLAN components as specified in 15.4.

Each C-VLAN component shall comprise a single Customer Edge Port and a single distinct Provider Edge Port for each service instance that can be provided through that Customer Edge Port. Each Provider Edge Port shall be connected within the Provider Edge Bridge, as specified in 6.10, to a distinct Customer

Network Port on the S-VLAN component. Each C-VLAN component shall implement RSTP, with the enhancements to support Customer Edge Ports, as specified in 13.38.

NOTE—The single Customer Edge Port supported by a C-VLAN component can be supported by two or more independent instances of a MAC, aggregated as specified by Link Aggregation (Clause 43 of IEEE Std 802.3™).

Renumber the existing subclause 5.4 as 5.9.