IEEE Standard for Local and metropolitan area networks—

Virtual Bridged Local Area Networks

Amendment 5: Connectivity Fault Management

IEEE Computer Society

Sponsored by the
LAN/MAN Standards Committee

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

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IEEE Std 802.1ag™-2007
(Amendment to
IEEE Std 802.1Q™-2005
as amended by
IEEE Std 802.1ad™-2005
and IEEE Std 802.1ak™-2007)

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Approved 27 September 2007

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Abstract: This amendment specifies protocols, procedures, and managed objects to support connectivity fault management. These allow discovery and verification of the path, through bridges and LANs, taken for frames addressed to and from specified network users. Connectivity faults can be detected and isolated to an individual bridge or LAN.
Keywords: error detection, fault management, LANs, local area networks, MAC Bridges, MANs, metropolitan area networks, OAM, transparent bridging, VLANs

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Introduction

This introduction is not part of IEEE Std 802.1ag-2007, IEEE Standard for Local and Metropolitan Area Networks—Virtual Bridged Local Area Networks—Amendment 5: Connectivity Fault Management.

The MAC Bridge standardization activities that resulted in the development of IEEE Std 802.1D™ introduced the concept of Filtering Services in Bridged Local Area Networks, mechanisms whereby filtering information in such LANs can be acquired and held in a Filtering Database, as well as support for expedited data, dynamic filtering of Group MAC addresses through the GMRP protocol, and the GARP protocol that supports GMRP and can support other applications.

IEEE Std 802.1Q-2005, a revision of IEEE Std 802.1Q-1998, defines mechanisms that allow the implementation of Virtual Bridged Local Area Networks, including:

a) Virtual LAN Services;
b) The operation of the Forwarding Process that is required;
c) The structure of the Filtering Database that is required;
d) The nature of the protocols and procedures that are required in order to provide Virtual LAN services, including the definition of the frame formats used to represent VLAN identification information, and the procedures used in order to insert and remove VLAN identifiers and the headers in which they are carried;
e) The ability to support end-to-end signaling of priority information regardless of the intrinsic ability of the underlying MAC protocols to signal priority information;
f) The GARP VLAN Registration Protocol (GVRP) that allows distribution and registration of VLAN membership information (the protocol described makes use of the GARP protocol defined in IEEE Std 802.1D);
g) The management services and operations that are required in order to configure and administer networks;
h) The ability to restrict Dynamic Group and VLAN registration based on the contents of static filtering entries;
i) VLAN classification according to link layer protocol type;
j) Support for VLANs carried over multiple Spanning Tree instances.

IEEE Std 802.1ad-2005, an amendment to IEEE Std 802.1Q-2005, defines mechanisms that allow the implementation of Provider Bridged Networks, including:

k) The differentiation between Service VLANs (S-VLANs), identified by a new S-VLAN tag, and customer VLANs (C-VLANs), identified by the IEEE 802.1Q tag;
l) The encapsulation of C-VLAN tags within S-VLAN tags, in order to allow a service provider to carry some or all of a customer's C-VLANs within a single S-VLAN;
m) The provision of two levels of drop precedence separate from the priority levels of IEEE Std 802.1D, and the replacement of the Canonical Format Indicator of the C-VLAN tag by a Drop Eligible Indicator in the S-VLAN tag to carry the drop precedence;
n) The passing of certain of the customers' control PDUs, including IEEE 802.1AB LLDP PDUs and IEEE 802.1Q Bridge PDUs, transparently through the Provider Bridged Network as ordinary data;
o) The reassignment of MAC addresses used for control PDUs, including BPDUs, for use by Provider Bridges;
p) The definition of C-VLAN components, added to Provider Bridge Ports to provide the functions necessary to support the allocation of C-VLANs to S-VLANs, to map priorities between networks, and to interact with the customers' control protocols; and
q) The managed objects necessary to control these functions.

This standard provides Connectivity Fault Management (CFM) capabilities useful to Virtual Bridged Local Area Networks for detecting, isolating, and reporting connectivity faults. It is aimed primarily at Provider

Bridged Networks, but is useful also for C-VLAN networks. The mechanisms defined in this standard include:

r) The ability to configure multiple nested Maintenance Domains over a Bridged Network or a network of Bridged Networks, each potentially managed by a different administrative organization;
s) The ability to configure Maintenance Associations (MAs), each identified with a single Maintenance Domain, and on any given Bridge, a set of VLANs;
t) The protocols, procedures, and CFM Protocol Data Unit (CFM PDU) formats required to detect, isolate, and report connectivity faults;
u) The ability, within an MA, to configure and manage Maintenance Points (MPs) that generate and respond to CFM PDUs; and
v) The ability to command MPs to perform certain fault isolation operations, and to inspect the results

CFM is not to be confused with the Ethernet OAM capabilities described in IEEE Std 802.3™, Clause 57. IEEE 802.3 OAM is concerned with detecting and reporting faults on a single point-to-point IEEE 802.3 LAN. IEEE Std 802.1ag-2007 is concerned with detecting, isolating, and reporting connectivity faults spanning networks comprising multiple LANs, including LANs other than IEEE 802.3 media.

This standard contains state-of-the-art material. The area covered by this standard is undergoing evolution. Revisions are anticipated within the next few years to clarify existing material, to correct possible errors, and to incorporate new related material. Information on the current revision state of this and other IEEE 802 standards can be obtained from

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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 ~~strikethrough~~ (to remove old material) or 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. Editing instructions, change markings, and this NOTE 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 paragraphs in Clause 1:

This standard specifies protocols and protocol entities within the architecture of VLAN-aware Bridges that provide capabilities for detecting, verifying, and isolating connectivity failures in Virtual Bridged Local Area Networks. These capabilities can be used in networks operated by multiple independent organizations, each with restricted management access to each other's equipment.

1.1 Scope

Insert the following at end of 1.1, renumbering the list items so that they follow in order from those in the existing text.

This standard specifies protocols, procedures, and managed objects to support connectivity fault management. These allow discovery and verification of the path, through bridges and LANs, taken for frames addressed to and from specified network users, and support detection and isolation of a connectivity fault to a specific bridge or LAN. To this end it:

a) Defines Maintenance Domains, Maintenance Associations, their constituent Maintenance Points, and the managed objects required to create and administer them;
b) Describes the protocols and procedures used by Maintenance Points to detect and diagnose connectivity faults within a Maintenance Domain.