802.1ak™

IEEE Standard for
Local and metropolitan area networks—

Virtual Bridged Local Area Networks

Amendment 7: Multiple Registration Protocol

IEEE Computer Society

Sponsored by the
LAN/MAN Standards Committee

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

22 June 2007

IEEE Std 802.1ak™-2007
(Amendment to
IEEE Std 802.1Q™-2005)

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Approved 22 March 2007

IEEE-SA Standards Board

Abstract: This amendment specifies a set of protocols that replaces the GARP, GMRP, and GVRP protocols specified in earlier versions of IEEE Std 802.1Q.
Keywords: Bridged Local Area Networks, LANs, local area networks, MAC Bridges, metropolitan area networks, MRP, MMRP, MVRP, Virtual Bridged Local Area Networks, virtual LANs

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

Print: ISBN 0-7381-5587-X SH95679
PDF: ISBN 0-7381-5588-8 SS95679

Introduction

This introduction is not part of IEEE Std 802.1ak, IEEE Standards for Local and Metropolitan Area Networks—Virtual Bridged Local Area Networks—Amendment 7: Multiple Registration Protocol.

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[This document amends IEEE Std 802.1Q™-2005.]

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.

This amendment specifies changes to IEEE Std 802.1Q that specifies a replacement for the GARP, GMRP, and GVRP protocols. Changes are applied to the base text of IEEE Std 802.1Q-2005 as modified by IEEE Std 802.1ad™-2006. 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 underscore 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, renumbering the list items appropriately:

In addition, this standard specifies protocols, procedures, and managed objects to support the Multiple Registration Protocol (MRP). MRP allows participants in an MRP Application to register attributes with other participants in a Bridged Local Area Network. Two applications are defined—one to register VLANs [Multiple VLAN Registration Protocol (MVRP)] and one to register MAC addresses [Multiple MAC Registration Protocol (MMRP)]. MVRP will furthermore provide for the rapid healing of network failures without interrupting services to unaffected VLANs. To this end, it specifies the following:

a) MRP and the operation of the MRP protocol entities.[1, 2]
b) The generic frame formats used in MRP protocol exchanges.

[1]MRP replaces the Generic Attribute Registration Protocol (GARP), defined in IEEE Std 802.1D, that was used to support GVRP and GMRP in earlier revisions of IEEE Std 802.1Q. Similarly, GVRP and GMRP are replaced by MVRP and MMRP respectively.

[2]As a result of the protocol changes described in this amendment, corresponding changes will be required in the managed objects and SNMP MIB modules, to reflect the fact that GARP, GMRP, and GVRP functionality are replaced by MRP, MMRP, and MVRP.

c) The Multiple MAC Registration Protocol (MMRP) application of MRP, and the frame formats that it uses.
d) The Multiple VLAN Registration Protocol (MVRP) application of MRP, and the frame formats that it uses.

3. Definitions

Change the introductory paragraphs of this clause as shown:

For the purposes of this standard, the following terms and definitions apply. *The Authoritative Dictionary of IEEE Standards Terms* [B1],[3] should be referenced for terms not defined in this clause.

~~This Standard makes use of the following terms defined in IEEE Std 802.1D~~

— ~~Active topology~~
— ~~Bridge Port~~
— ~~GARP Participant~~
— ~~GARP Application~~
— ~~GIP Context~~
— ~~Group~~
— ~~Port~~

Change the definition of Group as follows:

3.24 Group: A Group associates

a) A group MAC address; and
b) A set of properties that define membership characteristics; and
c) A set of properties that define the forwarding/filtering behavior of a Bridge with respect to frames destined for members of that group MAC address;

with a set of end stations that all wish to receive information destined for that group MAC address. Members of such a set of end stations are said to be *Group members.*

A Group is said to *exist* if the properties associated with that Group are visible in an entry in the Filtering Database of a Bridge, or in the ~~GARP~~MRP state machines that characterize the state of the Group; a Group is said to *have members* if the properties of the Group indicate that members of the Group can be reached through specific Ports of the Bridge.

NOTE—An example of the information that Group members might wish to receive is a multicast video data stream.

[3] The numbers in brackets correspond to those of the bibliography in Annex H.

4. Abbreviations

Delete the following abbreviations from the list:

GARP
GID
GIP
GMRP
GVRP

Insert the following abbreviations in Clause 4 in the correct alphabetical sequence:

MAD	MRP Attribute Declaration
MAP	MRP Attribute Propagation
MMRP	Multiple MAC Registration Protocol
MMRPDU	Multiple MAC Registration Protocol Data Unit
MRP	Multiple Registration Protocol
MRPDU	Multiple Registration Protocol Data Unit
MVRP	Multiple VLAN Registration Protocol
MVRPDU	Multiple VLAN Registration Protocol Data Unit

5. Conformance

5.1 Requirements terminology

Change the penultimate paragraph as shown:

The PICS proformas (see Annex A for Bridges and Annex I for end station implementations) reflects~~s~~ the occurrences of the words shall, may, and should within the standard.

5.3 Protocol Implementation Conformance Statement (PICS)

Change the penultimate paragraph before NOTE 1 as shown:

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 Bridge component or system, or Annex I for an end station implementation, together with ~~the~~ any further information and completed PICS(s) required to identify subcomponents.

5.4 VLAN-aware bridge component requirements

Change list item i) as shown:

i) Allow automatic configuration and management of VLAN topology using the ~~Generic Attribute Registration Protocol (GARP)~~ Multiple VLAN Registration Protocol (~~GVRP~~MVRP) (5.4.2, Clause 11) on all Ports;

5.4.1 VLAN-aware bridge component options

Change list item c) as follows:

c) Support Extended Filtering Services (6.12.5) and the operation of ~~GARP~~ Multiple MAC~~Multicast~~ Registration Protocol (~~GMRP~~MMRP, see 10.9) ~~(IEEE Std 802.1D-2004 Clause 10) as modified by Clause 10 of this Standard~~ to support automatic configuration and management of MAC address information on all Ports (5.4.1.3);

Change list item m) as follows:

m) Allow configuration of the ~~Restricted_Group_Registration~~ Restricted_MAC_Address_Registration parameter (~~IEEE Std 802.1D~~ 10.12.2.3) for each Port of the Bridge;

5.4.1.1 Multiple Spanning Tree (MST) operation (optional)

Change item 10) as shown:

10) Support the operation of ~~GVRP~~MVRP in each supported spanning tree context (11.2.3.1.1, 11.2.3.1.2);

Insert new subclause 5.4.1.3, as follows:

5.4.1.3 Multiple MAC Registration Protocol (MMRP) operation (optional)

A VLAN-aware Bridge implementation in conformance to the provisions of this standard for the support of MMRP shall

a) Conform to the operation of the MRP Applicant, Registrar, LeaveAll, and Periodic Transmission state machines, as defined in 10.7.7, 10.7.8, 10.7.9, and 10.7.10, as required for one or the other of the following variants of the MRP Participant, as defined in 10.6 and 10.7:
   1) The Full Participant.
   2) The Full Participant, point-to-point subset.
b) Exchange MRPDUs as required by those state machines, formatted in accordance with the generic PDU format described in 10.8, and able to carry application-specific information as defined in 10.12, using the group MAC addresses reserved for use by MRP applications, as defined in Table 10-1.
c) Implement the MMRP Application component as defined in 10.12.
d) Propagate registration information in accordance with the operation of MAP for the Base Spanning Tree Context, as specified in 10.3.1.
e) Forward, filter or discard MAC frames carrying any MRP Application address as the destination MAC Address in accordance with the requirements of 8.13.6.

Insert new subclause 5.4.2, as follows:

5.4.2 Multiple VLAN Registration Protocol (MVRP) requirements

A VLAN-aware Bridge implementation in conformance to the provisions of this standard for the support of MVRP shall

a) Conform to the operation of the MRP Applicant, Registrar, LeaveAll, and Periodic Transmission state machines, as defined in 10.7.7, 10.7.8, 10.7.9, and 10.7.10, as required for one or the other of the following variants of the MRP Participant, as defined in 10.6 and 10.7:
   1) The Full Participant.
   2) The Full Participant, point-to-point subset.
b) Exchange MRPDUs as required by those state machines, formatted in accordance with the generic PDU format described in 10.8, and able to carry application-specific information as defined in 11.2, using the group MAC addresses reserved for use by MRP applications, as defined in Table 10-1.
c) Implement the MVRP Application component as defined in 11.2.
d) Propagate registration information
   1) In an SST bridge, in accordance with the operation of MAP for the Base Spanning Tree Context, as specified in 10.3 and 10.3.1; or
   2) in an MST bridge, in accordance with the operation of MAP for multiple Spanning Tree contexts as specified in 11.2.3.1.2 of this standard.
e) Forward, filter or discard MAC frames carrying any MRP Application address as the destination MAC Address in accordance with the requirements of 8.13.6.
f) If a VID Translation Table (6.7) is in use for a Bridge Port, translate VIDs in MVRPDUs as specified in 11.2.4.

Renumber existing subclause 5.9 as 5.10. Insert the following as new subclauses 5.9, 5.9.1, and 5.9.2, following subclause 5.8, as follows:

5.9 End station requirements for MMRP and MVRP

This subclause defines the conformance requirements for end station implementations claiming conformance to MVRP and MMRP. Although this standard is principally concerned with defining the requirements for VLAN-aware Bridges, the conformance requirements for end station implementations of MVRP and MMRP are included in order to give guidance to such implementations. The PICS Proforma defined in Annex I is concerned with conformance claims with respect to end station implementations.

For the reasons stated in 10.6, it is recommended that end stations that do not require the ability to perform Source Pruning implement the Applicant-Only Participant, in preference to the Simple-Applicant Participant.

5.9.1 MMRP requirements and options

An end station for which conformance to MMRP is claimed shall

a) Conform to the operation of the MRP Applicant, Registrar, LeaveAll, and Periodic Transmission state machines, as defined in 10.7.7, 10.7.8, 10.7.9, and 10.7.10, as required for one or more of the following variants of the MRP Participant, as defined in 10.6 and 10.7:
   1) The Full Participant.
   2) The Full Participant, point-to-point subset.
   3) The Applicant-Only Participant.
   4) The Simple-Applicant Participant.
b) Exchange MPDUs as required by the MRP state machine(s) implemented, formatted in accordance with the generic PDU format described in 10.8, and able to carry application-specific information as defined in 10.12.1, using the MMRP Application address as defined in Table 10-1.

An end station for which conformance to the operation of the Applicant state machine (10.7.7) is claimed may

c) Perform source pruning, as defined in 10.10.3 and 10.12.

It is recommended that only those end stations that require the ability to perform Source Pruning (10.10.3) conform to the operation of the Full Participant or the Full Participant, point-to-point subset.

NOTE—If an end station does not require the ability to perform Source Pruning, then there is no need for it to implement Registrar functionality.

5.9.2 MVRP requirements and options

An end station for which conformance to MVRP is claimed shall

a) Conform to the operation of the MRP Applicant, Registrar, LeaveAll, and Periodic Transmission state machines, as defined in 10.7.7, 10.7.8, 10.7.9, and 10.7.10, as required for one or more of the following variants of the MRP Participant, as defined in 10.6 and 10.7:
   1) The Full Participant.
   2) The Full Participant, point-to-point subset.
   3) The Applicant-OnlyApplicant-Only Participant.
   4) The Simple-Applicant Participant.
b) Exchange MPDUs as required by the MRP state machine(s) implemented, formatted in accordance with the generic PDU format described in 10.8, and able to carry application-specific information as defined in 11.2.3, using the MVRP Application address as defined in Table 10-1.

An end station for which conformance to MVRP is claimed may

c) Perform source pruning, as defined in 10.10.3 and 11.2.1.1.

It is recommended that only those end stations that require the ability to perform Source Pruning (11.2.1.1) conform to the operation of the Full Participant or the Full Participant, point-to-point subset.

NOTE—If an end station does not require the ability to perform Source Pruning, then there is no need for it to implement Registrar functionality.

6. Support of the MAC Service in VLANs

Insert the following as a new subclause 6.12:

6.12 Filtering services in Bridged Local Area Networks

MAC Bridges provide filtering services that support aspects of the maintenance of QoS—in particular, transit delay, priority, and throughput. In addition, these services provide a degree of administrative control over the propagation of particular MAC Addresses in the network.

The services described are services in the most general sense; i.e., descriptions of functionality available to a MAC Service user or an administrator to control and access filtering capabilities. The descriptions make no assumptions as to how the service might be realized. There are at least the following possibilities:

a) Use of existing protocols and mechanisms, defined in IEEE 802® standards and elsewhere.
b) Use of management functionality, either locally defined or via remote management protocols.
c) Other means, standardized or otherwise.

6.12.1 Purpose(s) of filtering service provision

Filtering services are provided for the purposes described in 6.12.1.1 and 6.12.1.2.

6.12.1.1 Administrative control

Filtering services provide administrative control over the use of particular source and destination addresses in designated parts of the network. Such control allows network managers and administrators to limit the extent of operation of network layer and other protocols that use individual and group MAC addresses by establishing administrative boundaries across which specific MAC Addresses are not forwarded.

6.12.1.2 Throughput and end station load

Filtering services increase the overall throughput of the network, and reduce the load placed on end stations caused by the reception of frames that are destined for other end stations, by

a) Limiting frames destined for specific MAC Addresses to parts of the network that, to a high probability, lie along a path between the source MAC Address and the destination MAC Address.
b) Reducing the extent of group addressed frames to those parts of the network that contain end stations that are legitimate recipients of that traffic.
c) In Virtual Bridged Local Area Networks, reducing the extent of frames on specific VLANs to those parts of the network that contain stations that are legitimate recipients of traffic on that VLAN.

NOTE—Some aspects of the filtering services described in this standard are dependent upon the active participation of end stations. Where such participation is not possible, those aspects of the filtering services will be unavailable.

6.12.2 Goals of filtering service provision

The filtering services provided can be used to

a) Allow the MAC Service provider to dynamically learn where the recipients of frames addressed to individual MAC Addresses are located.
b) Allow end stations that are the potential recipients of MAC frames destined for group MAC addresses to dynamically indicate to the MAC Service provider which destination MAC Address(es) they wish to receive.
c) Exercise administrative control over the extent of propagation of specific MAC Addresses.

6.12.3 Users of filtering services

The filtering services provided are available to the following users:

a) Network management and administration, for the purposes of applying administrative control. Interactions between administrators of the network and the filtering service provider may be achieved by local means or by means of explicit management mechanisms.
b) End stations, for the purposes of controlling the destination addresses that they will receive. Interactions between end stations and the filtering service provider may be implicit, as is the case with the Learning Process (8.7), or by explicit use of filtering service primitives.

6.12.4 Basis of service

Filtering in Bridged Local Area Networks relies on the establishment of filtering rules, and subsequent filtering decisions, that are based on the value(s) contained in the Source MAC Address, Destination MAC Address, or VID fields in MAC frames.

NOTE—The filtering services defined by this standard use source address learning, destination address, and VID filtering.

6.12.5 Categories of service

Filtering services in Bridged Local Area Networks fall into the following categories:

a) *Basic Filtering Services*. These services are supported by the Forwarding Process (8.6) and by Static Filtering Entries (8.8.1), Static VLAN Registration Entries (8.8.2), Dynamic Filtering Entries (8.8.3), and Dynamic VLAN Registration Entries (8.8.5) in the Filtering Database. The information contained in the Dynamic Filtering Entries is maintained through the operation of the Learning Process (8.7), while the information contained in the Dynamic VLAN Registration Entries is maintained through the operation of MVRP (Clause 11).
b) *Extended Filtering Services*. These services are supported by the Forwarding Process (8.6), and the Static Filtering Entries (8.8.1) and Group Registration Entries (8.8.4) in the Filtering Database. The information contained in the Group Registration Entries is maintained through the operation of MMRP (10.9).

All Bridges shall support Basic Filtering Services and may support Extended Filtering Services.

6.12.6 Service configuration

In the absence of explicit information in the Filtering Database, the behavior of the Forwarding Process with respect to the forwarding or filtering of frames destined for group MAC addresses depends upon the categories of service supported by the Bridge.

Basic Filtering Services support the filtering behavior required for regions of a Bridged Local Area Network in which potential recipients of multicast frames exist, but where either the recipients or the Bridges are either unable to support the dynamic configuration of filtering information for those group MAC addresses, or the recipients have a requirement to receive all traffic destined for group MAC addresses.

Extended Filtering Services support the filtering behavior required for regions of a network in which potential recipients of multicast frames exist, and where both the potential recipients of frames and the Bridges are able to support dynamic configuration of filtering information for group MAC addresses. In order to integrate this extended filtering behavior with the needs of regions of the network that support only Basic Filtering Services, Bridges that support Extended Filtering Services can be statically and dynamically configured to modify their filtering behavior on a per-group MAC address basis, and also on the basis of the overall filtering service provided by each outbound Port with regard to multicast frames. The latter capability permits configuration of the Port's default forwarding or filtering behavior with regard to group MAC addresses for which no specific static or dynamic filtering information has been configured.

Service configuration provides the ability to configure the overall filtering for the following cases:

a) Bridges that only implement Basic Filtering Services.
b) Bridges that support Extended Filtering Services in a heterogeneous environment, where some equipment is unable to participate in Dynamic Multicast Filtering, or where some equipment (e.g., routers) have specific needs to see unfiltered traffic.
c) Bridges that support Extended Filtering Services in a homogeneous environment, where all equipment is able to participate in Dynamic Multicast Filtering.

6.12.7 Service definition for Extended Filtering Services

The Filtering Services are described by means of service primitives that define particular types of interaction between MAC Service users and the MAC Service provider across the MAC Service boundary. As these interactions are not defined between peer entities, they are described simply in terms of service requests sent from the MAC Service user to the MAC Service provider.

6.12.7.1 Dynamic registration and de-registration services

These services allow MAC Service users dynamic control over the set of destination MAC Addresses that they will receive from the MAC Service provider, by:

a) Registering/deregistering membership of specific Groups associated with those addresses.
b) Registering/deregistering individual MAC address information.
c) Registering/deregistering service requirements with regard to the overall forwarding/filtering behavior for Groups.

Provision of these services is achieved by means of MMRP and its associated procedures, as described in 10.9.

NOTE 1—These services can provide the MAC Service user with dynamic control over access to multicast data streams, for example, multiple video channels made available by a server using a different group MAC address for each channel. The ability to both register and deregister Group membership, coupled with the filtering action associated with the Group membership, limits the impact of such services on the bandwidth available in the network. These services can be used to control the reception of other categories of multicast traffic, for similar reasons.

REGISTER_MAC_ADDRESS (MAC_ADDRESS)

Indicates to the MAC Service provider that the MAC Service user wishes to receive frames containing the MAC Address indicated in the MAC_ADDRESS parameter as the destination address. The MAC Addresses that can be carried by this parameter do not include the following:

d) Any of the Reserved Addresses identified in Table 8-1 or Table 8-2.
e) Any of the MRP Application addresses, as defined in Table 10-1.

DEREGISTER_MAC_ADDRESS (MAC_ADDRESS)

Indicates to the MAC Service provider that the MAC Service user no longer wishes to receive frames containing the MAC Address indicated in the MAC_ADDRESS parameter as the destination address.

REGISTER_SERVICE_REQUIREMENT (REQUIREMENT_SPECIFICATION)

Indicates to the MAC Service provider that the MAC Service user has a requirement for any devices that support Extended Filtering Services to forward frames in the direction of the MAC Service user in accordance with the definition of the service requirement defined by the REQUIREMENT_SPECIFICATION parameter. The values that can be carried by this parameter are as follows:

f) Forward All Groups.
g) Forward Unregistered Groups.

DEREGISTER_SERVICE_REQUIREMENT (REQUIREMENT_SPECIFICATION)

Indicates to the MAC Service provider that the MAC Service user no longer has a requirement for any devices that support Extended Filtering Services to forward frames in the direction of the MAC Service user in accordance with the definition of the service requirement defined by the REQUIREMENT_SPECIFICATION parameter. The values that can be carried by this parameter are as follows:

h) Forward All Groups.
i) Forward Unregistered Groups.

The use of these services can result in the propagation of group MAC address and service requirement information across the Spanning Tree, affecting the contents of Group Registration Entries (8.8.4) in Bridges and end stations, and thereby affecting the frame forwarding behavior of the Bridges and end stations with regard to multicast frames.

NOTE 2—If the Enhanced Internal Sublayer Service (EISS) is supported, the Extended Filtering Service primitives issued by the MAC Service user should also include a VID parameter in order to identify the VLAN associated with the MAC_ADDRESS or REQUIREMENT_SPECIFICATION specified.

7. Principles of network operation

Delete existing Figure 7-1 and insert new Figure 7-1 as follows:

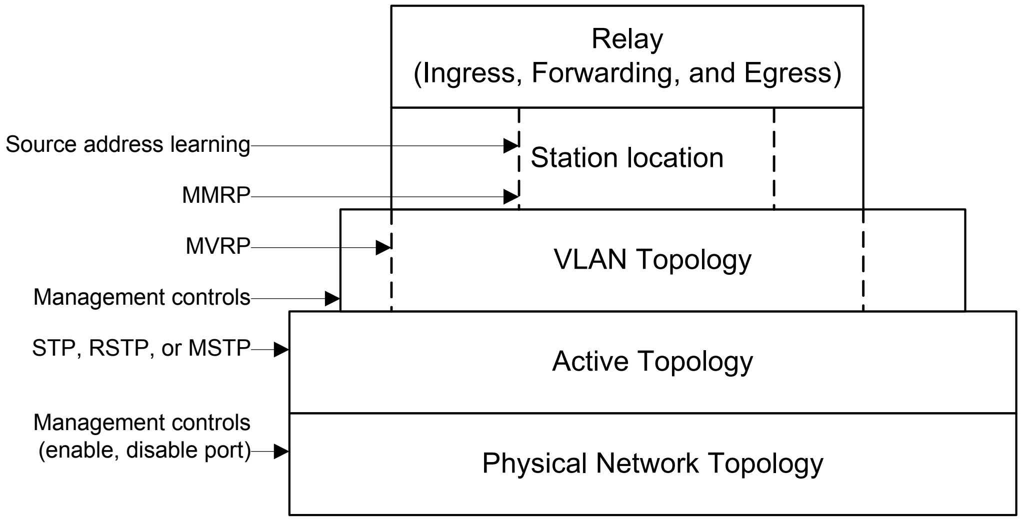

Figure 7-1—VLAN Bridging overview

7.3 VLAN Topology

Change NOTE 2 as follows:

NOTE 2—To accommodate end stations that do not participate in the ~~GVRP~~MVRP protocol specified in Clause 11, management controls associated with each Bridge Port allow the Port to identify the attached LAN segment as connecting end stations that require services using specified VLANs.

7.4 Locating end stations

Change the paragraph following NOTE 1, and NOTE 2, as follows:

The multiple ~~multicast~~MAC registration protocol (~~GMRP~~MMRP), specified in ~~Clause 10 of IEEE Std 802.1D~~ Clause 10, allows end stations to advertise their presence and their desire to join (or leave) a multicast group, or to register an individual MAC address, in the context of a VLAN. The protocol communicates this information to other Bridges, using the VLAN and its active topology.

NOTE 2—To accommodate end stations that do not participate in ~~GMRP~~MMRP, management controls associated with each Bridge Port allow the Port to identify the attached LAN segment as connecting end stations that are intended to receive specified group addresses. The continuous operation of ~~GMRP~~MMRP, and the propagation of location information through Bridges using the current active topology for the VLAN, supports multicast traffic reduction, while ensuring rapid restoration of multicast connectivity, without management intervention, if alternate connectivity is selected following network component failure.

7.5 Ingress, forwarding, and egress rules

Change the NOTE, and the preceding paragraph, as follows:

Frames that carry control information to determine the active topology and current extent of each VLAN, i.e., spanning tree and ~~GVRP~~MVRP ~~B~~PDUs, and frames from other link constrained protocols, such as

EAPOL and LLDP, are not forwarded. Permanently configured static entries in the filtering database (8.2, 8.3, and 8.12) ensure that such frames are discarded by the Forwarding Process (8.6).

NOTE—~~GARP PDUs~~ MRPDUs destined for any ~~GARP~~MRP application are forwarded or filtered depending upon whether the application concerned is supported by the bridge, as specified in 8.12.

8. Principles of bridge operation

8.1 Bridge operation

8.1.4 Traffic segregation

Change list item e) as follows:

e) Configuration of Static Filtering Entries (8.8.1) and ~~Group~~ MAC Address Registration Entries (8.8.4).

8.1.5 Traffic reduction

Change list items c) through f) as follows:

c) Automatic inclusion and removal of Bridge Ports in the VLAN, through configuration of Dynamic VLAN Registration Entries by means of ~~GVRP~~MVRP (8.8.5 and 11.2);

d) Explicit configuration of management controls associated with the operation of ~~GVRP~~MVRP by means of Static VLAN Registration Entries (8.8.2 and 11.2);

e) Automatic configuration of Group Registration Entries by means of ~~GMRP~~MMRP exchanges;

f) Explicit configuration of the management controls associated with the operation of ~~GMRP~~MMRP by means of Group Registration Entries.

8.3 Model of operation

Change list item b) 2), as shown:

2) ~~Generic Attribute registration Protocol~~Multiple Registration Protocol;

Change the 7th paragraph, and Figure 8-6, as shown:

Figure 8-6 illustrates the operation of the ~~Generic Attribute~~ Multiple Registration Protocol (~~GARP~~MRP) Entity (8.10).

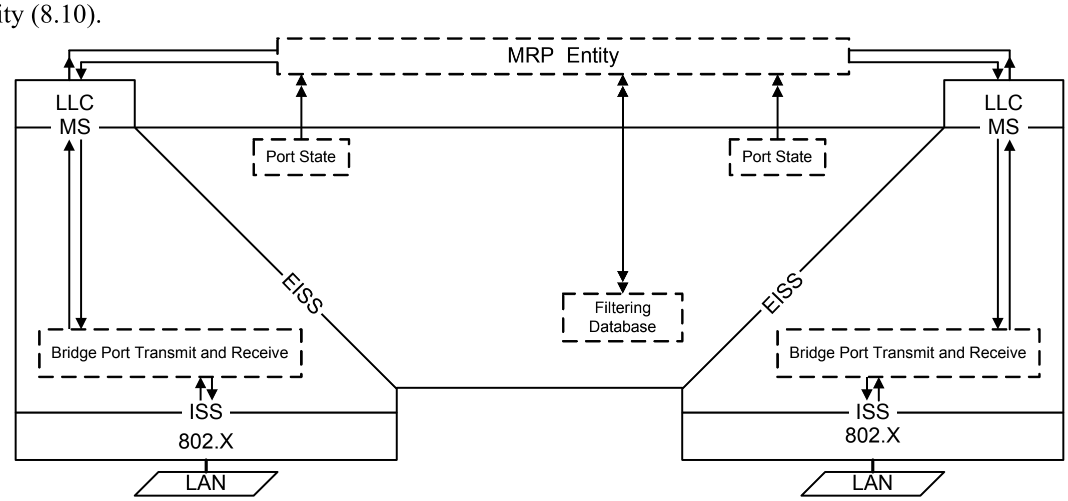

Figure 8-6—Operation of ~~GARP~~MRP

8.6 The Forwarding Process

8.6.3 Frame filtering

Change Table 8-1 as shown:

Table 8-1—C-VLAN component Reserved addresses

Assignment	Value
Bridge Group Address	01-80-C2-00-00-00
IEEE Std 802.3 Full Duplex PAUSE operation	01-80-C2-00-00-01
IEEE Std 802.3 Slow_Protocols_Multicast address	01-80-C2-00-00-02
IEEE Std 802.1X PAE address	01-80-C2-00-00-03
Reserved for future standardization—media access method specific	01-80-C2-00-00-04
Reserved for future standardization—media access method specific	01-80-C2-00-00-05
Reserved for future standardization	01-80-C2-00-00-06
Reserved for future standardization	01-80-C2-00-00-07
Provider Bridge Group Address	01-80-C2-00-00-08
Reserved for future standardization	01-80-C2-00-00-09
Reserved for future standardization	01-80-C2-00-00-0A
Reserved for future standardization	01-80-C2-00-00-0B
Reserved for future standardization	01-80-C2-00-00-0C
Provider Bridge ~~GVRP~~MVRP Address[a]	01-80-C2-00-00-0D
IEEE Std 802.1AB Link Layer Discovery Protocol multicast address	01-80-C2-00-00-0E
Reserved for future standardization	01-80-C2-00-00-0F

[a]In IEEE Std 802.1ad-2005, this was assigned as the Provider Bridge GVRP address; as this amendment replaces GVRP with MVRP, the same address has been assigned for use with MVRP.

8.8 The Filtering Database

Change list items i) and j) as shown:

i) ~~Group~~ MAC Address Registration Entries support the registration of group MAC addresses. They are created, updated, and removed by the ~~GMRP~~MMRP protocol in support of Extended Filtering Services (8.8.4; Clause 10), subject to the state of the Restricted_~~Group~~MAC_Address_Registration management control (10.12.2.3~~10.3.2.3 of IEEE Std 802.1D~~). If the value of this control is TRUE, then the creation of a ~~Group~~ MAC Address Registration Entry is not permitted unless a Static Filtering Entry exists that permits dynamic registration for the Group concerned.

j) Dynamic VLAN Registration Entries are used to specify the Ports on which VLAN membership has been dynamically registered. They are created, updated, and removed by the ~~GVRP~~MVRP protocol, in support of automatic VLAN membership configuration (Clause 11), subject to the state of the Restricted_VLAN_Registration management control (11.2.3.2.3). If the value of this control is

TRUE, then the creation of a Dynamic VLAN Registration Entry is not permitted unless a Static VLAN Registration Entry exists that permits dynamic registration for the VLAN concerned.

Change the line following list item j) as follows:

Static Filtering Entries and ~~Group~~ MAC Address Registration Entries comprise

Change the line immediately before list item s) as follows:

In Bridges that support Extended Filtering Services, the default forwarding behavior for group MAC addresses, for each Port, and for each VID, can be configured both statically and dynamically by means of Static Filtering Entries and/or ~~Group~~ MAC Address Registration Entries that can carry the following MAC Address specifications:

Change list item t) as follows:

t) All Unregistered Group Addresses (i.e., all group MAC addresses for which no ~~Group~~ MAC Address Registration Entry exists), for which no more specific Static Filtering Entry exists.

Change the paragraph following NOTE 1 as follows:

The Filtering Database shall support the creation, updating and removal of Dynamic Filtering Entries by the Learning Process (8.7). In Bridges that support Extended Filtering Services, the Filtering Database shall support the creation, updating, and removal of ~~Group~~ MAC Address Registration Entries by ~~GMRP~~MMRP (~~Clause 10 of IEEE Std 802.1D~~ Clause 10).

Change list item u) as follows:

u) The total number of entries (Static Filtering Entries, Dynamic Filtering Entries, ~~Group~~ MAC Address Registration Entries, Static VLAN Registration Entries, and Dynamic VLAN Registration Entries) that the implementation of the Filtering Database can support, and

8.8.1 Static Filtering Entries

Change the final paragraph of this subclause as follows:

In addition to controlling the forwarding of frames, Static Filtering Entries ~~for group MAC Addresses~~ provide the Registrar Administrative Control values for the ~~GMRP~~MMRP protocol (~~Clauses 10, 12, and 12.9.1 of IEEE Std 802.1D~~ Clause 10). Static configuration of forwarding of ~~specific group addressed frames~~ a specific destination MAC address to an outbound port indicates Registration Fixed on that port~~;~~, which indicates a desire to receive the specific frames ~~addressed to that Group~~ even in the absence of dynamic information. Static configuration of filtering of frames that might otherwise be sent to an outbound port indicates Registration Forbidden. The absence of a Static Filtering Entry for ~~the group~~ a MAC address, or the configuration of forwarding or filtering on the basis of dynamic filtering information, indicates Normal Registration.

8.8.2 Static VLAN Registration Entries

Change list item b) 1) as follows:

b) A Port Map, consisting of a control element for each outbound Port, specifying
   1) The Registrar Administrative Control values for the ~~GVRP~~ MVRP protocol (Clause 11) for the VLAN. In addition to providing control over the operation of ~~GVRP~~ MVRP, these values can also directly affect the forwarding behavior of the Bridge, as described in 8.8.9. The values that can be represented are

Change the heading and text of subclause 8.8.4 as shown:

8.8.4 ~~Group~~ MAC Address Registration Entries

A ~~Group~~ MAC Address Registration Entry specifies

a) A MAC Address specification, comprising
   1) An individual MAC address; or
   2) A group MAC address; or
   3) All Group Addresses, for which no more specific Static Filtering Entry exists; or
   4) All Unregistered Group Addresses, for which no more specific Static Filtering Entry exists.
b) The VID of the VLAN in which the dynamic filtering information was registered;
c) A Port Map, consisting of a control element for each outbound Port, which specifies forwarding (Registered) or filtering (Not registered) of frames destined to the MAC Address and VID.

~~Group~~ MAC Address Registration Entries are created, modified and deleted by the operation of ~~GMRP~~ MMRP (~~Clause 10 of IEEE Std 802.1D, as modified by~~ Clause 10 ~~of this standard~~). No more than one ~~Group~~ MAC Address Registration Entry shall be created in the Filtering Database for a given combination of MAC Address specification and VID.

NOTE—It is possible to have a Static Filtering Entry which has values of Forward or Filter on some or all Ports that mask the dynamic values held in a corresponding ~~Group~~ MAC Address Registration Entry. The values in the ~~Group~~ MAC Address Registration Entry will continue to be updated by ~~GMRP~~MMRP; hence, subsequent modification of that entry to allow the use of dynamic filtering information on one or more Ports immediately activates the true ~~GMRP~~MMRP registration state that was hitherto masked by the static information.

The creation of ~~Group~~ MAC Address Registration Entries is subject to the Restricted_~~Group~~MAC_Address_Registration management control (~~10.3.2.3 of IEEE Std 802.1D~~ 10.12.2.3). If the value of this control is TRUE, a dynamic entry for a given ~~Group~~ MAC address may only be created if a Static Filtering Entry already exists for that ~~Group~~ MAC address, in which the Registrar Administrative Control value is Normal Registration.

8.8.6 Default Group filtering behavior

Change list item b) 2) as follows:

2) An explicit Static Filtering Entry specifies forwarding or filtering on the basis of dynamic filtering information, and an applicable explicit ~~Group~~ MAC Address Registration Entry exists specifying filtering; or

Change list items c) 2) and c) 3) as follows:

2) An explicit Static Filtering Entry specifies forwarding or filtering on the basis of dynamic filtering information, and an applicable explicit ~~Group~~ MAC Address Registration Entry exists specifying forwarding; or
3) An applicable explicit Static Filtering Entry does not exist, but an applicable ~~Group~~ MAC Address Registration entry specifies forwarding.

Change NOTE 2 as follows:

NOTE 2—Forward All Groups corresponds directly to the behavior specified in ISO/IEC 10038:1993 when forwarding group MAC addressed frames for which no static filtering information exists in the Filtering Database. Forward All Groups makes use of information contained in Static Filtering Entries for specific group MAC addresses, but overrides any information contained in ~~Group~~ MAC Address Registration Entries. Forward Unregistered Groups is analogous to the forwarding behavior of a Bridge with respect to individual MAC Addresses. If there is no static or dynamic information for a specific group MAC address, then the frame is forwarded; otherwise, the frame is forwarded in accordance with the statically configured or dynamically learned information.

Change list item e) as follows:

e) Any ~~Group~~ MAC Address Registration Entries applicable to that VLAN with Group Addresses or All Unregistered Group Addresses.

Change NOTE 3 as follows:

NOTE 3—The result is that the default Group filtering behavior for each VLAN can be configured for each Port of the Bridge via Static Filtering Entries, determined dynamically via Group Registration Entries created/updated by ~~GMRP~~MMRP (Clause 10), or both. For example, in the absence of any static or dynamic information in the Filtering Database for All Group Addresses or All Unregistered Group Addresses, the default Group filtering behavior will be Filter Unregistered Groups on all Ports, for all VLANs. Subsequently, the creation of a Dynamic Group Registration Entry for All Unregistered Group Addresses indicating "Registered" for a given VLAN on a given Port would cause that Port to exhibit Forward Unregistered Groups behavior for that VLAN. Similarly, creating a Static Filtering Entry for All Group Addresses indicating "Registration Fixed" on a given Port for that VLAN would cause that Port to exhibit Forward All Groups behavior.

Hence, by using appropriate combinations of "Registration Fixed," "Registration Forbidden," and "Normal Registration" in the Port Maps of Static Filtering Entries for the All Group Addresses and All Unregistered Group Addresses address specifications, it is possible, for a given Port and VLAN, to

— Fix the default Group filtering behavior to be just one of the three behaviors described above; or

— Restrict the choice of behaviors to a subset of the three, and allow ~~GMRP~~MMRP registrations (or their absence) to determine the final choice; or

— Allow any one of the three behaviors to be adopted, in accordance with any registrations received via ~~GMRP~~MMRP.

8.8.7 Allocation of VIDs to FIDs

8.8.7.3 VLAN Learning Constraint inconsistencies and violations

Change list item d) as follows:

d) When a VLAN that was hitherto not a member of the set of active VLANs (8.8.7) becomes active, either as a result of management action or as a result of the operation of ~~GVRP~~MVRP, resulting in the Bridge no longer being able to support the defined set of constraints and/or fixed allocations for the set of active VLANs; or

8.8.8 Querying the Filtering Database

Change the first and second paragraphs following Table 8-5, and change Table 8-6 and Table 8-7, as follows:

Table 8-6 specifies the result, Registered or Not Registered, of combining a Static Filtering Entry and a ~~Group~~ MAC Address Registration Entry for the "All Group Addresses" address specification, and for the "All Unregistered Group Addresses" address specification for an outbound Port.

Table 8-7 combines Static Filtering Entry and ~~Group~~ MAC Address Registration Entry information for a specific group MAC address with the Table 8-6 results for All Group Addresses and All Unregistered Group Addresses to specify forwarding, or filtering, of a frame with that destination group MAC address through an outbound Port.

Table 8-6—Combining Static Filtering Entry and ~~Group~~ MAC Address Registration Entry for "All Group Addresses" and "All Unregistered Group Addresses"

	Static Filtering Entry Control Element for this group MAC address, VID, and outbound Port specifies:				
Filtering Information	Registration Fixed (Forward)	Registration Forbidden (Filter)	Use ~~Group~~ MAC Address Registration Information, or no Static Filtering Entry present. ~~Group~~ MAC Address Registration Entry Control Element for this group MAC address, VID and outbound Port specifies:		
			Registered (Forward)	Not Registered (Filter)	No ~~Group~~ MAC Address Registration Entry present
Result	Registered	Not Registered	Registered	Not Registered	Not Registered

Table 8-7—Forwarding or Filtering for specific group MAC addresses

				Static Filtering Entry Control Element for this group MAC address, VID and outbound Port specifies:				
				Registration Fixed (Forward)	Registration Forbidden (Filter)	Use ~~Group~~ MAC Address Registration Information, or no Static Filtering Entry present. ~~Group~~ MAC Address Registration Entry Control Element for this group MAC address, VID and outbound Port specifies:		
						Registered (Forward)	Not Registered (Filter)	No ~~Group~~ MAC Address Registration Entry present
All Group Addresses control elements for this VID and Port specify (Table 8-6):	Not Registered	All Unregistered Group Addresses control elements for this VID and Port specify (Table 8-6):	Not Registered	Forward	Filter	Forward	Filter	Filter (Filter Unregistered Groups)
			Registered	Forward	Filter	Forward	Filter	Forward (Forward Unregistered Groups)
	Registered			Forward	Filter	Forward (Forward All Groups)	Forward (Forward All Groups)	Forward (Forward All Groups)

8.8.10 Permanent Database

Change NOTE 2 as follows:

NOTE 2—Subclause ~~10.3.2.3 of IEEE Std 802.1D~~ 10.12.2.3 defines an initial state for the contents of the Permanent Database, required for the purposes of ~~GMRP~~MMRP operation.

Change the title and text of subclause 8.11 as follows:

8.11 ~~GARP~~MRP Entities

The ~~GARP Protocol Entities~~ MRP protocol entities operate the algorithms and protocols associated with the ~~GARP~~MRP applications supported by the Bridge, and consist of the set of ~~GARP~~MRP Participants for those ~~GARP~~MRP applications (Clause 10 ~~and 12.3 of IEEE Std 802.1D~~).

Figure 8-6 illustrates the operation of a ~~GARP Protocol Entity~~ MRP protocol entity including the reception and transmission of frames containing ~~GARP PDUs~~ MRPDUs, the use of control information contained in the Filtering Database, and notification of the Filtering Database of changes in filtering information.

8.13 Addressing

8.13.1 End stations

Change the second paragraph as follows:

In the absence of explicit filters configured via management as Static Filtering Entries, or via ~~GMRP~~MMRP as Group Registration Entries (8.8, Clause 10), frames with a destination address of the broadcast address or any other group address that is not a Reserved Address (8.6.3) are assigned to a VLAN and relayed throughout that VLAN.

Change the title and text of subclause 8.13.3 as follows:

8.13.3 Use of LLC by Spanning Tree Protocol ~~and GARP~~ Entities

~~Both~~ Spanning Tree Protocol ~~and GARP~~ Entities use~~s~~ the DL_UNITDATA.request and DL_UNITDATA.indication primitives (ISO/IEC 8802-2) provided by individual LLC Entities associated with each Bridge Port to transmit and receive frames. The source_address and destination_address parameters of the DL_UNITDATA.request shall both denote the standard LLC address assigned to the Bridge Spanning Tree Protocol (Table 8-9). Each DL_UNITDATA request primitive gives rise to the transmission of an LLC UI command PDU, which conveys the BPDU ~~or GARP PDU~~ in its information field.[4]

IEEE Std 802.1D defines a Protocol Identifier field, present in all BPDUs (IEEE Std 802.1D, Clause 9) ~~and GARP PDUs (IEEE Std 802.1D, 12.11)~~, which serves to identify different protocols supported within the scope of the LLC address assignment. Further values of this field are reserved for future standardization. A Spanning Tree Protocol Entity ~~or GARP Protocol Entity~~ that receives a BPDU ~~or a GARP PDU~~ with an unknown Protocol Identifier shall discard that PDU.

[4]~~ISO/IEC TR 11802-1: 1997, Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Technical reports and guidelines—Part 1: The structure and coding of Logical Link Control addresses in Local Area Networks, contains the full list of standard LLC address assignments, and documents the criteria for assignment.~~ Administration of LLC address assignments is the responsibility of the IEEE Registration Authority (IEEE RA). A full list of standard LLC address assignments, and the criteria for assignment, can be found on the IEEE RA website at http://standards.ieee.org/regauth/index.html.

Table 8-9—Standard LLC address assignment

Assignment	Value
Bridge spanning tree protocol	01000010

Code Representation: The least significant bit of the value shown is the right-most. The bits increase in significance from right to left. It should be noted that the code representation used here has been chosen in order to maintain consistency with the representation used elsewhere in this standard, and with the representation used in IEEE Std 802.1D.

8.13.4 Reserved MAC Addresses

Change the text of this subclause as shown:

Any frame with a destination address that is a Reserved MAC Address shall not be forwarded by a Bridge. Reserved MAC Addresses for C-VLAN components and S-VLAN components are specified in Table 8-1 and Table 8-2 respectively. These group MAC addresses are reserved for assignment to standard protocols, according to the criteria for such assignments.[5] ~~(Clause 5.5 of ISO/IEC TR 11802-2)~~

Change the title and text of subclause 8.13.6 as follows:

8.13.6 Group MAC Addresses for ~~GARP~~MRP Applications

~~A GARP~~An MRP ~~E~~entity that supports a given ~~GARP~~MRP ~~A~~application transmits frames addressed to all other ~~GARP~~MRP ~~E~~entities that implement the same ~~GARP~~MRP ~~A~~application. The peers of each such entity bound a region of the network that contains no peers, commonly a single LAN in the case where all Bridges attached to the LAN implement the application.

~~A distinct universally administered 48-bit Group Address is assigned to each GARP application. Filtering Database Entries for each GARP Application address assigned to an application that is supported by a C-VLAN component should be configured in the Filtering Database so as to confine frames for that application to the peer region, while addresses for applications that are not supported should not be included.~~

~~A set of 48-bit Universal Addresses, known as GARP Application addresses, have been assigned for use by C-VLAN components. The values of the GARP Application addresses are defined in IEEE Std 802.1D, Table 12-1. These group MAC Addresses are reserved for assignment to standard protocols, according to the criteria for such assignments (Clause 5.5 of ISO/IEC TR 11802-2).~~

~~NOTE—Table 11-1 allocates a group MAC Address for use by the GVRP application; however, the value allocated in that table is one of the GARP Application addresses reserved by IEEE Std 802.1D, Table 12-1.~~

~~Since a network of Provider Bridges needs to appear to attached Customer Bridges as if it were a single LAN, Customer Bridge MRP Application Addresses are always forwarded by S-VLAN components. Certain MRP Applications may also be used by Provider Bridges, so distinct 48-bit universally administered Group Addresses that are C-VLAN component Reserved MAC Addresses but not S-VLAN component Reserved MAC Addresses are assigned for such use. One such address, the Provider Bridge GVRP Address, is assigned by this standard (Table 8-1).~~

[5] Administration of standard Group MAC address assignments is the responsibility of the IEEE Registration Authority (IEEE RA). A full list of standard Group MAC address assignments, and the criteria for assignment, can be found on the IEEE RA website at http://standards.ieee.org/regauth/index.html.

Universally administered 48-bit Group Addresses are assigned to MRP applications, from a set of 48-bit Universal Addresses, known as MRP application addresses, as shown in Table 10-1; these addresses are for use by VLAN components that support the MRP applications concerned. Filtering Database Entries for each MRP application address assigned to an application that is supported by a VLAN component should be configured in the Filtering Database so as to confine frames for that application to the peer region, while addresses for applications that are not supported should not be included. These group MAC addresses are reserved for assignment to standard protocols, according to the criteria for such assignments (see 8.13.4).

Certain MRP Applications may be used by both Customer and Provider Bridges, so distinct 48-bit universally administered Group Addresses that are both C-VLAN component Reserved MAC Addresses and S-VLAN component Reserved MAC Addresses are assigned for such use. One such address, the Customer and Provider Bridge MMRP Address, is assigned by this standard (Table 10-1). Certain MRP Applications may be used by Provider Bridges, so distinct 48-bit universally administered Group Addresses that are C-VLAN component Reserved MAC Addresses but not S-VLAN component Reserved MAC Addresses are assigned for such use. One such address, the Provider Bridge MVRP Address, is assigned by this standard (Table 8-1).

The source address field of MAC frames conveying ~~BPDUs or GARP PDUs~~ MRPDUs contains the individual MAC Address for the Bridge Port through which the PDU is transmitted (8.13.2).

8.13.9 Points of attachment and connectivity for Higher Layer Entities

Change the first paragraph as shown:

The Higher Layer Entities in a Bridge, such as the Spanning Tree Protocol Entity (8.10), ~~GARP Entities~~MRP entities (8.11), and Bridge Management (8.12), are modeled as attaching directly to one or more individual LANs connected by the Bridge's Ports, in the same way that any distinct end station is attached to the network. While these entities and the relay function of the Bridge use the same individual MAC entities to transmit and receive frames, the addressing and connectivity to and from these entities is the same as if they were attached as separate end stations "outside" the Port or Ports where they are actually attached. Figure 8-10 is functionally equivalent to Figure 8-2, but illustrates this logical separation between the points of attachment used by the Higher Layer Entities and those used by the MAC Relay Entity.

Change list item b) as shown:

b) A distinct point of attachment to each individual LAN attached by a Bridge Port, providing connectivity only to peer entities connected directly to that LAN, as do the Spanning Tree Protocol Entity and the ~~GARP Entity~~MRP entity.

8.13.10 VLAN attachment and connectivity for Higher Layer Entities

Change NOTE 3 and list item b) and item c) as shown:

NOTE 3—Any BPDUs or ~~GVRP PDUs~~ MVRPDUs that carry a tag header are not recognized as well-formed BPDUs or ~~GVRP PDUs~~ MVRPDUs and are not forwarded by the Bridge.

b) The definition of the ~~GVRP~~MVRP application (11.2.3) calls for all ~~GVRP~~MVRP frames to be transmitted untagged for similar reasons;

c) The definition of the ~~GMRP~~MMRP application (Clause 10) calls for all ~~GMRP~~MMRP frames originating from VLAN-aware devices to be transmitted VLAN-tagged, in order for the VID in the tag to be used to identify the VLAN Context in which the registration applies;

Delete the existing contents of Clause 10 and its title. Insert a replacement Clause 10 as follows:

10. Multiple Registration Protocol (MRP) and Multiple MAC Registration Protocol (MMRP)

The Multiple Registration Protocol allows participants in an MRP application to register attributes with other participants in a Bridged Local Area Network. The definition of attribute types, their values, and the semantics associated with values when registered, are specific to each MRP application.

This clause

a) Provides an overview of the use of MRP within a bridged network (10.1)
b) Describes the architecture of MRP participants for end stations and Bridge Ports (10.2)
c) Specifies registration propagation between the per-Port Participants in a Bridge (10.3)
d) Details requirements to be met by the MRP design (10.4)
e) Details requirements for interoperability between MRP participants (10.5)
f) Provides an overview of protocol operation (10.6)
g) Provides a detailed specification of the protocol (10.7)
h) Describes the structure of protocol data units exchanged between MRP participants (10.8)

Subclauses 10.9 through 10.12 define an MRP application, the Multiple MAC Registration Protocol (MMRP), that registers attributes of two types—MAC Addresses and Group service requirements. Values of these attributes control MAC address filtering by MMRP participants.

Clause 11 defines a second MRP application, the Multiple VLAN Registration Protocol (MVRP), that registers VLAN membership information.

10.1 MRP overview

MRP allows a participant in a given MRP application to make or withdraw *declarations* of *attributes*, and for those declarations (or withdrawals) to result in the *registration* (or removal of registrations) of those attributes with the other MRP Participants for that application.

A declaration by an MRP Participant for an end station or Bridge Port is recorded by an Applicant state machine for the declared attribute and Port. Changes in the Applicant state machine's variables trigger the transmission of MRPDUs to communicate the declaration (or withdrawal).

A registration is recorded by a Registrar state machine for the attribute at each participating end station and Bridge Port that receives the MRPDU. Removal of a given attribute registration occurs only if all the other participants connected to the same LAN withdraw the declaration.

Attributes registered on Bridge Ports that are part of the applicable *active topology* (8.4, 10.3.1) are declared on all the other Bridge Ports that are also part of that active topology. Hence, a given declaration is propagated to all application participants, and registered in each Bridge on those Ports that are "nearest" to the source or sources of the declaration within the active topology.

Figure 10-1 illustrates the result of a single end station making a declaration, and shows the Bridge Ports that also make declarations to propagate the attribute. The attribute is propagated to all LANs in the Bridged Local Area Network, but the directional nature of the propagation results in registration only on Bridge Ports that receive (as opposed to transmit) declarations.

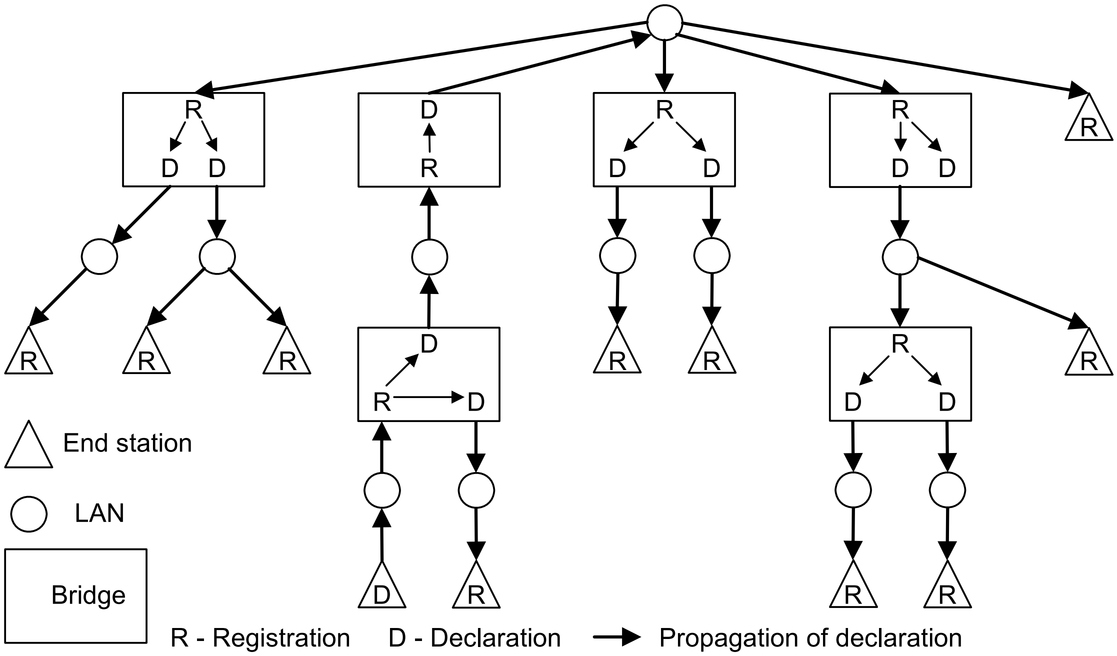

Figure 10-1—Example—Attribute value propagation from one station

NOTE—Unless otherwise stated, the following description assumes operation within the Base Spanning Tree Context (see 10.3.1). While registration can occur on any Bridge Port, regardless of Port State (8.4), propagation follows the spanning tree active topology. All the Bridge Ports shown in Figure 10-1, Figure 10-2, and Figure 10-3 are in the Forwarding Port State.

Figure 10-2 illustrates the result of different end stations declaring the same attribute on different LANs. All end stations register the attribute, and some Bridges register it on more than one Port.

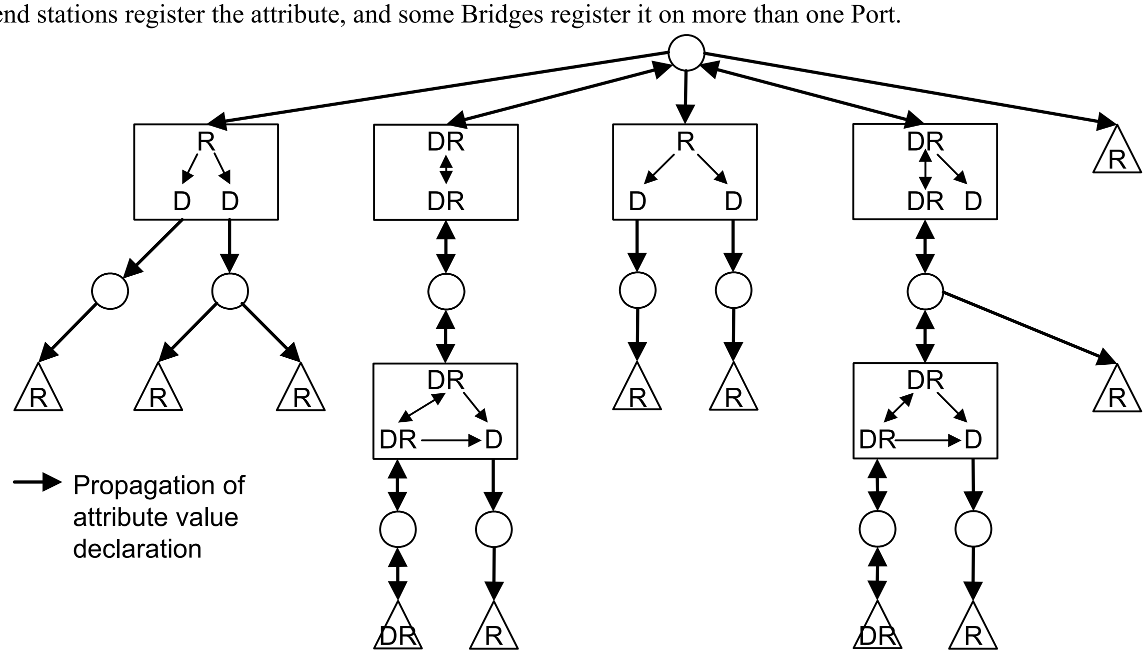

Figure 10-2—Example—Attribute value propagation from two stations

The set of Bridge Ports and end stations that both declare and register a given attribute defines the subset of the active topology that contains all the participants declaring that attribute. A registration can be regarded as a pointer to participants that have declared that attribute, as illustrated in Figure 10-3 (using the same set of declarations and registrations that were illustrated in Figure 10-2).

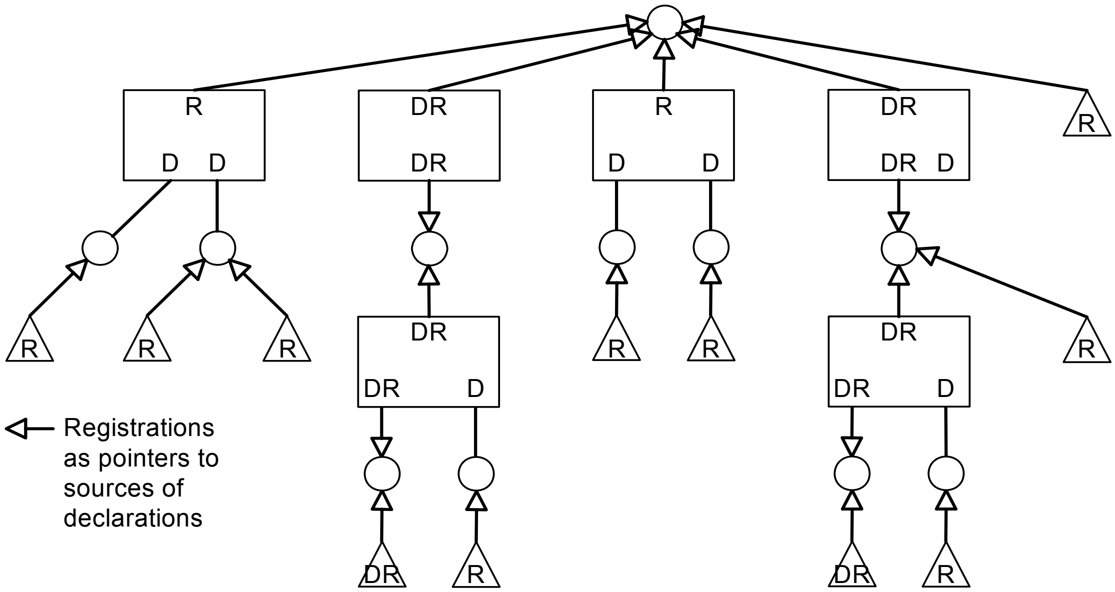

Figure 10-3—Example—Registrations as pointers to the sources of declarations

Situations where it is desirable to form “reachability trees” are generally good candidates for the use of MRP. For example, if the attribute in Figure 10-3 is a Group MAC Address that is used as a destination address for a video data stream, and it is deemed desirable for that video data to be sent only to the subset of the active topology that contains end stations that have declared that attribute, then an end station that is the source of that video stream could use the presence or absence of a registration as an indication of whether or not to send the data on the LAN to which it is attached. Any Bridge receiving the data could determine on which Ports the data should be forwarded.

VLAN Bridges that do not support MRP are transparent to MRP protocol exchanges, and forward received MRPDUs on all Ports that are in Forwarding. Similarly, VLAN Bridges that do not implement a given MRP application are transparent to MRP protocol exchanges destined for that application, and forward any such received MRPDUs on all Ports that are in Forwarding.

MRP operates only on Ports that are MAC_Operational (6.4.2). If the Port is operating as a network access port (IEEE Std 802.1X), MRP uses the controlled port (8.13.9). On any Port whose MAC_Operational parameter is FALSE or whose AuthControlledPortStatus is not Authorized, any MRP entity shall not transmit MRPDUs, and shall discard, without processing, any received MRPDUs.

MRP provides a means to mark initial attribute declarations and propagated attribute declarations as “new”, signaling to the recipient of the declaration that the attribute value is being newly declared, or is being re-declared following a change in the underlying topology. The rules applied to the marking and propagation of newly declared values in this way are common to all MRP Applications; however, the action taken on receipt of an attribute declaration marked as “new” is specific to each MRP Application. For example, MMRP (10.9) makes no use of the “new” marking, whereas MVRP (Clause 11) uses the “new” marking to permit Filtering Database entries to be flushed on a per-VLAN basis following a topology change.

10.2 MRP architecture

An MRP Participant consists of an application component, and an MRP Attribute Declaration (MAD) component. The application component is responsible for the semantics associated with Attribute values and their registration, including the use of explicitly signaled new declarations, and uses the following two primitives to request MAD to make or withdraw Attribute declarations:

MAD_Join.request (attribute_type, attribute_value, new)

MAD_Leave.request (attribute_type, attribute_value)

where *attribute_type* specifies the type of the attribute declaration, and *attribute_value* specifies the instance of that type, and the Boolean *new* parameter indicates an explicit new declaration. If the value of tcDetected (13.21) for the Port and MAP Context associated with the MRP Participant is non-zero, then the value of the *new* parameter in the propagated MAD_Join.request is set TRUE.

The MAD component executes the MRP protocol (10.6, 10.7), generating MRP messages for transmission and processing messages received from other Participants, and uses the following two primitives to notify its application component of a change in Attribute registration:

MAD_Join.indication (attribute_type, attribute_value, new)

MAD_Leave.indication (attribute_type, attribute_value)

One such Participant, per MRP application, exists for each point of attachment to a LAN where Attributes for that application are to be declared or registered, i.e., one Participant per application in an end station, and one per application per Port in a Bridge. The encoding of Attribute values in MRPDUs and their subsequent decoding is application specific, within the general structure specified in 10.8, and each MRPDU conveys messages generated by the MAD component for a single application.

Within a Bridge, a per application MRP Attribute Propagation (MAP) component (10.3) propagates information between the per-Port Participants, using the same request and indication primitives.

Figure 10-4 illustrates the components of MRP Participants in a two-Port Bridge and an end station.

For each MRP application, the following are defined:

a) A set of Attribute types used by the application.
b) The Attribute values permitted for each Attribute type.
c) The semantics associated with each Attribute type and value.
d) The use made of MAP Contexts by the application.
e) The group MAC address and EtherType for protocol exchanges between application Participants.
f) The structure and encoding of the Attribute types and values in MRPDUs.
g) The requirements for MRP state machine support in end stations and Bridges.
h) The circumstances, if any, in which the application makes use of the “new” declaration capability.

NOTE 1—Not all applications of MRP will make use of the “new” declaration capability.

i) If the application makes use of the “new” declaration capability, the semantics that new registrations carry in that application.
j) The number of attribute values out of the possible range of values for which the application is expected to be capable of maintaining current state information.

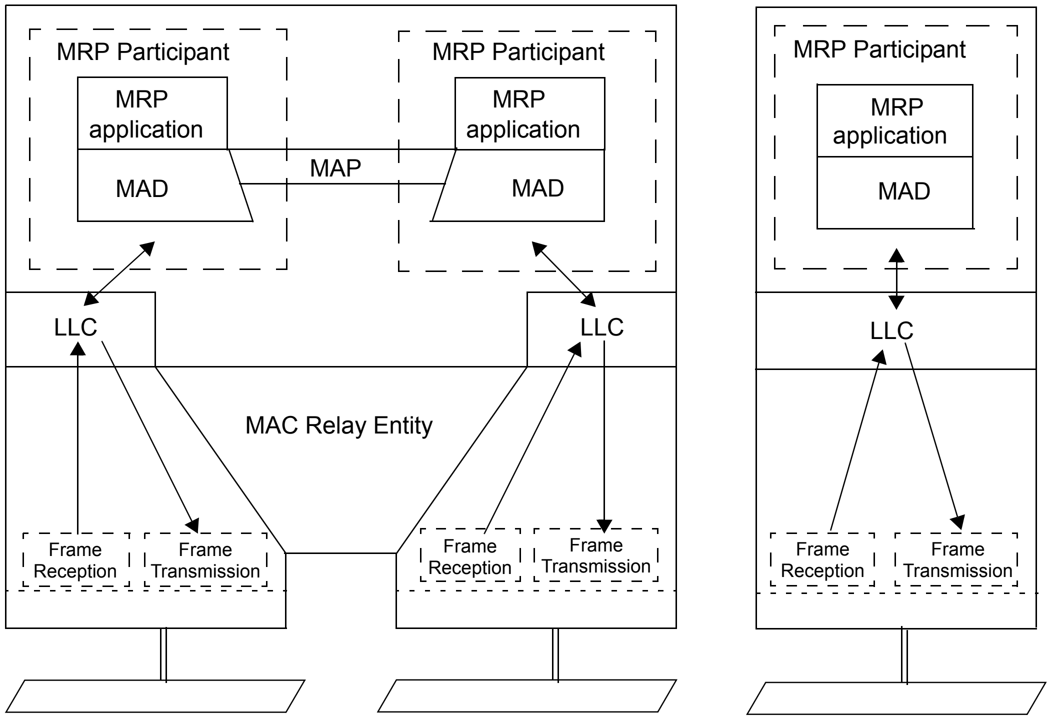

Figure 10-4—MRP architecture

NOTE 2—In some applications, such as MVRP, the failure of one bridge in a network to maintain state for all possible attribute values would have major consequences for the integrity of the network. For such applications, the application definition will mandate the ability to track the state of all possible attribute values.

10.3 MRP Attribute Propagation (MAP)

The MRP Attribute Propagation (MAP) function operates in the same way for all MRP applications and enables propagation of attributes registered on Bridge Ports across the network to other participants.

For a given MRP application and MAP Context (10.3.1), and for the set of Ports that are in a Forwarding state as defined by that MAP Context:

a) Any MAD_Join.indication, or any MAD_Join.request issued by the MRP application, received by MAP from a given Port in the set is propagated as a MAD_Join.request to the instance(s) of MAD associated with each other Port in the set. If the value of tcDetected (13.21) for the Port and MAP Context is non-zero, then the value of the *new* parameter in the propagated MAD_Join.request is set TRUE, regardless of the value of this parameter in the indication or request that is being propagated.
b) Any MAD_Leave.indication, or any MAD_Leave.request issued by the MRP application, received by MAP from a given Port in the set is propagated as a MAD_Leave.request to the instance(s) of MAD associated with each other Port in the set (Port P, say) if and only if no registration now exists for that Attribute on any other Port in the set excluding P.

These rules propagate attribute registrations through any given Port if any other Port has seen a registration for that attribute, and propagate de-registrations if all other Ports are now deregistered.

As the set of Ports that are in a Forwarding state for a given MAP Context can change dynamically, for example as a result of Spanning Tree reconfiguration, MAP operates as follows after such a change:

c) If a Port is added to the set, and that Port has registered an attribute (i.e., a MAD_Join.indication or MAD_Join.request has occurred more recently than any MAD_Leave.indication or MAD_Leave.request for the attribute), then MAD_Join.requests are propagated to the MAD instances for each of the other Ports in the set.
d) If a Port is added to the set, but that Port has not declared an attribute that other Ports in the set have registered, then MAD_Join.requests are propagated by those other Ports to the MAD instance for that Port.
e) If a Port is removed from the set, and that Port has registered an attribute and no other Port has, then MAD_Leave.requests are propagated to the MAD instances for each of the other Ports in the set.

NOTE—If a Port is removed from the set, and that Port has declared one or more attributes, then this Port transmits a Leave message (see 10.5) for every attribute that it has declared.

f) If a Port is removed from the set, and that Port has registered an attribute that another Port has also registered, then a MAD_Leave.request is propagated to the MAD instance for that other Port.

10.3.1 MAP Context

For a given Port of an MRP-aware Bridge and MRP application supported by that Bridge, an instance of an MRP Participant can exist for each *MRP Attribute Propagation Context (MAP Context)* understood by the Bridge. A MAP Context identifies the set of Bridge Ports that form the applicable *active topology* (8.4).

Examples of MAP Contexts are as follows:

a) The active topology formed by the operation of RSTP (IEEE Std 802.1D Clause 17). This MAP Context provides the same connectivity as the Spanning Tree in each Bridge and is known as the *Base Spanning Tree Context*.
b) The active topology formed by the subset of Bridge Ports, and the underlying Spanning Tree, that support a given VLAN. This MAP Context is known as a *VLAN Context.*

NOTE—This standard uses the Base Spanning Tree Context and VLAN Contexts to define the operation of MMRP and MVRP; however, other MAP Contexts may be used for other applications, or for extending MMRP functionality.

MRP protocol exchanges can occur on all of the Ports of a Bridge; however propagation across a Bridged Local Area Network of attribute registrations for a given application uses only those Bridge Ports that are part of the active topology identified by the MAP Context. Each MRP application specification identifies the contexts it can operate within, specifies rules for selecting forwarding Ports, and assigns MAP Context identifiers for use in conjunction with the operation of MRP and its administrative controls (10.7.2, 10.7.3).

A MAP Context identifier of 0 always identifies the *Base Spanning Tree Context*. The MRP application specifies how the MAP Context of each MRPDU is identified if any other context is used.

10.3.1.1 MAD and Port role changes

A spanning tree provides a loop-free active topology connecting all the bridges and all the LANs in a network. Hence, any Bridge Port that is in a forwarding state connects two otherwise disconnected parts of the topology. Each Alternate Port on a Bridge A (say) connects to a LAN that has a Port of another Bridge with a better priority vector than A can supply; hence, each of A's Alternate Ports is a potential connection to part of the network that is not connected to any of A's Designated Ports, all LANs and Bridges in any such part having an equal or worse priority vector than A. Therefore, an Alternate Port on A potentially connects to the part of the network connected to by A's Root Port. Since any part of the network is fully connected, in the absence of registration controls, A's Alternate Port will have registered the same attributes as its Root Port.

For implementations running over RSTP or MSTP, this gives rise to the risk of information loops when Port roles change; because of the store and forward nature of attribute propagation and the potentially rapid transitions of Port roles (compared to the relatively slow transitions that occurred with STP), these can arise even when there are no data loops.

To prevent such information loops from occurring, the information held by MAD's Registrars for a Port (i.e., information registered on a Port as a result of protocol activity on the LAN to which that Port is connected) is discarded whenever the Port transitions from an Alternate port or Root Port role to become a Designated Port. No such discard is needed for changes in the other direction, i.e., changes from Designated Port to Root Port or Alternate Port.

10.4 Requirements to be met by MRP

MRP establishes, maintains, withdraws, and disseminates attribute declarations and registrations among the MRP Participants attached to a single LAN. The protocol meets the following requirements for Applicant and Registrar behavior, error recovery, performance, scalability, compatibility with non-MRP aware devices, and the load imposed on Bridges, end stations, and the network:

a) Participants can issue declarations for MRP application attributes (10.2, 10.3, 10.7.3, and 10.7.7).
b) Participants can withdraw declarations for attributes (10.2, 10.3, 10.7.3, and 10.7.7).
c) Each Bridge propagates declarations to MRP Participants (10.3).
d) MRP Participants can track the current state of declaration and registration of attributes on each Port of the participant device (10.7.7, and 10.7.8).
e) MRP Participants can remove state information relating to attributes that are no longer active within part or all of the network, e.g., as a result of the failure of a participant (10.7.8, and 10.7.9).
f) The latency involved in issuing, propagating, or revoking attribute declarations, is small (i.e., comparable to the frame propagation delay) and increases linearly as a function of the diameter of the network (10.7.7, 10.7.8, and 10.7.9).
g) MRP is resilient in the face of the failure of MRP Participants.
h) MRP is resilient in the face of single packet loss.
i) MRP will operate correctly in networks where
   1) All Bridges support both Basic and Extended Filtering Services; or where
   2) Some Bridges support only Basic Filtering Services and some both Basic and Extended Filtering Services (10.5, 10.7.7, 10.7.8, and 10.7.9).
j) The communications bandwidth consumed on any particular LAN by Applicants and Registrars in exchanging MRPDUs will be a small percentage of the total available bandwidth, and independent of the total traffic supported by the network. The bandwidth consumed will be a function of the number of attributes registered.

10.5 Requirements for interoperability between MRP Participants

To ensure the interoperability of MRP, the following are required:

a) All MRP applications use a group MAC address as the destination address of MRPDUs, selected in accordance with the stated requirements of the MRP application concerned for the type of bridge component in which the application is implemented. The addresses used may be taken from the set of addresses specified in Table 10-1, or taken from the set of reserved addresses specified in Table 8-1, or other group MAC addresses, chosen according to the particular properties required by the application concerned.

NOTE 1—The addresses in Table 8-1 and Table 10-1 differ from other group MAC addresses in terms of the scope of transmission within a network, as a consequence of the forwarding/filtering decisions that are taken relative to them by different types of bridge component.

b) Table 10-1 specifies a set of group MAC addresses, some that have been assigned for use by existing applications defined in this standard, and the others reserved for future standards use. Addresses in this set have the property that

   1) Where a given address in the set is used by a bridge component to support an MRP application, frames destined for that address shall not be forwarded by that bridge component; i.e., a static filtering entry for that address is maintained for that group MAC address in order to prevent the forwarding of frames destined for that address.

   2) Where a given address in the set is not used by a bridge component to support any MRP application, frames destined for that address received on any Port that is part of a given active topology shall be forwarded by that bridge component on all other Ports that are part of that active topology.

c) The transmission and reception of MRPDUs between MRP Participants, formatted as defined for the application using the generic PDU format defined in 10.8, shall use LLC procedures. Each MRP application uses a unique Ethertype value in order to identify the application protocol. Table 10-2 specifies the EtherType values assigned to existing applications.

NOTE 2—For the purposes of this standard, the expression "use LLC procedures" includes making use of the service provided by link layer protocol entities that support protocol discrimination by means of an EtherType value.

d) MRPDUs, i.e., frames with the destination MAC addresses selected as specified in item a) and the EtherType values specified in item c), that are destined for applications supported by a bridge component, and that are not well formed (i.e., are not structured and encoded as defined in 10.8 and with attribute types and values encoded as defined by the MRP application), shall be discarded on receipt.

Table 10-1—MRP application addresses

Assignment	Value
MMRP address	01-80-C2-00-00-20
MVRP address	01-80-C2-00-00-21
Reserved	01-80-C2-00-00-22
Reserved	01-80-C2-00-00-23
Reserved	01-80-C2-00-00-24
Reserved	01-80-C2-00-00-25
Reserved	01-80-C2-00-00-26
Reserved	01-80-C2-00-00-27
Reserved	01-80-C2-00-00-28
Reserved	01-80-C2-00-00-29
Reserved	01-80-C2-00-00-2A
Reserved	01-80-C2-00-00-2B
Reserved	01-80-C2-00-00-2C
Reserved	01-80-C2-00-00-2D
Reserved	01-80-C2-00-00-2E
Reserved	01-80-C2-00-00-2F

Table 10-2—MRP EtherType values

Assignment	Value
MMRP EtherType	88-F6
MVRP EtherType	88-F5

10.6 Protocol operation

This subclause provides an informal introduction. The definitive specification of MRP is contained in 10.7 and 10.8.

MRP is a simple, fully distributed, many-to-many protocol, that supports efficient, reliable, and rapid declaration and registration of attributes by multiple participants on shared and virtual shared media. MRP also incorporates optimizations to speed attribute declarations and withdrawals on point-to-point media. Correctness of MRP operation is independent of the relative values of protocol timers, and the protocol design is based primarily on the exchange of idempotent protocol state rather than commands.

A full MRP Participant maintains Registrar and Applicant state machines for each Attribute of interest, and a LeaveAll state machine and PeriodicTransmission state machine for the participant as a whole.

The job of the Registrar is to record declarations of the attribute made by other Participants on the LAN. It does not send any protocol messages, as the Applicant looks after the interests of all would-be Participants.

The job of the Applicant is twofold:

a) To ensure that this Participant's declaration is correctly registered by other Participants' Registrars.
b) To prompt other Participants to re-register after one withdraws a declaration.

NOTE 1—Applicant-Only implementations are concerned only with item a).

The basic design of MRP is oriented to LAN environments, where there is generally a low probability of frame loss, and ensures that timely registration of attributes is unaffected unless at least two out of a set of immediately related frames are lost. The LeaveAll state machine periodically ensures that Participants re-register attributes, thus guarding against an extended failure to register or deregister. In potentially lossy environments such as service instances supported by Provider Bridged Networks, where frame losses are temporally correlated, the PeriodicTransmission machine ensures successful registration without immediately contributing to congestive loss.

If one Applicant has both declared and registered an Attribute, other Applicants do not need to reiterate the declaration. MRP messages convey both Applicant and Registrar state to allow suppression of such repeated declarations. The Applicant state machine distinguishes between Active Participants (that have sent a message or messages to make a declaration), Passive Participants (that require registration, but have not had to declare the attribute so far to register it, and will not have to explicitly deregister), and Observers (that do not require registration at present, but track the attribute's registration in case they do and become Passive Participants). The following four distinct messages communicate the transmitting participant's state for an Attribute:

— Empty—Not declared, and not registered.
— In—Not declared, but registered.
— JoinEmpty—Declared, but not registered.
— JoinIn—Declared and registered.

One message communicates a withdrawal of a prior declaration, so that Registrars do not have to track individual Applicants:

— Leave—Previously registered, but now withdrawn.

A further message conveys a declaration from a new Participant, or a Participant newly added to the active topology reached through a Bridge Port. This information is propagated by the MAP component, and so includes additional registrations elsewhere in the bridged network:

— New—Newly declared, and possibly not previously registered.

The LeaveAll state machine uses the following single message that applies to all Attributes.

— LeaveAll—All registrations will shortly be deregistered; Participants need to re-register.

The Registrar for each Attribute actually implements the following three states for the Attribute:

— IN—Registered.
— LV—Previously registered, but now being timed out.
— MT—Not registered.

A single timer, the leavetimer, is associated with each Registrar and operates in the LV state. In that state, MRP messages for the Attribute report it as unregistered (using Empty or Join Empty) but the MAD Leave indication is delayed until the leavetimer expires and the state transitions to MT.

NOTE 2—The accuracy required for the leavetimer is sufficiently coarse as to permit the use of a single operating system timer per Participant with 2 bits of state for each Registrar.

The Applicant for each Attribute implements states that record whether it wishes to make a new declaration, to maintain or withdraw an existing declaration, or has no declaration to make. It also records whether it has actively made a declaration, or has been passive, taking advantage of or simply observing the declarations of others. It counts the New, JoinIn, and JoinEmpty messages it has sent, and JoinIn messages sent by others, to ensure that at least two such messages have been sent since it last received a LeaveAll or Leave message, and at least one since it last received a JoinEmpty or Empty message. This ensures that each of the other Participant's Registrars for the Attribute have either received (assuming no packet loss) two Join or New messages or have reported the Attribute as registered. The Applicant state machine (Table 10-3) uses the following states:

— VO—Very anxious Observer. The applicant is not declaring the attribute, and has not received a JoinIn message since the state machine was initialized, or since last receiving a Leave or LeaveAll.
— VP—Very anxious Passive. The applicant is declaring the attribute, but has neither sent a Join nor received a JoinIn since the state machine was initialized, or since last receiving a LeaveAll or Leave.
— VN—Very anxious New. The applicant is declaring the attribute, but has not sent a message since receiving a MAD Join request for a new declaration.
— AN—Anxious New. The applicant is declaring the attribute, and has sent a single New message since receiving the MAD Join request for the new declaration.
— AA—Anxious Active. The applicant is declaring the attribute, and has sent a Join message, since the last Leave or LeaveAll, but has either not received another JoinIn or In, or has received a subsequent message specifying an Empty registrar state.
— QA—Quiet Active. The applicant is declaring the attribute and has sent at least one of the required Join or New messages since the last Leave or LeaveAll, has seen or sent the other, and has received no subsequent messages specifying an Empty registrar state.

- LA—Leaving Active. The applicant has sent a Join or New message since last receipt of a Leave or LeaveAll, but has subsequently received a MAD Leave request and has not yet sent a Leave message.
- AO—Anxious Observer. The applicant is not declaring the attribute, but has received a JoinIn since last receiving a Leave or LeaveAll.
- QO—Quiet Observer. The applicant is not declaring the attribute, but has received two JoinIns since last receiving a Leave or LeaveAll, and at least one since last receiving a message specifying an Empty registrar state.
- AP—Anxious Passive. The applicant is declaring the attribute, and has not sent a Join or a New since last receiving a Leave or a LeaveAll but has received messages as for the Anxious Observer state.
- QP—Quiet Passive. The applicant is declaring the attribute, and has not sent a Join or a New since last receiving a Leave or a LeaveAll but has received messages as for the Quiet Observer state.
- LO—Leaving Observer. The applicant is not declaring the attribute, and has received a Leave or LeaveAll message.

If an Applicant receives a Leave or LeaveAll message it will send a JoinEmpty or Empty message, and that message will prompt any other Applicants that are declaring the attribute to send a JoinIn. An Applicant that sends a LeaveAll message will also ensure that an Empty message is sent to prompt other Applicants to repeat their declaration. Thus, if any Participant's Registrar deregisters an Attribute, at least two messages will be lost before another Participant's Applicant fails to make a required redeclaration.

To facilitate and encourage the transmission of timely protocol information and the encoding of messages for multiple Attributes within the same MRPDU, rather than the use and subsequent queuing of multiple PDUs prior to transmission, PDU transmission is specified in terms of requests for a transmission opportunity, and the Applicant and LeaveAll state machines specify the necessary addition of messages to an MRPDU when that opportunity occurs. Whenever a state machine transitions to a state that requires transmission of a message, a transmit opportunity is requested if one is not already pending. The message actually transmitted (if any) is that appropriate to the state of the machine when the opportunity is presented.

NOTE 3—Specifying transmit opportunity requests and their subsequent use is also intended to aid correct implementation in systems where a transmission is not possible immediately, e.g., shortly after whole or part of the system is initialized when other claims on system resources take precedence or interfaces are not yet available.

To support the efficient encoding of many messages in a single MRPDU, the number of message types has been kept to the minimum consistent with protocol goals and requirements, and the state machines specify both whether it is necessary to send a message and a message type that can always be sent—thus removing the need for a further "no message" encoding. The MRPDU structure and compact encoding (10.8) allows all potential attributes for certain MRP applications, e.g., MVRP (Clause 11), to be encoded in a single IEEE 802.3 frame and this further promotes protocol efficiency through ready detection of missing registrations. Protocol efficiency and correct registration are further supported by encoding a LeaveAll message (if required) at the beginning of the MRPDU, and by using an Applicant state machine that minimizes state changes for those Attributes whose redeclaration can be encoded in the same PDU—if the LeaveAll is received by another Participant so also will be the redeclaration, and sequential processing of the encoded messages by the recipient will ensure that the registration is uninterrupted. Applicant states for Attributes that cannot be re-declared in the same PDU allow for receipt of the LeaveAll but loss of the redeclaration.

LeaveAll messages are transmitted to ensure that any failure to withdraw a declaration does not result in an unwanted permanent registration—perhaps the system or process responsible for the registration has been removed from the LAN or has ceased to operate. Attributes registered by the Participant transmitting the LeaveAll as well as those receiving it are therefore timed out. The LeaveAll state machine (10.7.9) for the Participant operates a single timer, the leaveAllTimer, that causes a transmit opportunity to be requested when it expires, and transmission of a LeaveAll at the next opportunity. Reception of a LeaveAll message from another Participant causes the timer to be restarted without generating a message, thus suppressing multiple LeaveAll messages from Participants connected to the same LAN.

NOTE 4—In the face of changing inputs, arbitrary loss, delay, reordering, and unsignaled interruption in participation, no protocol will meet its objectives. What can be said is that the objectives will be met after a known period of operation within specified limits, and what failures are most likely otherwise. MRP favors ensuring that registrations are made, at the expense of tolerating prolonged registrations. Thus, the LeaveAll mechanism, when it has an effect, most often implements “garbage collection”. At the same time it will also ensure that failed registrations are (re-)established.

When MRP Participants are connected by a shared or virtual shared medium, protocol performance is improved and the effect on other protocols using the LAN minimized if the Participants transmit at different times, avoiding a multicast storm and allowing some to optimize their transmissions based on messages received. A request for a transmit opportunity starts a randomized join timer, with a maximum value chosen to ensure successful re-registration(s) within a Leave time period (10.7.4), and the transmit opportunity is offered when the timer expires. If more messages are to be sent than can fit in a single PDU, a further transmit opportunity is requested.

When two MRP Participants are connected by a point-to-point medium or service instance delaying MRPDU transmission provides no benefit. In bridged networks it is desirable to transmit without delay, minimizing the denial of service that might occur while registration changes propagate after reconfiguration, and maximizing the benefit from using protocols such as RSTP and MSTP. When operPointToPointMAC (6.4.3) is TRUE, transmit opportunities are scheduled immediately on request, subject to rate limiting (10.7.4).

Use of point-to-point service connecting at most two Participants allows further protocol optimization, e.g., receipt of an In message does acknowledge registration. However not all LAN media support reliable determination of point-to-point status, particularly if non-standard bridge-like devices are present. When operating in point-to-point mode, MRP avoids behavior that could cause failure, potentially continuous rapid exchanges of messages, or flapping registrations if there are more than two Participants. This standard permits simple point-to-point subset implementations of MRP, but these will successfully operate on shared media—albeit at reduced efficiency.

NOTE 5—IEEE Std 802.1AE (MAC Security) can ensure that there are at most two communicating Participants.

It is also possible to simplify an MRP Participant that only wishes to make declarations; for example, for an end station that uses MMRP (10.9) to declare a need to receive group addressed frames, but is not a source of such frames, and therefore does not need to support source pruning by registering declarations from other Participants. Such an Applicant-Only Participant does not implement the Registrar or LeaveAll state machines, never sends LeaveAll, Empty, or JoinEmpty messages (which would elicit unnecessary Joins from its peer Participants), and does not implement the administrative controls defined in 10.7.2 and 10.7.3. The following four types of MRP implementation conform to this standard:

— Full Participant
— Full Participant, point-to-point subset
— Applicant-Only Participant
— Applicant-Only point-to-point subset, also referred to as the Simple-Applicant Participant

While Simple-Applicant and Full Participant point-to-point subset implementations can operate on shared media, their initial Join and Leave messages are not suppressed. Significant additional, and unnecessary, traffic can result from attaching several such implementations to the same shared medium. Devices that do not perform registration should use an Applicant-Only Participant rather than a Simple-Applicant Participant.

NOTE 6—At the time of the development of this standard the LAN MACs most commonly used were point-to-point but the use of virtual shared media was increasing.

10.7 Protocol specification

The operation of MRP as executed by the MRP Attribute Declaration (MAD, 10.2) component of an MRP Participant is represented by the following state machines:

a) A per-Attribute Applicant state machine (10.7.7)
b) A per-Attribute Registrar state machine (10.7.8)
c) A LeaveAll state machine for the Participant as a whole (10.7.9)
d) A PeriodicTransmission state machine for the Participant as a whole (10.7.10)

These state machines are specified as compact state tables, and make use of the following:

e) Notational conventions and abbreviations for protocol events, actions, and timer operations (10.7.1)
f) Registrar Administrative Controls (10.7.2)
g) Applicant Administrative Controls (10.7.3)
h) Protocol timers (10.7.4)
i) Protocol event definitions (10.7.5)
j) Protocol action definitions (10.7.6)

A Full Participant implements the complete Applicant state machine (Table 10-3) and the Registrar state machine (Table 10-4) for each Attribute declared, registered, or tracked, together with a single instance of the LeaveAll state machine (Table 10-5) and the PeriodicTransmission state machine (Table 10-6).

The point-to-point subset of the Full Participant implements the same state machines, but omits certain Applicant state machine states and actions as specified by Table 10-3.

An Applicant-Only Participant implements the Applicant state machine, with the omission of certain states and actions as specified by Table 10-3, for each Attribute declared, registered, or tracked, together with a single instance of the PeriodicTransmission state machine (Table 10-6).

The point-to-point subset of the Applicant-Only Participant (the Simple-Applicant Participant) implements the same state machines, but omits certain Applicant state machine states and actions as specified by Table 10-3.

NOTE—Conceptually, per-Attribute state is maintained for all possible values of all Attribute types that are defined for a given application; however, in real implementations of MRP, it is likely that the range of possible Attribute values in some applications will preclude this, and the implementation will limit the state to those Attribute values in which the Participant has an immediate interest, either as a Member or as a likely future Member.

Timer values, their relationships, and default values are described in 10.7.11 and Table 10-7, protocol management statistics accumulated by each MAD component in 10.7.12, and interoperability considerations for potentially misordering networks in 10.7.13.

The encoding of MRP messages in MRPUs is specified in 10.8, which also specifies the parsing and checks applied to received PDUs.

10.7.1 Notational conventions and abbreviations

The following conventions are used in the abbreviations used in this subclause:

rXXX	receive PDU XXX
sXXX	send PDU XXX
txXXX	transmit opportunity

XXX!	state machine event
!XXX	“Not XXX”; i.e., logical NOT applied to the condition XXX

The following abbreviations are used in the state machine descriptions. For their meaning, see 10.7.5 and 10.7.6.

Protocol events:

Begin!	Initialize state machine (10.7.5.1)
New!	A new declaration (10.7.5.4)
Join!	Declaration without signaling new registration (10.7.5.5)
Lv!	Withdraw a declaration (10.7.5.6)
tx!	Transmission opportunity without a LeaveAll (10.7.5.7)
txLA!	Transmission opportunity with a LeaveAll (10.7.5.8)
txLAF!	Transmission opportunity with a LeaveAll, and with no room (Full) (10.7.5.9)
rNew!	receive New message (10.7.5.14)
rJoinIn!	receive JoinIn message (10.7.5.15)
rIn!	receive In message (10.7.5.18)
rJoinMt!	receive JoinEmpty message (10.7.5.16)
rMt!	receive Empty message (10.7.5.19)
rLv!	receive Leave message (10.7.5.17)
rLA!	receive a LeaveAll message (10.7.5.20)
Flush!	Port role changes from Root Port or Alternate Port to Designated Port (10.7.5.2)
Re-Declare!	Port role changes from Designated to Root Port orAlternate Port (10.7.5.3)
periodic!	A periodic transmission event occurs (10.7.5.10)
leavetimer!	leavetimer has expired (10.7.5.21)
leavealltimer!	leavealltimer has expired. (10.7.5.22)
periodictimer!	periodictimer has expired. (10.7.5.23)

Protocol actions:

New	send a New indication to MAP and the MRP application (10.7.6.12)
Join	send a Join indication to MAP and the MRP application (10.7.6.13)
Lv	send a Lv indication to MAP and the MRP application (10.7.6.14)
sN	send a New message (10.7.6.2)
sJ	send a JoinIn or JoinMT message (10.7.6.3)
sL	send a Lv message (10.7.6.4)
s	send an In or an Empty message (10.7.6.5)
[s]	send an In or an Empty message, if required for optimization of the encoding (10.7.6.5)
[sL]	send a Lv message, if required for optimization of the encoding (10.7.6.4)
[sJ]	send a Join message, if required for optimization of the encoding (10.7.6.3)
sLA	send a Leave All message (10.7.6.6)
periodic	Periodic transmission event (10.7.6.7).
leavetimer	Leave period timer (10.7.4.2)
leavealltimer	Leave All period timer. (10.7.4.3)
periodictimer	Periodic Transmission timer. (10.7.4.4)
-x-	Inapplicable event/state combination. No action or state transition occurs in this case.

Timers are used in the state machine descriptions in order to cause actions to be taken after defined time periods have elapsed. The following terminology is used in the state machine descriptions to define timer states and the actions that can be performed upon them:

a) A timer is said to be *running* if the most recent action to be performed upon it was a *start*.

b) A running timer is said to have *expired* when the time period associated with the timer has elapsed since the most recent start action took place.
c) A timer is said to be *stopped* if it has expired or if the most recent action to be performed upon it was a *stop* action.
d) A *start* action sets a stopped timer to the running state, and associates a time period with the timer. This time period supersedes any periods that might have been associated with the timer by previous start events.
e) A *stop* action sets a timer to the stopped state.

The following abbreviations are used for the state names in the state tables and state diagrams:

Registrar states (see 10.6):

IN In
LV Leaving
MT Empty

Applicant and Simple-Applicant states (see 10.6):

VO Very anxious Observer
VP Very anxious Passive
VN Very anxious New
AN Anxious New
AA Anxious Active
QA Quiet Active
LA Leaving Active
AO Anxious Observer
QO Quiet Observer
AP Anxious Passive
QP Quiet Passive
LO Leaving Observer

10.7.2 Registrar Administrative Controls

Associated with each instance of the Registrar state machines are *Registrar Administrative Control* parameters. These parameters allow administrative control to be exercised over the registration state of each Attribute value, and hence, via the propagation mechanism provided by MAP, allow control to be exercised over the propagation of declarations.

a) *Normal Registration.* The Registrar responds to incoming MRP messages as specified by Table 10-4.
b) *Registration Fixed.* The Registrar ignores all MRP messages, and remains IN (registered).
c) *Registration Forbidden.* The Registrar ignores all MRP messages, and remains MT (unregistered).

The default value of this parameter is *Normal Registration*.

If the value of this parameter is *Registration Fixed* or *Registration Forbidden,* In and JoinIn messages are sent rather than Empty or JoinEmpty messages.

NOTE—The Registrar Administrative Controls are realized by means of the contents of the Port Map parameters of static entries in the Filtering Database for all MRP applications. In the case of MMRP, the static entries concerned are Static Filtering Entries (8.8.1); in the case of MVRP, the static entries concerned are Static VLAN Registration Entries (8.8.2). The contents of the Port Map parameters in static entries can be modified by means of the management operations defined in Clause 12. In the absence of such control information for a given attribute, the default value “Normal Registration” is assumed.

10.7.3 Applicant Administrative Controls

An overall control parameter for each Applicant state machine, the *Applicant Administrative Control,* determines whether or not the Applicant state machine participates in MRP protocol exchanges.

a) *Normal Participant.* The state machine participates normally in MRP protocol exchanges.
b) *Non-Participant.* The state machine does not send any MRP messages.

The default value of this parameter is Normal Participant.

NOTE 1—The Applicant Administrative Control parameters can be modified for any MRP application by means of the management operations defined in Clause 12. In the absence of such information for a given attribute, the default value "Normal Participant" is assumed.

NOTE 2—The Applicant Administrative Control parameters can be set per attribute type (see 12.9.2).

10.7.4 Protocol timers

10.7.4.1 jointimer

The Join Period Timer, jointimer, controls the interval between transmit opportunities that are applied to the Applicant state machine. An instance of this timer is required on a per-Port, per-MRP Participant basis. The value of JoinTime used to initialize this timer is determined in accordance with 10.7.11.

10.7.4.2 leavetimer

The Leave Period Timer, leavetimer, controls the period of time that the Registrar state machine will wait in the LV state before transiting to the MT state. An instance of the timer is required for each state machine that is in the LV state. The Leave Period Timer is set to the value LeaveTime when it is started; LeaveTime is defined in Table 10-7.

10.7.4.3 leavealltimer

The Leave All Period Timer, leavealltimer, controls the frequency with which the LeaveAll state machine generates LeaveAll PDUs. The timer is required on a per-Port, per-MRP Participant basis. The Leave All Period Timer is set to a random value, T, in the range LeaveAllTime < T < 1.5*LeaveAllTime when it is started. LeaveAllTime is defined in Table 10-7.

10.7.4.4 periodictimer

The Periodic Transmission timer, periodictimer, controls the frequency with which the PeriodicTransmission state machine generates periodic! events. The timer is required on a per-Port basis. The Periodic Transmission timer is set to one second when it is started.

10.7.5 Protocol event definitions

Unless stated otherwise in these event definitions, MRPDU reception in a Bridge can occur through all Ports of a Bridge, and events generated as a result of such reception affect only those state machines that are associated with the Port through which the PDU was received.

10.7.5.1 Begin!

The state machine is initialized or reinitialized.

10.7.5.2 Flush!

A Flush! event signals to the Registrar state machine that there is a need to rapidly deregister information on the Port associated with the state machine as a result of a topology change that has occurred in the network topology that supports the propagation of MRP information. If the network topology is maintained by means of the Spanning Tree state machines, then, for the set of Registrar state machines associated with a given Port and Spanning Tree instance, this event is generated when the Port Role changes from either Root Port or Alternate Port to Designated Port.

When a Flush! event occurs for a given Port and Spanning Tree instance, a leavealltimer! event (10.7.5.22) is also signaled to the LeaveAll state machine for that Port and Spanning Tree instance.

10.7.5.3 Re-declare!

A Re-declare! event signals to the Applicant and Registrar state machines that there is a need to rapidly re-declare registered information on the Port associated with the state machines as a result of a topology change that has occurred in the network topology that supports the propagation of MRP information. If the network topology is maintained by means of the Spanning Tree state machines, then, for the set of Applicant and Registrar state machines associated with a given Port and Spanning Tree instance, this event is generated when the Port Role changes from Designated Port to either Root Port or Alternate Port.

10.7.5.4 New!

A new declaration is made. The event is deemed to have occurred if the MAD Service User issues a MAD_Join.request service primitive for the Attribute instance associated with that state machine, indicating a new declaration.

10.7.5.5 Join!

A declaration is made. The event is deemed to have occurred if the MAD Service User issues a MAD_Join.request service primitive for the Attribute instance associated with that state machine.

10.7.5.6 Lv!

A declaration is withdrawn. The event is deemed to have occurred if the MAD Service User issues a MAD_Leave.request service primitive for the Attribute instance associated with that state machine.

10.7.5.7 tx!

A transmission opportunity occurs, without a LeaveAll being signaled by the LeaveAll state machine.

NOTE—The tx! event is modified by the behavior of the LeaveAll state machine. If the LeaveAll state machine has signaled LeaveAll, then tx! is modified to txLA! (see 10.7.5.8).

10.7.5.8 txLA!

A transmission opportunity occurs, with a LeaveAll being signaled by the LeaveAll state machine.

10.7.5.9 txLAF!

A transmission opportunity occurs, with a LeaveAll being signaled by the LeaveAll state machine, and with no room available in the PDU.

10.7.5.10 periodic!

This event indicates to the Applicant state machine that the timer used to stimulate periodic transmission has expired.

10.7.5.11 periodicEnabled!

This event indicates to the Periodic Transmission state machine that it has been enabled by management action (12.9.4).

10.7.5.12 periodicDisabled!

This event indicates to the Periodic Transmission state machine that it has been disabled by management action (12.9.4).

10.7.5.13 Message reception events

For an instance of the Applicant state machine or the Registrar state machine, a message reception event is deemed to have occurred if an MRPDU (10.8) is received, and the following conditions are true:

a) The PDU was addressed to the MRP application address (Table 10-1) and had an Ethertype (Table 10-2) in accordance with that of the MRP application associated with the state machine.
b) The PDU contains a Message (10.8.1) in which the Attribute Type is the type associated with the state machine.
c) The Message contains a VectorAttribute (10.8.1.2) where the range defined by the FirstValue and NumberOfValues includes the attribute value associated with the state machine.

The specific type of message reception event is determined by the event value (10.8.2.3) associated with the state machine. The possible message reception event types are specified in 10.7.5.14 through 10.7.5.20.

10.7.5.14 rNew!

For an instance of the Applicant or Registrar state machine, a message reception event (10.7.5.13) occurs, and the event value (10.8.2.3) associated with the state machine specifies the New message.

10.7.5.15 rJoinIn!

For an instance of the Applicant or Registrar state machine, a message reception event (10.7.5.13) occurs, and the event value (10.8.2.3) associated with the state machine specifies the JoinIn message.

10.7.5.16 rJoinMt!

For an instance of the Applicant or Registrar state machine, a message reception event (10.7.5.13) occurs, and the event value (10.8.2.3) associated with the state machine specifies the JoinMt message.

10.7.5.17 rLv!

For an instance of the Applicant or Registrar state machine, a message reception event (10.7.5.13) occurs, and the event value (10.8.2.3) associated with the state machine specifies the Lv message.

10.7.5.18 rIn!

For an instance of the Applicant or Registrar state machine, a message reception event (10.7.5.13) occurs, and the event value (10.8.2.3) associated with the state machine specifies the In message.

10.7.5.19 rMt!

For an instance of the Applicant or Registrar state machine, a message reception event (10.7.5.13) occurs, and the event value (10.8.2.3) associated with the state machine specifies the Mt message.

10.7.5.20 rLA!

For an instance of the Applicant state machine, the Registrar state machine, or the LeaveAll state machine, the rLA! event is deemed to have occurred if either:

a) The LeaveAll state machine associated with that instance of the Applicant or Registrar state machine performs the sLA action (10.7.6.6); or
b) An MRPDU (10.8) is received, and the following conditions are true:
    1) The PDU's destination MAC address and Ethernet type are in accordance with the definition of the MRP application associated with the state machine.
    2) The PDU contains a Message (10.8.1) in which the Attribute Type is the type associated with the state machine.
    3) The Message contains a LeaveAllEvent (10.8.2.4) that carries the value LeaveAll.

NOTE—The LeaveAll state machine operates on a per-application (not per-Attribute Type) basis, but the LeaveAll message operates on a per-Attribute Type basis. Hence, when the LeaveAll state machine issues a LeaveAll, it must generate a LeaveAll Attribute for each Attribute Type supported by the application concerned.

10.7.5.21 leavetimer!

For an instance of the Registrar state machine, the leavetimer! event is deemed to have occurred when the leavetimer associated with that state machine expires.

10.7.5.22 leavealltimer!

For an instance of the LeaveAll state machine, the leavealltimer! event is deemed to have occurred either when the leavealltimer associated with that state machine expires or when a Flush! event (10.7.5.2) occurs for the Port and Spanning Tree instance associated with that state machine.

10.7.5.23 periodictimer!

For an instance of the PeriodicTransmission state machine, the periodictimer! event is deemed to have occurred when the periodictimer associated with that state machine expires.

10.7.6 Protocol Action definitions

10.7.6.1 MRPDU transmission actions

Unless stated otherwise in these action definitions, MRPDU transmission as a result of the operation of a state machine in a Bridge occurs only through the Port associated with that state machine, and only if that Port is in the Forwarding state. MRPDUs shall be transmitted using the destination MAC Address and Ehernet Type value defined by the MRP application associated with the state machine.

When the action specifies the transmission of attribute state information, an MRPDU, formatted as defined in 10.8.1, is transmitted, such that:

a) The PDU contains a Message (10.8.1.2) that carries an Attribute Type (10.8.2.2) that corresponds to the type of attribute associated with the state machine concerned.

b) The Message contains a VectorAttribute (10.8.2.8) in which the FirstValue (10.8.2.5) and NumberOfValues (10.8.2.6) defines a range of attribute values that includes the attribute value associated with the state machine.
c) The Vector (10.8.2.8) encodes an AttributeEvent value in the vector position corresponding to the attribute value for this state machine. The choice of AttributeEvent value is determined by the specific transmission action, as defined below.

In the case of LeaveAll transmission actions, the LeaveAll event value specified by the transmission action is encoded in the NumberOfValues field of the VectorAttribute.

10.7.6.2 sN

The AttributeEvent value New is encoded in the Vector as specified in 10.7.6.1.

10.7.6.3 sJ, [sJ]

If the Registrar state is IN, then the AttributeEvent value JoinIn is encoded in the Vector as specified in 10.7.6.1.

If the Registrar state is MT or LV, then the AttributeEvent value JoinMt is encoded in the Vector as specified in 10.7.6.1.

NOTE—The [sJ] variant indicates that the action is only necessary in cases where transmitting the value, rather than terminating a vector and starting a new one, makes for more optimal encoding; i.e., transmitting the value is not necessary for correct protocol operation.

10.7.6.4 sL

The AttributeEvent value Lv is encoded in the Vector as specified in 10.7.6.1.

10.7.6.5 s, [s]

If the Registrar state is IN, then the AttributeEvent value In is encoded in the Vector as specified in 10.7.6.1.

If the Registrar state is MT or LV, then the AttributeEvent value Mt is encoded in the Vector as specified in 10.7.6.1.

NOTE—In the [s] variant, this value is transmitted only if its inclusion makes for more optimal encoding; i.e., transmitting the value is not necessary for correct protocol operation.

10.7.6.6 sLA

The LeaveAll event value specified by the transmission action is encoded in the NumberOfValues field of the VectorAttribute as specified in 10.7.6.1.

The sLA action also gives rise to a rLA! event (10.7.5.20) against all instances of the Applicant state machine, or the Registrar state machine, associated with the MRP participant.

10.7.6.7 periodic

Causes a periodic! event (10.7.5.10) against all Applicant state machines associated with the participant.

10.7.6.8 Start leavetimer

Causes leavetimer to be started, in accordance with the definition of the timer in 10.7.4.2.

10.7.6.9 Stop leavetimer

Causes leavetimer to be stopped.

10.7.6.10 Start leavealltimer

Causes leavealltimer to be started, in accordance with the definition of the timer in 10.7.4.3.

10.7.6.11 Start periodictimer

Causes periodictimer to be started, in accordance with the definition of the timer in 10.7.4.4.

10.7.6.12 New

This action causes a MAD_Join.indication primitive to be issued to the MAD Service User, indicating the Attribute instance corresponding to the state machine concerned.

10.7.6.13 Join

This action causes a MAD_Join.indication primitive to be issued to the MAD Service User, indicating the Attribute instance corresponding to the state machine concerned.

10.7.6.14 Lv

This action causes a MAD_Leave.indication primitive to be issued to the MAD Service User, indicating the Attribute instance corresponding to the state machine concerned.

10.7.7 Applicant state machine

A full MRP Participant maintains a single instance of the Applicant state machine (Table 10-3) for each Attribute value for which the Participant needs to maintain state information.

Table 10-3—Applicant state table

	STATE											
EVENT	**VO[11]**	**VP[6]**	**VN[6]**	**AN[6]**	**AA[6]**	**QA**	**LA[6]**	**AO[3,11]**	**QO[3,11]**	**AP[3,6]**	**QP[3]**	**LO[6]**
Begin!	—	VO	VO	VO	VO	VO	VO	VO	VO	VO	VO	VO
New!	VN	VN	—	—	VN	VN	VN	VN	VN	VN	VN	VN
Join!	VP	—	—	—	—	—	AA	AP	QP	—	—	VP
Lv!	—	VO	LA	LA	LA	LA	—	—	—	AO	QO	—
rNew!	—	—	—	—	—	—	—	—	—	—	—	—
rJoinIn!	AO[4]	AP[4]	—	—	QA	—	—	QO	—	QP	—	—
rIn!	—	—	—	—	QA[5]	—	—	—	—	—	—	—
rJoinMt! || rMt!	—	—	—	—	—	AA	—	—	AO	—	AP	VO
rLv! || rLA! || Re-declare!	LO[1]	—	—	VN	VP[9]	VP[9]	—[10]	LO[1]	LO[1]	VP	VP	—
periodic!	—	—	—	—	—	AA	—	—	—	—	AP	—
tx![7]	[s] —	sJ AA	sN AN	sN QA[8]	sJ QA	[sJ] —	sL VO	[s] —	[s] —	sJ QA	[s] —	s VO
txLA![2]	[s] LO	s AA	sN AN	sN QA	sJ QA	sJ —	[s] LO	[s] LO	[s] LO	sJ QA	sJ QA	[s] —
txLAF![2]	LO	VP	VN	VN	VP	VP	LO	LO	LO	VP	VP	—

Notes to the table:
[1]Applicant-Only participants exclude the LO state, and transition to VO.
[2]These events do not occur for Applicant-Only participants.
[3]Point-to-point subset participants exclude the AO, QO, AP, and QP states.
[4]Ignored (no transition) if point-to-point subset or if operPointToPointMAC is TRUE.
[5]Ignored (no transition) if operPointToPointMAC is FALSE.
[6]Request opportunity to transmit on entry to VN, AN, AA, LA, VP, AP, and LO states.
[7]If the MRPDU is full and cannot convey a required message there is no change of state and an additional transmit opportunity is requested if that has not been done already.
[8]QA if the Registrar is IN, and AA otherwise.
MRP design notes:
[5]On shared media the receipt of In does not confirm registration by all Participants, and the In could have been sent by an Applicant-Only participant.
[8]Since New messages do not convey registrar state, a Leave could have been received without an Empty or JoinEmpty prompt being sent, the transition to AA guards against loss of that Leave by another Applicant.
[9]The design accepts a small possibility of a continued registration (after rLv! if a Lv! occurs before a further Join is sent) in return for not accumulating many Active participants when Join!s and Lv!s are frequent. rLv! processing is deliberately not optimized for point-to-point.
[10]If a Leave has been received, the Registrar for the transmitting participant is very probably IN, as this Applicant has not yet sent a Leave, so the pending Leave is required. The small savings from avoiding transmission of Leaves pending on receipt of LeaveAlls does not merit distinguishing the rLv! and rLA! cases.
[11]The VO, AO, and QO states represent states where the attribute is neither being declared by the Participant nor being registered by any other station on the LAN. In implementations where dynamic creation and discarding of state machines is desirable, the state machine can be discarded when in any of these states, pending a future requirement to declare or register that attribute value.

10.7.8 Registrar state machine

A full MRP Participant maintains a single instance of this state machine for each Attribute value that is currently registered, or that the Registrar state machine is in the process of deregistering.

NOTE—As with the Applicant, state information is conceptually maintained for all possible values of all Attribute types that are defined for a given application; however, in real implementations of MRP, it is likely that the range of possible Attribute values in some applications will preclude this, and the implementation will limit the state to those Attribute values in which the Participant has an immediate interest. In the case of simple devices that have no interest in what other Participants have registered, it may be appropriate for that device to ignore Registrar operation altogether.

The detailed operation of this state machine is described in Table 10-4.

Table 10-4—Registrar state table

		STATE		
		IN	**LV**	**MT**
EVENT	**Begin!**	MT	MT	MT
	rNew!	New IN	New Stop leavetimer IN	New IN
	rJoinIn! || rJoinMt!	IN	Stop leavetimer IN	Join IN
	rLv! || rLA! || txLA! || Re-declare!	Start leavetimer LV	-x-	-x-
	Flush!	MT	Lv MT	MT
	leavetimer!	-x-	Lv MT	MT

10.7.9 LeaveAll state machine

A single LeaveAll state machine exists for each full MRP Participant. Leave All messages generated by this state machine also generate LeaveAll events against all the Applicant and Registrar state machines associated with that Participant and Port; hence, LeaveAll generation is treated by those state machines in the same way as reception of a LeaveAll message from an external source.

The detailed operation of this state machine is described in Table 10-5.

10.7.10 PeriodicTransmission state machine

A single PeriodicTransmission state machine exists for each Port. Periodic Transmission events are generated on a regular basis, against all Applicant state machines that are associated with that Port.

The detailed operation of this state machine is described in Table 10-6.

Table 10-5—LeaveAll state table

		STATE	
		Active	**Passive**
EVENT	**Begin!**	Start leavealltimer Passive	Start leavealltimer Passive
	tx!	sLA Passive	-x-
	rLA!	Start leavealltimer Passive	Start leavealltimer Passive
	leavealltimer!	Start leavealltimer Active	Start leavealltimer Active

Table 10-6—PeriodicTransmission state table

		STATE	
		Active	**Passive**
EVENT	**Begin!**	Start periodictimer Active	Start periodictimer Active
	periodicEnabled!	-x-	Start periodictimer Active
	periodicDisabled!	Passive	-x-
	periodictimer!	Start periodictimer periodic Active	-x-

10.7.11 Timer values

MRP *correctness* is not critically dependent on the values of protocol timers. However the protocol operates more efficiently, and with less likelihood of unwanted de-registrations, if the following relationships are maintained between timer values used by peer Participants:

a) LeaveTime should be at least twice the maximum JoinTime, plus six times the timer resolution, to allow re-registration after a Leave or LeaveAll even if a message is lost.

b) To minimize the volume of re-joining traffic generated following a LeaveAll, the value chosen for LeaveAllTime should be large relative to LeaveTime.

The default timer values (Table 10-7) maintain these relationships. They may be modified on a per-Port basis by means of the management functionality defined in Clause 12.

Table 10-7—MRP timer parameter values

Parameter	Value (centiseconds)
JoinTime	20
LeaveTime	60–100
LeaveAllTime	1000

NOTE—The default values for the MRP timers are independent of media access method or data rate. This is a deliberate choice, made in the interests of maximizing the "plug and play" characteristics of the protocol.

Implementation of the timers for MRP shall be based on a timer resolution of 1 centisecond or less.

If operPointToPointMAC (6.4.3) is TRUE, a request for a transmit opportunity should result in such an opportunity as soon as is practicable, given other system constraints, and shall occur within the value specified for JoinTime subject to not more than three such transmission opportunities occurring in any period of 1.5*JoinTime.

If operPointToPointMAC is FALSE, and there is no pending request, a transmit opportunity shall occur at a time value randomized between 0 and JoinTime seconds. These provisions shall apply even if a point-to-point subset Applicant has been implemented.

10.7.12 Operational reporting and statistics

10.7.12.1 Failure to register

Each MRP Participant maintains a count of the number of times that it has received a registration request, but has failed to register the attribute concerned due to lack of space in the Filtering Database to record the registration. The value of this count may be examined by management (see 12.9.2.1.3).

NOTE—Further action to be taken on such events is a matter for implementation choice.

10.7.12.2 Peer tracking

An implementation may support the ability to record against each Registrar state machine the MAC Address of the originator of the MRPDU that caused the most recent state change for that state machine (see 12.9.3.1.3).

10.7.13 Interoperability considerations

Correct operation of the MRP protocol for a given MRP application requires that protocol exchanges among a given set of communicating MRP Participants maintain sequentiality; i.e., that Participant A cannot receive MRPDU B (generated as a consequence of Participant B receiving MRPDU A) before Participant A has received MRPDU A. In circumstances where the Participants concerned are all attached to the same LAN, such sequentiality is ensured. However, if a set of MRP Participants communicates via an intervening Bridge that does not implement that MRP application (or does not implement MRP at all), the sequentiality constraints expressed in 8.6.6, 8.6.7, and 8.6.8 are insufficient to guarantee the correct operation of the MRP protocol. In order for the correct sequencing of PDUs to be maintained through such a Bridge, the following constraint must be met:

> If MRPDU A is received on Port X, and is due to be forwarded on Ports Y and Z, and subsequent to being forwarded on Y, MRPDU B is received on Port Y for forwarding on Port Z, then forwarding of B cannot precede A on Port Z.

NOTE—This expresses a stronger sequencing constraint for multicast frames than is stated in 8.6, but a weaker constraint than was required for conformance to IEEE Std 802.1D, 1993 Edition.

The consequence of failure to meet this constraint is that the users of a given MRP application may experience an increased incidence of loss of registration. Therefore, it is inadvisable to construct LAN configurations involving forwarding of MRPDUs through intervening Bridges if those Bridges do not meet the constraint expressed previously.

10.8 Structure and encoding of MRP Protocol Data Units

This subclause describes the generic structure and encoding of the MRP Protocol Data Units (MRPDUs) exchanged between all MRP Participants. The structure and encoding of elements that are specific to the operation of the MRP applications are defined by the applications themselves.

Each MRPDU identifies the MRP application by which it was generated, and to which it is being transmitted. Bridges that receive MRPDUs identified as belonging to an MRP application that they do not support shall forward such PDUs on all other Ports that are in a Forwarding state.

NOTE 1—If MRP is used to support an application that can operate in any MAP Context other than 0 (the Base Spanning Tree), the application specification describes how that context is identified in protocol exchanges.

Each MRPDU carries one or more MRP messages, each of which identify one or more MRP events (e.g., Join, Leave, LeaveAll) and the attribute class(es) and value(s) to which each event applies. A given MRP Participant shall process MRPDUs in the order in which they are received, and shall process the MRP Messages in a PDU in the order in which they were put into the Data Link Service Data Unit (DLSDU).

NOTE 2—Any messages generated as a consequence of state machine responses to an sLA action and its associated LeaveAll events will be put into the DLSDU after the LeaveAll message(s), or into a later DLSDU.

10.8.1 Structure

10.8.1.1 Transmission and representation of octets

All MRPDUs consist of an integral number of octets, numbered starting from 1 and increasing in the order that they are put into a Data Link Service Data Unit (DLSDU). The bits in each octet are numbered from 1 to 8, where 1 is the low-order bit.

When consecutive octets are used to represent a binary number, the lower octet number has the most significant value.

When the encoding of (an element of) an MRPDU is represented using a diagram in this clause, the following representations are used:

a) Octet 1 is shown towards the top of the page, higher numbered octets being towards the bottom.
b) Where more than one octet appears on a given line, octets are shown with the lowest numbered octet to the left, higher numbered octets being to the right.
c) Within an octet, bits are shown with bit 8 to the left and bit 1 to the right.

10.8.1.2 Structure definition

MRP makes use of an EtherType value as the means of identifying the MRP application that has transmitted, and that will receive, a given MRPDU. Table 10-2 lists the set of MRP applications that are defined, and the EtherType values that correspond to them.

A protocol version field is included in the structure of the MRPDU, in order to provide the ability to identify future enhancements to MRP applications.

MRPDUs exchanged according to the protocol specified in this clause shall have the following structure:

a) The first octet contains the *ProtocolVersion*.
b) Following the Protocol Version are one or more *Messages*. The last element in the PDU is an *EndMark*.

c) Each Message consists of an *AttributeType* and an *AttributeList,* in that order.
d) An Attribute List consists of one or more *VectorAttribute*s. The last element in the AttributeList is an EndMark.
e) A VectorAttribute consists of a *VectorHeader*, a *FirstValue*, and a *Vector,* in that order. The VectorHeader is able to encode both a *LeaveAllEven*t and the number of attribute events encoded in the vector.
f) If the end of an MRPDU is encountered before an EndMark is reached, then processing of the PDU is terminated as if an EndMark had been reached.

The following BNF productions give the formal description of the MRPDU structure:

MRPDU ::= ProtocolVersion, Message {, Message}, EndMark
ProtocolVersion BYTE ::= *Defined by the specific MRP application*
Message ::= AttributeType, AttributeList
AttributeType BYTE ::= *Non-zero integer defined by the specific MRP application*
AttributeList ::= VectorAttribute {, VectorAttribute}, EndMark
VectorAttribute ::= VectorHeader, FirstValue, Vector
VectorHeader SHORT ::= (LeaveAllEvent * 8192) + NumberOfValues
FirstValue ::= Defined by the specific MRP application
Vector ::= ThreePackedEvents {, ThreePackedEvents}
ThreePackedEvents BYTE ::= (((((AttributeEvent) *6) + AttributeEvent) *6) + AttributeEvent)
AttributeEvent BYTE ::= New | JoinIn | In | JoinMt | Mt | Lv
LeaveAllEvent BYTE ::= NullLeaveAllEvent | LeaveAll
NumberOfValues SHORT ::= Number of events encoded in the vector
EndMark BYTE ::= 0x00 | End of PDU
NullLeaveAllEvent ::= 0
LeaveAll ::= 1
New ::= 0
JoinIn ::= 1
In ::= 2
JoinMt ::= 3
Mt ::= 4
Lv ::= 5

The parameters carried in MRPDUs, as identified in this structure definition, shall be encoded as specified in 10.8.2.

Figure 10-5 illustrates the structure of the MRPDU and its components.

10.8.2 Encoding of MRPDU parameters

10.8.2.1 Encoding of ProtocolVersion

A ProtocolVersion shall be encoded in a single octet, taken to represent an unsigned binary number. It takes a hexadecimal value that is determined by the application concerned.

NOTE—The handling of protocol version information is defined in 10.8.3.5.

10.8.2.2 Encoding of AttributeType

An AttributeType shall be encoded as a single octet, taken to represent an unsigned binary number. The AttributeType identifies the type of Attribute to which the message applies. The range of values that can be taken by the AttributeType, and the meanings of those values, are defined by the application concerned. The

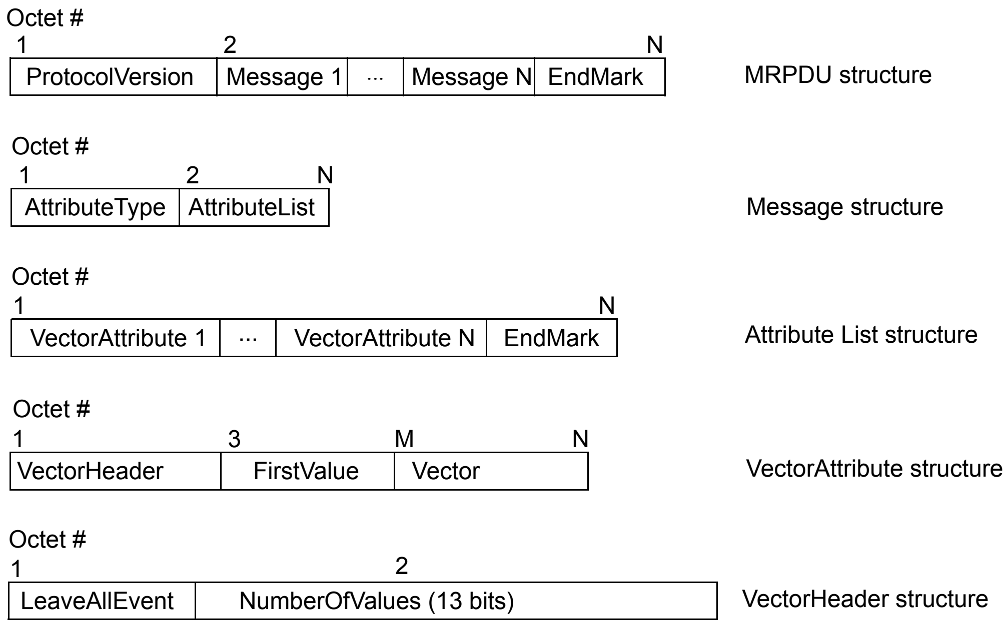

Figure 10-5—Format of the major components of an MRPDU

value 0 is reserved, and shall not be used as an AttributeType by any MRP application. MRP applications may otherwise allocate meanings to any set of values of AttributeType in the range 1 through 255.

The definition of AttributeType values in the application associates the following with each AttributeType value defined:

a) The size, in octets, of AttributeValues, and how they are encoded.
b) Any restrictions that are placed upon the range of attribute values that the vector is permitted to represent.

10.8.2.3 Encoding of AttributeEvent

An AttributeEvent shall be encoded as an unsigned decimal number in the range 0 through 5. The permitted values and meanings of the AttributeEvent are as follows:

0: New operator
1: JoinIn operator
2: In operator
3: JoinMt operator
4: Mt operator
5: Lv operator

Further values of AttributeEvent are reserved.

The AttributeEvent is interpreted on receipt as a MAD event to be applied to the state machine for the Attribute defined by the AttributeType and AttributeValue to which the AttributeEvent relates.

10.8.2.4 Encoding of LeaveAllEvent

A LeaveAllEvent shall be encoded as an unsigned binary number. The permitted values and meanings of LeaveAllEvent are as follows:

0: NullLeaveAllEvent operator
1: LeaveAll operator

Further values of LeaveAllEvent are reserved.

The LeaveAllEvent is interpreted on receipt as a MAD Leave All event to be applied to the state machines for all Attributes of the type defined by the AttributeType field.

The value NullLeaveAllEvent signifies that there is no Leave All event to process, and is included purely for encoding efficiency in the vector attribute structures. Receipt of this value does not cause any event to be applied to any state machine.

10.8.2.5 Encoding of FirstValue

A FirstValue is encoded in N octets, taken to be an unsigned binary number, in accordance with the specification for the AttributeType defined by the MRP application concerned.

10.8.2.6 Encoding of VectorHeader

The VectorHeader is used to encode both the value of the LeaveAllEvent (10.8.2.4) and the NumberOfValues, the number of AttributeEvent values encoded in a Vector (10.8.2.8). The VectorHeader is taken to be an unsigned binary number, encoded in two octets, as follows:

a) The value of the LeaveAllEvent is multiplied by 8192.
b) The resulting number is added to NumberOfValues.

The range of values that NumberOfValues can take is restricted, such that the following are true:

c) The size of the Vector that is defined by this number will fit in the available space in the PDU.
d) The number of AttributeEvent values, added to the number encoded in FirstValue, does not exceed the permitted numeric range of FirstValue as defined for the application concerned.
e) The number of AttributeEvent values is non-zero, and does not exceed 8191.

10.8.2.7 Encoding of EndMark

An EndMark shall be encoded as a single octet, taken to represent the unsigned binary number. It takes the numeric value 0.

Further values of EndMark are reserved and shall not be used.

NOTE—As defined by the MRPDU structure definition in 10.8.1, if the end of the MRPDU is encountered, this is taken to be an End Mark from the point of view of processing the PDU contents.

10.8.2.8 Encoding of Vector

The Vector is encoded as one or more 8-bit values, each containing a numeric value, ThreePackedEvents, derived from three packed numeric values, each of which represent an AttributeEvent, in the range 0 though 5.

As can be seen from the BNF definition of ThreePackedEvents, each 8-bit value is derived by successively adding an event value and multiplying the result by 6. In order to facilitate the subsequent description, the event values are numbered form *first* to *third*, as follows:

ThreePackedEvents BYTE ::= (((((*first*AttributeEvent) *6) + *second*AttributeEvent)

*6) + *third*AttributeEvent)

The NumberOfValues field in the VectorHeader of the VectorAttribute determines the number of 8-bit ThreePackedEvents values, *E*, that will be present in the vector; hence E is determined by dividing NumberOfValues by 3 and rounding any non-integer answer up to the nearest larger integer.

The FirstValue field of the VectorAttribute determines which of the originator's state machines the *first* AttributeEvent value in the first ThreePackedEvents value relates to. The *second* AttributeEvent value in the first ThreePackedEvents value corresponds to the state machine identified by (FirstValue + 1), and the *third* AttributeEvent value in the first ThreePackedEvents value corresponds to the state machine identified by (FirstValue + 2), and so on, through subsequent packed values.

Where the NumberOfValues field carries a value that is not a multiple of 3, there will be either one or two AttributeEvent values packed in the final ThreePackedEvents that are ignored; these values are encoded as the numeric value 0 on transmission and are ignored on receipt.

10.8.3 Packing and parsing MRPDUs

The use of the End Mark (10.8.2.7) to signal the end of an AttributeList and the end of an MRPDU, and the fact that the (physical) end of the PDU is interpreted as an End Mark, simplifies the requirements both for packing information into MRPDUs and for correctly interpreting that information on receipt.

10.8.3.1 Packing

Successive Messages are packed into the MRPDU, and within each Message, successive VectorAttributes are packed into each Message, until the end of the PDU is encountered or there are no more VectorAttributes to pack at that time. The following cases can occur:

a) The PDU has sufficient room for all the VectorAttributes that require to be transmitted at that time to be packed. In this case, the PDU is transmitted, and subsequent PDUs are transmitted when there are further VectorAttributes to transmit.
b) The PDU has enough room for the first N VectorAttributes that require to be transmitted at that time to be packed. In this case, the PDU is transmitted, and the next N VectorAttributes are encoded in a subsequent PDU.

10.8.3.2 Handling of received MRPDUs

Received MRPDUs, i.e., PDUs that are constructed in accordance with the MRPDU format defined in 10.8, that carry a destination MAC address and MRP EtherType value as specified for use by a defined MRP application, are processed as follows:

a) In Bridges and end stations that support the operation of the MRP application concerned, all such PDUs shall be submitted to the MRP Participant associated with the receiving Port for further processing.
b) In Bridges that do not support the operation of the MRP application concerned, all such PDUs shall be submitted to the Forwarding Process.

10.8.3.3 Discarding badly formed MRPDUs

An MRP Participant that receives an MRPDU shall discard that PDU if the PDU is not formatted according to the MRPDU format defined in 10.8.

10.8.3.4 Parsing

Successive Messages, and within each Message, successive VectorAttributes, are unpacked from the PDU. If this process terminates because the end of the PDU is reached, then the end of the PDU is taken to signal termination both of the current AttributeList and the overall PDU. The following two cases can occur:

a) The last VectorAttribute to be unpacked was complete. In this case, the VectorAttribute is processed normally, and processing of the PDU terminates.
b) The last VectorAttribute to be unpacked was incomplete. In this case, the entire PDU is discarded, and processing of the PDU terminates.

10.8.3.5 Handling of protocol versions

In order to ensure compatibility with previous protocol versions, while allowing the protocol to be extended in the future, the following requirements shall be met by the implementation:

a) MRPDUs that carry a protocol version lower than the protocol version implemented shall be interpreted according to the definition corresponding to the protocol version carried in the PDU.
b) MRPDUs that carry a protocol version equal to or higher than the protocol version implemented shall be interpreted according to the definition corresponding to the protocol version implemented.
c) Where the MRPDU carries a higher protocol version than the version implemented, then:
    1) If a Message is encountered in which the AttributeType is not recognized, then that Message is discarded. This is achieved by discarding the successive VectorAttributes in the AttributeList until either an EndMark or the end of the PDU is reached. If an EndMark is reached, processing continues with the next Message.
    2) If a VectorAttribute is encountered in which the AttributeEvent is not recognized for the AttributeType concerned, then the VectorAttribute is discarded and processing continues with the next VectorAttribute, if the end of the PDU has not been reached.

10.9 Multiple MAC Registration Protocol (MMRP)—Purpose

MMRP provides a mechanism that allows end stations and MAC Bridges to dynamically register (and subsequently, deregister) Group membership and individual MAC address information with the Bridges attached to the same LAN, and disseminates that information across all the Bridges that support Extended Filtering Services in the Bridged Local Area Network. The operation of MMRP relies upon the services provided by MRP.

The information registered, deregistered, and disseminated via MMRP is in the following forms:

a) *Group membership information*. This indicates the presence of MMRP participants that are members of a particular Group (or Groups), and carries the group MAC address(es) associated with the Group(s). The exchange of specific Group membership information can result in the creation or updating of Group Registration Entries in the Filtering Database to indicate the Port(s) and VID(s) of the VLAN(s) on which members of the Group(s) have been registered. The structure of these entries is described in 8.8.4.
b) *Group service requirement information*. This indicates that one or more MMRP participants require Forward All Groups or Forward Unregistered Groups to be the default Group filtering behavior (see 6.12.7 and 8.8.6).
c) *Individual MAC address information*.

Registration of Group membership information makes Bridges aware that frames destined for the group MAC address concerned should only be forwarded in the direction of the registered members of the Group.

Therefore, forwarding of frames destined for the address associated with that Group occurs only on Ports on which such membership registration has been received.

Registration of Group service requirement information makes the Bridges aware that Ports that can forward frames in the direction from which the information has been received should modify their default Group forwarding behavior in accordance with the service requirement expressed.

NOTE—Modification of default Group forwarding behavior allows Bridge Ports to accommodate MMRP-unaware devices in the Bridged Local Area Network by forwarding frames destined for unregistered group MAC addresses.

The operation of MMRP can result in

d) The propagation of Group membership information and Group service requirement information, and consequent creation, updating, or deletion of Group Registration Entries in the Filtering Databases of all Bridges in the network that support Extended Filtering Services.
e) Consequent changes to the Group filtering behavior of such Bridges.

In VLAN Bridges, MMRP operates only when the Bridge Filtering Mode is set to Extended Filtering Mode. Bridges that are unable to operate in Extended Filtering Mode, or have been set to operate in Basic Filtering Mode, are transparent with respect to MMRP protocol exchanges, and forward any MRPDUs destined for the MMRP application through all Ports that are in Forwarding.

NOTE—An MMRP user is not prevented from registering an individual MAC address associated with a location different from its actual location. Such registration could result in denial of service to the station associated with that MAC Address and, possibly, the interception of associated traffic by an unintended recipient. Such consequences of the misuse of individual MAC address registration can be prevented by using MMRP individual MAC address registration only in secure network environments (i.e., only in networks providing perimeter security).

10.10 Model of operation

MMRP defines an *MRP application* that provides the extended filtering services defined in 6.12.5 and 6.12.7. To this end, MMRP makes use of

a) The declaration and propagation services offered by *MRP Attribute Distribution* (MAD; 10.2 and 10.3,) and *MRP Attribute Propagation* (MAP; 10.2 and 10.3) to declare and propagate Group membership, Group service requirement, and individual MAC address information within the Bridged Local Area Network.
b) The registration services offered by MAD (10.2 and 10.3) to allow Group membership, Group service requirement, and individual MAC address information to control the frame filtering behavior of participating devices.

Figure 10-6 illustrates the architecture of MMRP in the case of a two-Port Bridge and an end station, for a given VLAN Context. Where MMRP is used in multiple VLAN Contexts, an instance of the MMRP Participant exists for each VLAN context.

As shown in the diagram, the MMRP Participant consists of the following components:

c) The MMRP application, described in 10.12
d) MRP Attribute Propagation (MAP), described in 10.3
e) MRP Attribute Declaration, described in 10.2

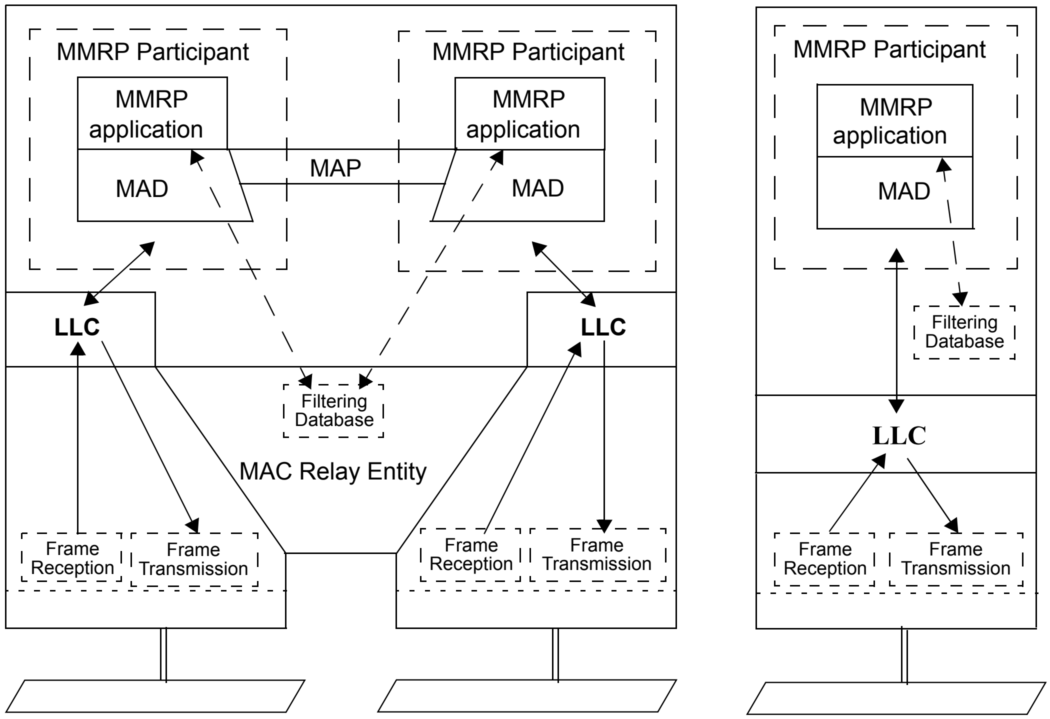

Figure 10-6—Operation of MMRP for a single VLAN Context

10.10.1 Propagation of Group Membership information

The Forwarding Process uses the Group Registration Entries in the Filtering Databases to ensure that frames are transmitted only through those Bridge Ports necessary to reach LANs to which Group members are attached. Figure 10-7 illustrates the Group Registration Entries created by MMRP for a single Group.

By receiving frames from all Ports and forwarding only through Ports for which MMRP has created Group Registration Entries, Bridges facilitate Group distribution mechanisms based on the concept of an Open Host Group. Any MMRP Participants (10.2) that wish to receive frames transmitted to a particular Group or Groups request membership of the Group(s) concerned. Any MAC Service user that wishes to send frames to a particular Group can do so from any point of attachment to the Bridged Local Area Network. These frames can be received on all LANs to which registered MMRP Participants are attached, but the filtering applied by Bridges ensures that frames are not transmitted on LANs that are not part of the active topology between the sources of the frames and the registered Group members. MMRP and the Group Registration Entries thus restrict the frames to pruned subsets of the overall loop-free active topology.

NOTE—The term "Open Host Group" comes from the terminology introduced in the definition of the Internet Group Membership Protocol (IGMP) defined by the IETF.

MAC Service users that are sources of MAC frames destined for the Group do not have to register as members of the Group themselves unless they also wish to receive frames transmitted to the Group address by other sources.

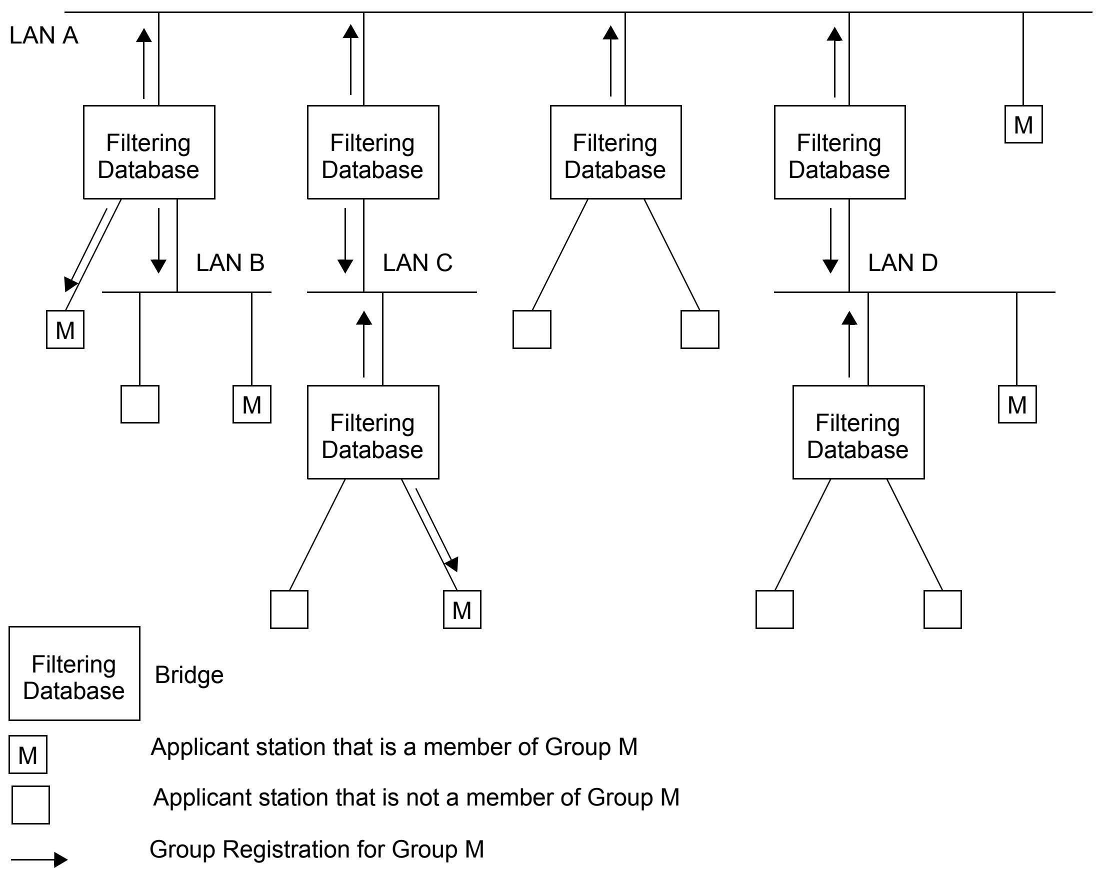

Figure 10-7—Example Directed Graph

10.10.2 Propagation of Group service requirement information

MMRP propagates Group service requirement information in the same manner as for Group Registration information. If any Port in a given Bridge has a registered Group service requirement of All Groups or All Unregistered Groups (expressed in terms of the control information in Static Filtering Entries and/or Group Registration Entries with a MAC Address specification of All Groups or All Unregistered Groups), this fact is propagated on all other Ports of the Bridge, resulting in the registration of that information on Ports of adjacent Bridges. As a consequence of that registration, the default Group filtering behavior of those Ports can change in order to maintain compatibility with the service requirements expressed by the registered information, as defined in 8.8.6. This ensures that connectivity can be maintained in LANs where the service requirements of different regions of the Bridged Local Area Network differ.

NOTE—In a Bridged Local Area Network where the default Group filtering behavior is not the same for all “edge” Ports, service requirement propagation will tend to result in all “backbone” Ports switching to the highest precedence Group filtering behavior in use in the network. The precedence rules are defined in 8.8.6.

10.10.3 Source pruning

As described in 10.10.1, the operation of MMRP defines a subtree of the Spanning Tree as a result of the creation of Group Registration Entries in the Filtering Databases of the Bridges. End stations are also able to make use of the Group Membership information registered via MMRP to allow them to keep track of the set of Groups for which active members currently exist and the service requirements of upstream devices. This allows end stations that are sources of frames destined for a Group to suppress the transmission of such frames, if their registered Group membership and Group service requirement information indicates that there are no valid recipients of those frames reachable via the LANs to which they are attached.

NOTE—In effect, for the purposes of frame transmission, the end station can be viewed as if it operates as a single Port Bridge, with its own default Group filtering behavior and "Filtering Database" entries updated via MMRP that tell it whether or not multicast frames that it has generated should be forwarded onto the attached LAN. In order to achieve this, it is necessary for the end station to implement both the Registrar and the Applicant functionality of MRP, as described in 10.6, 10.7.7, and 10.7.8. The Applicant-Only and Simple-Applicant Participants described in 10.6 do not contain the Registrar functionality that would be required for source pruning.

This end system behavior is known as *source pruning.* Source pruning allows MAC Service users that are sources of MAC frames destined for a number of Groups, such as server stations or routers, to avoid unnecessary flooding of traffic on their local LANs in circumstances where there are no current Group members in the network that wish to receive such traffic.

10.10.4 Use of Group service requirement registration by end stations

The ability to propagate Group service requirement information is described in this standard primarily as a means of propagating the requirements of the Bridges themselves. However, this mechanism can also be used by end stations that have requirements involving some aspect of promiscuous reception, such as Routers or network monitors. A MMRP-aware end station wishing to receive all multicast traffic can declare membership of All Groups on the LAN to which it is attached; similarly, an end station that wishes to receive unregistered multicast traffic can do so by declaring membership of All Unregistered Groups.

10.11 Default Group filtering behavior and MMRP propagation

The propagation of MMRP registrations within a VLAN Context has implications with respect to the choice of default Group filtering behavior within a Bridged LAN. As MMRP frames are transmitted only on outbound Ports that are in the Member set (8.8.9) for the VLAN concerned, propagation of Group registrations by a given Bridge occurs only towards regions of the Bridged LAN where that VLAN has been (statically or dynamically) registered. This is illustrated in Figure 10-8; dotted lines in the diagram show those regions of the LAN where propagation of registrations for Group M in VLAN V does not occur. Consequently, the Filtering Databases of the lower two Bridges will not contain any Dynamic Group Registration Entry for Group M in VLAN V.

The action of these two Bridges on receipt of frames, on either of their lower Ports, destined for Group M and VLAN V, will depend upon the Default Group Filtering Behavior adopted by their upper Ports, which are the Ports that are in the Member set for VLAN V. If the Default Group Filtering Behavior is either Forward All Groups or Forward Unregistered Groups, then these Bridges will forward the frames. If the Default Group Filtering Behavior is Filter Unregistered Groups, then these Bridges will filter the frames. In the scenario shown, the choice of Default Group Filtering Behavior is therefore crucial with respect to whether or not end station S, or any other station that is "outside" the VLAN, is able to send frames to members of the Group. The choice between Filter Unregistered Groups and the other default behaviors therefore has the effect of defining VLANs that are closed to external unregistered traffic (Filter Unregistered Groups) or open to external unregistered traffic (either of the other default behaviors).

10.12 Definition of the MMRP application

10.12.1 Definition of MRP protocol elements

10.12.1.1 Use of MAP Contexts by MMRP

MMRP, as defined in this standard, operates within the set of VLAN Contexts that correspond to the VLANs that are supported by the VLAN Bridged Local Area Network. The Base Spanning Tree Context is not used

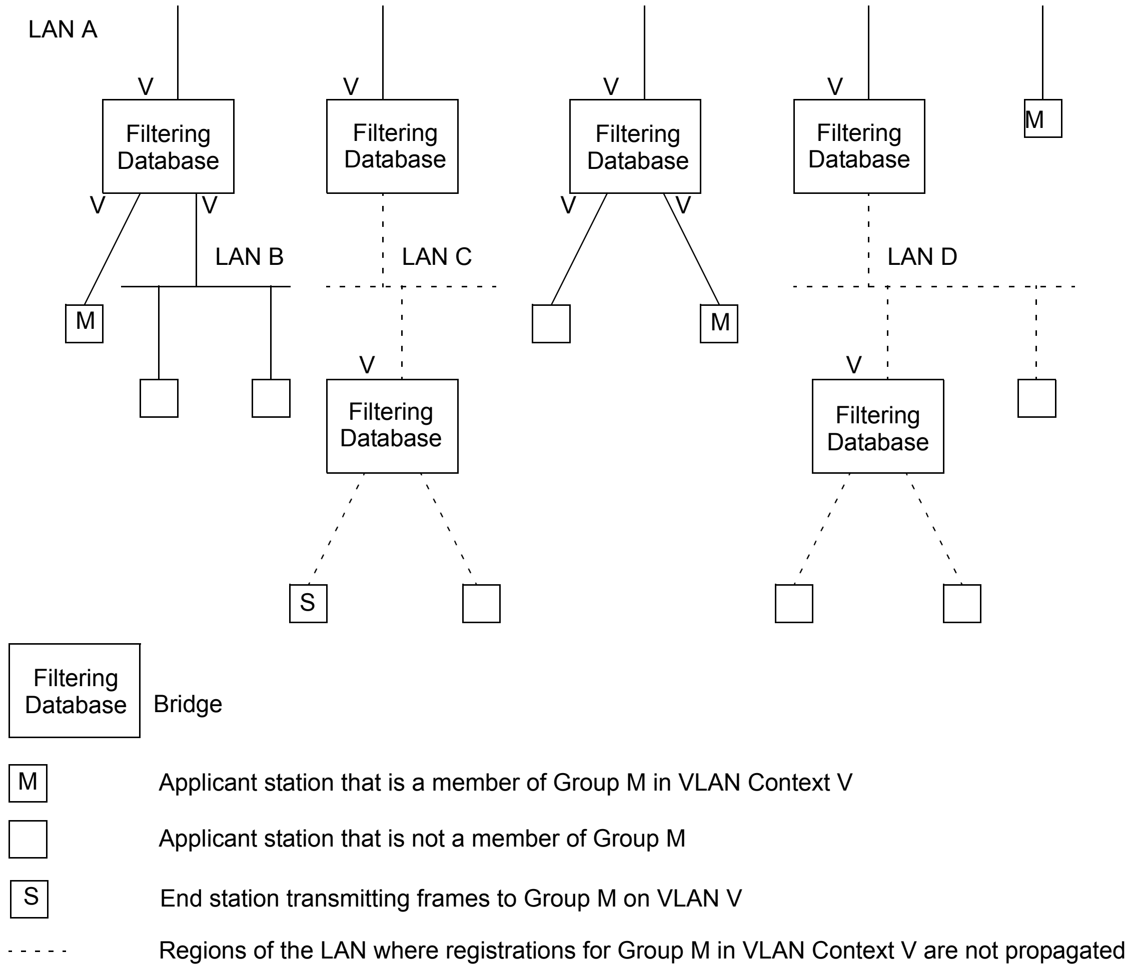

Figure 10-8—Example of MMRP propagation in a VLAN Context

for the propagation of MMRP protocol information. The use of MMRP in any other MAP Context is outside the scope of this standard.

NOTE 1—In IEEE Std 802.1D, propagation of GMRP protocol information takes place only in the Base Spanning Tree Context.

The MAP Context Identifier used to identify a VLAN Context shall be equal to the VID used to identify the corresponding VLAN.

The set of Ports of a Bridge defined to be part of the active topology for a given VLAN Context shall be equal to the set of Ports of a Bridge for which the following are true:

a) The Port is a member of the *Member set* (8.8.9) for that VLAN; and
b) The Port is one of the Ports of the Bridge that are part of the active topology for the spanning tree that supports that VLAN.

NOTE 2—The above definition applies equally to SST and MST environments. It ensures that MMRP operates in either environment, without the MMRP implementations needing to be aware of whether the VLAN Contexts that apply are all supported by the same spanning tree, as in the SST environment, or are potentially distributed across two or more spanning trees, as in the MST environment.

10.12.1.2 Context identification in MMRP

Implementations of MMRP in VLAN Bridges apply the same ingress rules (8.6.2) to received MMRPDUs that are defined for the reception Port. Therefore

a) MMRP frames with no VLAN classification (i.e., untagged or priority-tagged MMRPDUs) are discarded if the Acceptable Frame Types parameter (8.6.2) for the Port is set to *Admit Only VLAN-tagged frames*. Otherwise, they are either classified according to the PVID for the Port, or as determined by port-and-protocol-based VLAN classification (6.8) if that capability is implemented.
b) VLAN-tagged MMRP frames are classified according to the VID carried in the tag header, optionally translated using the VID translation table (6.7).
c) If Ingress Filtering (8.6.2) is enabled, and if the Port is not in the Member set (8.8.9) for the MMRP frame's VLAN classification, then the frame is discarded.

The VLAN classification thus associated with a received MMRP frame establishes the VLAN Context for the received PDU, and identifies the MRP Participant instance to which the PDU is directed.

MMRPDUs transmitted by MMRP Participants are VLAN classified according to the VLAN Context associated with that Participant. MMRP Participants in VLAN Bridges apply the same egress rules that are defined for the transmission Port (8.6.4). Therefore

d) MMRPDUs are transmitted through a given Port only if the value of the Member Set for the Port for the VLAN concerned indicates that the VLAN is registered on that Port.
e) MMRPDUs are transmitted as VLAN-tagged frames or as untagged frames in accordance with the state of the Untagged Set (8.8.9) for that Port for the VLAN concerned. Where VLAN-tagged frames are transmitted, the VID field of the tag header carries the VLAN Context Identifier value, optionally translated using the VID translation table (6.7).

10.12.1.3 MMRP application address

The group MAC address used as the destination address for MRPDUs destined for MMRP Participants shall be the group MAC address identified in Table 10-1 as "Customer and Provider Bridge MMRP address."

10.12.1.4 MMRP application EtherType

The EtherType used for MRPDUs destined for MMRP Participants shall be the MMRP EtherType identified in Table 10-2.

10.12.1.5 MMRP ProtocolVersion

The ProtocolVersion for the version of MMRP defined in this standard takes the hexadecimal value 0x00.

10.12.1.6 MMRP AttributeType definitions

MMRP defines two AttributeTypes (10.8.2.2) that are carried in MRP protocol exchanges, as follows:

a) The Service Requirement Vector Attribute Type.
b) The MAC Vector Attribute Type.

Attributes identified by the Service Requirement Vector Attribute Type are instances of VectorAttributes (10.8.1), used to identify values of Group service requirements. The value of AttributeType used to identify the Service Requirement Vector Attribute Type in MRPDUs (10.8.2.2) shall be 1.

Attributes identified by the MAC Vector Attribute Type are instances of VectorAttributes (10.8.1), used to identify a sequence of values of MAC Addresses. The value of AttributeType used to identify the MAC Vector Attribute Type in MRPDUs (10.8.2.2) shall be 2.

10.12.1.7 MMRP FirstValue definitions

The FirstValue field (10.8.2.5) in instances of the MAC Vector Attribute Type shall be encoded in MRPDUs as six octets, each taken to represent an unsigned binary number. The octets are derived from the Hexadecimal Representation of a 48-bit MAC Address (defined in IEEE Std 802) as follows:

a) Each two-digit hexadecimal numeral in the Hexadecimal Representation is taken to represent an unsigned hexadecimal value, in the normal way, i.e., the rightmost digit of each numeral represents the least significant digit of the value, the leftmost digit is the most significant.
b) The first octet of the attribute value encoding is derived from the left-most hexadecimal value in the Hexadecimal Representation of the MAC Address. The least significant bit of the octet (bit 1) is assigned the least significant bit of the hexadecimal value, the next most significant bit is assigned the value of the second significant bit of the hexadecimal value, and so on.
c) The second through sixth octets of the encoding are similarly assigned the value of the second through sixth hexadecimal values in the Hexadecimal Representation of the MAC Address.

There are no restrictions on the range of values that can be represented in this data type.

The FirstValue field in instances of the Service Requirement Attribute Type shall be encoded in MRPDUs (10.8.2.5) as a single octet, taken to represent an unsigned binary number. Only two values of this type are defined:

d) All Groups shall be encoded as the value 0.
e) All Unregistered Groups shall be encoded as the value 1.

The remaining possible values (2 through 255) are reserved.

10.12.2 Provision and support of Extended Filtering Services

10.12.2.1 Initiating MMRP registration and de-registration

The MMRP application element of an MRP Participant provides the dynamic registration and de-registration services defined in 6.12.7.1, as follows:

On receipt of a REGISTER_MAC_ADDRESS service primitive, the MMRP Participant issues a MAD_Join.request. The attribute_type parameter of the request carries the value of the MAC Vector Attribute Type (10.12.1.6) and the attribute_value parameter carries the value of the MAC_ADDRESS parameter of the service primitive.

On receipt of a DEREGISTER_MAC_ADDRESS service primitive, the MMRP Participant issues a MAD_Leave.request. The attribute_type parameter of the request carries the value of the MAC Vector Attribute Type (10.12.1.6) and the attribute_value parameter carries the value of the MAC_ADDRESS parameter of the service primitive.

On receipt of a REGISTER_SERVICE_REQUIREMENT service primitive, the MMRP Participant issues a MAD_Join.request. The attribute_type parameter of the request carries the value of the Service Requirement Vector Attribute Type (10.12.1.6) and the attribute_value parameter carries the value of the REQUIREMENT_SPECIFICATION parameter of the service primitive.

On receipt of a DEREGISTER_SERVICE_REQUIREMENT service primitive, the MMRP Participant issues a MAD_Leave.request. The attribute_type parameter of the request carries the value of the Service Requirement Vector Attribute Type (10.12.1.6) and the attribute_value parameter carries the value of the REQUIREMENT_SPECIFICATION parameter of the service primitive.

NOTE—If the EISS is supported, the Extended Filtering service primitives issued by the MAC Service user should include a VID parameter in addition to the MAC_ADDRESS or REQUIREMENT_SPECIFICATION parameters, in order to identify the MMRP Participant associated with the primitive.

10.12.2.2 Registration and de-registration events

The MMRP application element of an MRP Participant responds to registration and de-registration events signaled by MAD as follows:

On receipt of a MAD_Join.indication, the MMRP application element specifies the Port associated with the MMRP Participant as Forwarding in the Port Map field of the MAC Address Registration Entry (8.8.4) for the MAC Address specification carried in the attribute_value parameter and the VID associated with the MAP Context. If such a MAC Address Registration Entry does not exist in the Filtering Database, a new MAC Address Registration Entry is created.

Creation of new MAC Address Registration Entries may be restricted by the Restricted_MAC_Address_Registration control (10.12.2.3). If this control is TRUE, creation of a new dynamic entry is permitted only if there is a Static Filtering Entry for the MAC Address with a Registrar Administrative Control value of Normal Registration.

NOTE—Group Membership and Group service requirement information can be recorded in the Filtering Database by means of MAC address Registration Entries (see 8.8.4). In the case of Group Membership Information, the MAC Address specification in the MAC address Registration Entry is a Group MAC Address. In the case of Group service requirement information, the MAC Address specification is either “All Group Addresses” or “All Unregistered Group Addresses.”

On receipt of a MAD_Leave.indication, the MMRP application element specifies the Port associated with the MMRP Participant as Filtering in the Port Map field of the MAC Address Registration Entry (8.8.4) for the MAC Address specification carried in the attribute_value parameter and the VID associated with the MAP Context. If such a Filtering Database entry does not exist in the Filtering Database, then the indication is ignored. If setting that Port to Filtering results in there being no Ports in the Port Map specified as Forwarding (i.e., all MMRP members are deregistered), then that MAC Address Registration Entry is removed from the Filtering Database.

10.12.2.3 Administrative controls

The provision of static control over the registration state of the state machines associated with the MMRP application is achieved by means of the Registrar Administrative Control parameters associated with the operation of MRP (10.7.2). These parameters are represented in the Filtering Database by the information held in Static Filtering Entries (8.8.1). If no Static Filtering Entry exists for a given MAC Address specification, the value of the Registrar Administrative Control parameter for the corresponding attribute value is Normal Registration for all Ports of the Bridge.

The initial state of the Permanent Database (i.e., the state of the Permanent Database in a Bridge that has not been otherwise configured by management action) includes a Static Filtering Entry with a MAC Address specification of All Groups, in which the Port Map indicates Registration Fixed. This Static Filtering Entry will have the effect of determining the default Group filtering behavior of all Ports of the Bridge to be Forward All Groups. This Permanent Database entry may be deleted or updated by management action.

NOTE—This specification of an initial Static Filtering Entry means that operation using Forward Unregistered Groups or Filter Unregistered Groups requires a conscious action on the part of the network manager or administrator.

Where management capability is implemented, the Registrar Administrative Control parameters can be applied and modified by means of the management functionality defined in 12.7.

The provision of static control over the ability of Applicant state machines to participate in protocol exchanges is achieved by means of the Applicant Administrative Control parameters associated with the operation of MRP (10.7.3). Where management capability is implemented, the Applicant Administrative Control parameters can be applied and modified by means of the management functionality defined in Clause 12.

Further administrative control over dynamic MAC Address registration may be achieved, if supported, by means of a per-Port Restricted_MAC_Address_Registration control parameter. If the value of this control is TRUE for a given Port, the creation or modification of Dynamic MAC Address Registration Entries as a result of MMRP exchanges on that Port shall be restricted only to those MAC addresses for which Static Filtering Entries exist in which the Registrar Administrative Control value is Normal Registration. If the value of the Restricted_MAC_Address_Registration control is FALSE, dynamic MAC Address registration is not so restricted. Where management capability is implemented, the value of the Restricted_MAC_Address_Registration control can be manipulated by means of the management functionality defined in Clause 12. If management of this parameter is not supported, the value of this parameter shall be FALSE for all Ports.

10.12.3 Use of “new” declaration capability

MMRP does not make use of the “new” declaration capability.

10.12.4 Attribute value support requirements

Implementations of MMRP shall maintain state information for all attribute values that support the Group service requirement registration (10.12.1.7).

Implementations of MMRP shall be capable of supporting any attribute value in the range of possible values that can be registered using Group membership and individual MAC address registration (10.12.1.7); however, the maximum number of attribute values for which the implementation is able to maintain current state information is an implementation decision. The number of values that the implementation can support shall be stated in the PICS.

Delete the existing Clause 11. Insert a replacement Clause 11 as follows:

11. VLAN topology management

The egress rules (8.6.4) defined for the Forwarding Process in VLAN Bridges rely on the existence of configuration information for each VLAN that defines the set of Ports of the Bridge through which one or more members are reachable. This set of Ports is known as the Member Set (8.8.9), and its membership is determined by the presence or absence of configuration information in the Filtering Database, in the form of Static and Dynamic VLAN Registration Entries (8.8.2, 8.8.5).

Reliable operation of the VLAN infrastructure requires VLAN membership information held in the Filtering Database to be maintained in a consistent manner across all VLAN-aware Bridges in the Bridged Local Area Network, in order to ensure that frames destined for end station(s) on a given VLAN can be correctly delivered, regardless of where in the Bridged Local Area Network the frame is generated. Maintenance of this information by end stations that are sources of VLAN-tagged frames can allow such stations to suppress transmission of such frames if no members exist for the VLAN concerned.

This standard defines the following mechanisms that allow VLAN membership information to be configured:

a) Dynamic configuration and distribution of VLAN membership information by means of the Multiple VLAN Registration Protocol (MVRP), as described in 11.2.
b) Static configuration of VLAN membership information via Management mechanisms, as described in Clause 12, which allow configuration of Static VLAN Registration Entries.

These mechanisms provide for the configuration of VLAN membership information as a result of the following:

c) Dynamic registration actions taken by end stations or Bridges in the Bridged Local Area Network.
d) Administrative actions.

11.1 Static and dynamic VLAN configuration

The combined functionality provided by the ability to configure Static VLAN Registration Entries in the Filtering Database, coupled with the use of the Restricted_VLAN_Registration control (11.2.3.2.3) and the ability of MVRP to dynamically create and update Dynamic VLAN Registration Entries, offers the following possibilities with respect to how VLANs are configured on a given Port:

a) *Static configuration only*. The management facilities described in Clause 12 are used to establish precisely which VLANs have this Port in their Member set, and the MVRP management controls are used to disable the operation of the MVRP protocol on that Port. Hence, any use of MVRP by devices reachable via that Port is ignored, and the Member set for all VLANs can therefore only be determined by means of static entries in the Filtering Database.
b) *Dynamic configuration only*. The operation of MVRP is relied upon to establish Dynamic VLAN Registration Entries that will dynamically reflect which VLANs are registered on the Port, their contents changing as the configuration of the network changes. The MVRP management controls are set to enable the operation of the MVRP protocol on that Port.
c) *Combined static and dynamic configuration*. The static configuration mechanisms are used in order to configure some VLAN membership information; for other VLANs, MVRP is relied upon to establish the configuration. The MVRP management controls are set to enable the operation of the MVRP protocol on that Port.

All of the previous approaches are supported by the mechanisms defined in this standard, and each approach is applicable in different circumstances. For example:

d) Use of static configuration may be appropriate on Ports where the configuration of the attached devices is fixed, or where the network administrator wishes to establish an administrative boundary outside of which any MVRP registration information is to be ignored. For example, it might be desirable for all Ports serving end user devices to be statically configured in order to ensure that particular end users have access only to particular VLANs.
e) Use of dynamic configuration may be appropriate on Ports where the VLAN configuration is inherently dynamic; where users of particular VLANs can connect to the network via different Ports on an ad hoc basis, or where it is desirable to allow dynamic reconfiguration in the face of Spanning Tree topology changes. In particular, if the "core" of the Virtual Bridged Local Area Network contains redundant paths that are pruned by the operation of Spanning Tree, then it is desirable for Bridge Ports that form the core network to be dynamically configured.
f) Use of both static and dynamic configuration can be appropriate on Ports where it is desirable to place restrictions on the configuration of some VLANs, while maintaining the flexibility of dynamic registration for others. For example, on Ports serving mobile end user devices, this would maintain the benefits of dynamic VLAN registration from the point of view of traffic reduction, while still allowing administrative control over access to some VLANs via that Port.

11.2 Multiple VLAN Registration Protocol

The Multiple VLAN Registration Protocol (MVRP) defines an *MRP application* that provides the VLAN registration service defined in 11.2.2. MVRP makes use of MRP Attribute Declaration (MAD) and MRP Attribute Propagation (MAP), which provide the common state machine descriptions and the common attribute propagation mechanisms defined for use in MRP-based applications. The MRP architecture, MAD, and MAP are defined in Clause 10.

MVRP provides a mechanism for dynamic maintenance of the contents of Dynamic VLAN Registration Entries for each VLAN, and for propagating the information they contain to other Bridges. This information allows MVRP-aware devices to dynamically establish and update their knowledge of the set of VLANs that currently have active members, and through which Ports those members can be reached.

11.2.1 MVRP overview

The operation of MVRP is closely similar to the operation of MMRP (10.9), which is used for registering Group membership and individual MAC address information. The primary differences are as follows:

a) The attribute values carried by the protocol are 12-bit VID values, rather than Group service requirement information and 48-bit MAC Addresses.
b) The act of registering/deregistering a VID affects the contents of Dynamic VLAN Registration Entries (8.8.5), rather than the contents of Group Registration Entries (8.8.4).
c) In an SST environment, there is a single MVRP Participant per port, as opposed to one MMRP Participant per VLAN per port, and the MVRP Participants all operate in a single MAP Context.
d) In an MST environment, there is again a single MVRP Participant per port, but each MVRP Participant operates in multiple MAP Contexts.

MVRP allows both end stations and Bridges in a Bridged Local Area Network to issue and revoke declarations relating to membership of VLANs. The effect of issuing such a declaration is that each MVRP Participant that receives the declaration will create or update a Dynamic VLAN Registration Entry in the Filtering Database to indicate that VLAN is registered on the reception Port. Subsequently, if all Participants on a segment that had an interest in a given VID revoke their declarations, the Port attached to that segment is set to Unregistered in the Dynamic VLAN Registration Entry for that VLAN by each MVRP Participant attached to that segment.

Figure 11-1 illustrates the architecture of MVRP in the case of a two-Port Bridge and an end station.

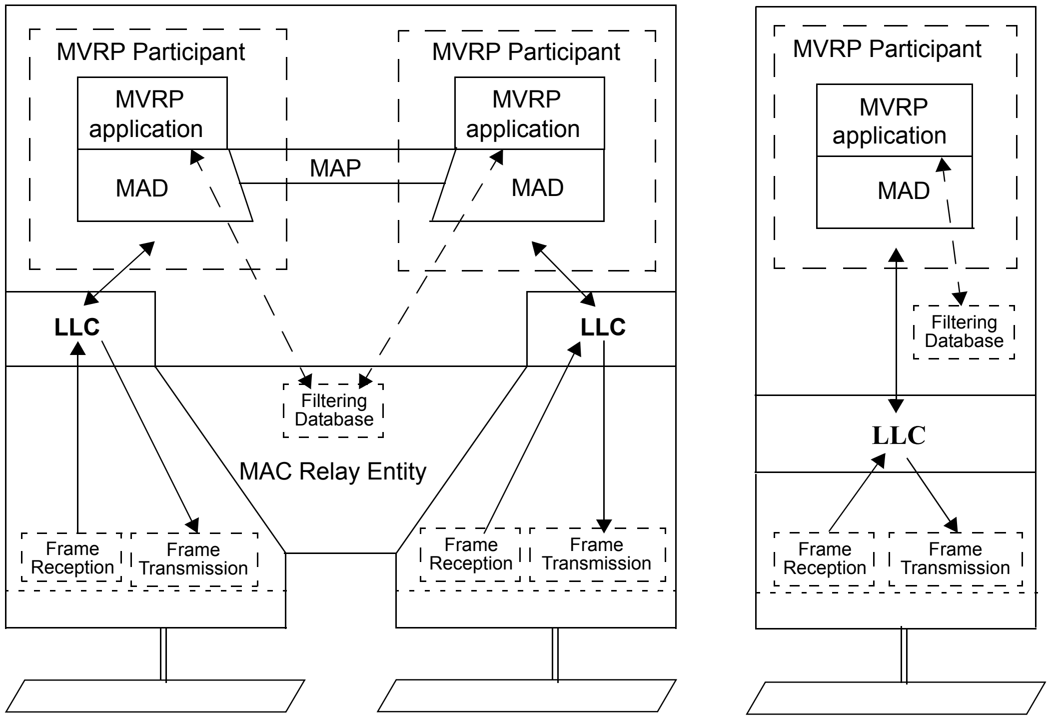

Figure 11-1—Operation of MVRP

As shown in the diagram, the MVRP Participant consists of the following components:

e) The MVRP application, described in 11.2.3
f) MRP Attribute Propagation (MAP), described in 10.3
g) MRP Attribute Declaration, described in 10.2

11.2.1.1 Behavior of end stations

VLAN-aware end stations participate in MVRP protocol activity, as appropriate for the set of VLANs of which they are currently members. MVRP provides a way for such an end station to ensure that the VLAN(s) of which it is a member are registered for each Port on any LAN segment to which the end station is attached. MVRP also provides for that VID information to be propagated across the Spanning Tree to other VLAN-aware devices, as described in 11.2.1.2.

Incoming VLAN membership information (from all other devices on the same LAN segment) allows such end stations to "source prune" (i.e., discard at source; see 10.10.3) any traffic destined for VLANs that currently have no other members in the Bridged Local Area Network, thus avoiding the generation of unnecessary traffic on their local LAN segments. This is illustrated in Figure 11-1 by a Filtering Database shown as being present in the end station.

NOTE—Non-VLAN-aware end stations have no need to register VLAN membership via MVRP; indeed, this would be impossible for them to achieve if truly VLAN-unaware, as they would have no knowledge of the set of VLANs in which they participate. Their VLAN registration requirements are taken care of by means of the configuration of PVIDs (and possibly other VLAN classification mechanisms) and the propagation of registered VLAN IDs by the Bridges.

11.2.1.2 Behavior of Bridges

VLAN-aware Bridges register and propagate VLAN memberships on all Bridge Ports that are part of the active topology of the underlying Spanning Tree(s). Incoming VID registration and de-registration information is used to update the Dynamic VLAN Registration Entries associated with each VLAN. Any changes in the state of registration of a given VID on a given Port are propagated on Ports that are part of the active topology of the underlying Spanning Tree, in order to ensure that other MVRP-aware devices in the Bridged Local Area Network update their Filtering Databases appropriately. In Bridges that support multiple Spanning Tree instances, the MST Configuration Table (12.12, 13.7) is used to determine which spanning tree instance is to be used to propagate registration information for each supported VLAN.

The Filtering Databases in all MVRP-aware devices are thus automatically configured such that the Port Map in the Dynamic VLAN Registration Entry for a given VID indicates that a given Port is registered if one or more members of the corresponding VLAN are reachable through the Port.

NOTE—The information that determines whether frames destined for each VLAN are transmitted VLAN-tagged or untagged is carried in Static VLAN Registration Entries (8.8.2); if no such entry exists for a VLAN, then it is assumed that frames for that VLAN are transmitted VLAN-tagged on all Ports. Therefore, if the configuration information held in the Filtering Database for a given VLAN consists only of information configured by the operation of MVRP (i.e., only a Dynamic VLAN Registration Entry), then all traffic for that VLAN will be VLAN-tagged on transmission.

11.2.1.3 Use of the PVID and VID Set

The initial state of the Permanent Database contains a Static VLAN Registration Entry for the Default PVID, in which the Port Map indicates Registration Fixed on all Ports. This ensures that in the default state, where the value of every PVID of each Port is the Default PVID and where the VID Set of each Port is empty, membership of the Default PVID is propagated across the Bridged Local Area Network to all other MVRP-aware devices. Subsequent management action may change both the Permanent Database and the Filtering Database in order to modify or remove this initial setting, and may change the PVID and/or VID Set value(s) on any Port of the Bridge.

NOTE—In the absence of any modification of these initial settings, this ensures that connectivity is established across the Bridged Local Area Network for the VLAN corresponding to the Default PVID.

11.2.2 VLAN registration service definition

The VLAN registration service allows MAC Service users to indicate to the MAC Service provider the set of VLANs in which they wish to participate; i.e., that the MAC Service user wishes to receive traffic destined for members of that set of VLANs. The service primitives allow the service user to

a) Register membership of a VLAN
b) Deregister membership of a VLAN

Provision of these services is achieved by means of MVRP and its associated procedures, as described in 11.2.3.

ES_REGISTER_VLAN_MEMBER (VID)

Indicates to the MAC Service provider that the MAC Service user wishes to receive frames destined for the VLAN identified by the VID parameter.

ES_DEREGISTER_VLAN_MEMBER (VID)

Indicates to the MAC Service provider that the MAC Service user no longer wishes to receive frames destined for the VLAN identified by the VID parameter.

The use of these services can result in the propagation of VID information across the Spanning Tree, affecting the contents of Dynamic VLAN Registration Entries (8.8.5) in Bridges and end stations in the Bridged Local Area Network, and thereby affecting the frame forwarding behavior of those Bridges and end stations.

11.2.3 Definition of the MVRP application

11.2.3.1 Definition of MRP protocol elements

11.2.3.1.1 MAP Context for MVRP in SST environments

In an SST environment, MVRP operates in the Base Spanning Tree Context (10.3.1); i.e., MVRP operates only on the CIST. Consequently, all MVRPDUs sent and received by MVRP Participants in SST bridges are transmitted as untagged frames.

11.2.3.1.2 MAP Contexts for MVRP in MST environments

In an MST environment, MVRP operates in multiple spanning-tree contexts, one for each of the spanning trees. Each spanning-tree context consists of the ports that are in the forwarding state for the corresponding spanning tree. The MVRP Participants associated with a given spanning tree operate in the MAP context identified by that spanning tree instance. MST bridges can identify the MAP Contexts using the mappings of VID values to MSTID values (see 8.9.1). All MVRPDUs sent and received by MVRP Participants in MST bridges are transmitted as untagged frames.

11.2.3.1.3 MVRP application address

The group MAC address used as the destination address for MRPDUs destined for MVRP Participants shall be either:

a) The group MAC address identified in Table 10-1 as “Customer Bridge MVRP address” if the MVRP Participant is implemented in a C-VLAN component; or
b) The group MAC address identified in Table 8-1 as “Provider Bridge MVRP Address” if the MVRP Participant is implemented in an S-VLAN component.

11.2.3.1.4 MVRP application EtherType

The EtherType used for MRPDUs destined for MVRP Participants shall be the MVRP EtherType identified in Table 10-2.

11.2.3.1.5 MVRP ProtocolVersion

The ProtocolVersion for the version of MVRP defined in this standard takes the hexadecimal value 0x00.

11.2.3.1.6 MVRP AttributeType definitions

MVRP defines a single Attribute Type (10.8.2.2) that is carried in MRP protocol exchanges, as follows:

Attributes identified by the VID Vector Attribute Type are instances of VectorAttributes (10.8.1), used to identify a sequence of values of VLAN Identifiers (VIDs). The value of AttributeType used to identify the VID Vector Attribute Type in MRPDUs (10.8.2.2) shall be 1.

11.2.3.1.7 MVRP FirstValue definitions

The FirstValue field in instances of the VID Vector Attribute Type shall be encoded in MRPDUs (10.8) as two octets, taken to represent an unsigned binary number, and equal to the value of the VLAN identifier that is to be encoded.

The range of permitted VLAN identifier values that can be encoded in the FirstValue fields in MVRP is restricted to the range 1 though 4094.

11.2.3.2 Provision and support of the VLAN registration service

11.2.3.2.1 Initiating VLAN membership declaration

The MVRP application element of a MVRP Participant provides the dynamic registration and de-registration services defined in 11.2.2, as follows:

On receipt of an ES_REGISTER_VLAN_MEMBER service primitive, the MVRP Participant issues a MAD_Join.request service primitive (10.2, 10.3). The attribute_type parameter of the request carries the value of the VID Vector Attribute Type (11.2.3.1.6) and the attribute_value parameter carries the value of the VID parameter carried in the ES_REGISTER_VLAN_MEMBER primitive.

On receipt of an ES_DEREGISTER_VLAN_MEMBER service primitive, the MVRP Participant issues a MAD_Leave.request service primitive (10.2, 10.3). The attribute_type parameter of the request carries the value of the VID Vector Attribute Type (11.2.3.1.6) and the attribute_value parameter carries the value of the VID parameter carried in the ES_REGISTER_VLAN_MEMBER primitive.

11.2.3.2.2 VLAN membership registration

The MVRP application element of a MVRP Participant responds to registration and de-registration events signaled by MAD as follows:

On receipt of a MAD_Join.indication whose attribute_type is equal to the value of the VID Vector Attribute Type (11.2.3.1.6), the MVRP application element indicates the reception Port as Registered in the Port Map of the Dynamic VLAN Registration Entry for the VID indicated by the attribute_value parameter. If no such entry exists, there is sufficient room in the Filtering Database, and the VID is within the range of values supported by the implementation (see 9.6), then an entry is created. If not, then the indication is not propagated and the registration fails.

The creation of new Dynamic VLAN Registration Entries can be restricted by use of the Restricted_VLAN_Registration control (11.2.3.2.3). If the value of this control is TRUE, then creation of a new dynamic entry is permitted only if there is a Static VLAN Registration Entry for the VLAN concerned, in which the Registrar Administrative Control value is Normal Registration.

On receipt of a MAD_Leave.indication whose attribute_type is equal to the value of the VID Vector Attribute Type (11.2.3.1.6), the MVRP application element indicates the reception Port as not Registered in the Port Map of the Dynamic VLAN Registration Entry for the VID indicated by the attribute_value parameter. If no such entry exists, the indication is ignored.

11.2.3.2.3 Administrative controls

The provision of static control over the declaration or registration state of the state machines associated with the MVRP application is achieved by means of the Registrar Administrative Control parameters provided by MRP (10.7.2). These parameters are represented as Static VLAN Registration Entries in the Filtering

Database (8.8.2). Where management capability is implemented, these parameters can be manipulated by means of the management functionality defined in 12.7.

The provision of static control over the ability of Applicant state machines to participate in protocol exchanges is achieved by means of the Applicant Administrative Control parameters associated with the operation of MRP (10.7.3). Where management capability is implemented, the Applicant Administrative Control parameters can be applied and modified by means of the management functionality defined in 12.9.

Further administrative control over dynamic VLAN registration can be achieved, if supported, by means of a per-Port Restricted_VLAN_Registration control parameter. If the value of this control is TRUE for a given Port, the creation or modification of Dynamic VLAN Registration Entries as a result of MVRP exchanges on that Port shall be restricted only to those VLANs for which Static VLAN Registration Entries exist in which the Registrar Administrative Control value is Normal Registration. If the value of the Restricted_VLAN_Registration control is FALSE, dynamic VLAN registration is not so restricted. The recommended default value of this parameter is FALSE. Where management capability is implemented, the value of the Restricted_VLAN_Registration control can be manipulated by means of the management functionality defined in 12.10. If management of this parameter is not supported, the value of this parameter shall be FALSE for all Ports.

11.2.4 VID translation table

If a VID Translation Table (6.7) is in use for a Bridge Port, the VID values received in MVRP Attributes are translated on reception of MVRPDUs prior to MVRP processing as specified in this subclause (11.2), and translated after processing for encoding MVRP Attributes in transmitted MVRPDUs.

11.2.5 Use of “new” declaration capability

MVRP makes use of the “new” declaration capability in order to allow filtering database entries to be removed or rapidly aged out on a per-VLAN basis following a topology change in the network connectivity supporting the VLAN concerned. The rules for propagation of “new” declarations as defined in Clause 10 ensure that all MRP attribute declarations that originate from, or are propagated through, a bridge Port that has recently transitioned to Forwarding are marked as “new” declarations.

When any MVRP declaration marked as “new” is received on a given Port, either as a result of receiving an MVRPDU from the attached LAN (MAD_Join.indication), or as a result of receiving a request from MAP or the MVRP Application (MAD_Join.request), any entries in the filtering database for that Port and for the VLAN corresponding to the attribute value in the MAD_Join primitive are removed.

11.2.6 Attribute value support requirements

Implementations of MVRP shall be capable of supporting all attribute values in the range of possible values that can be registered using MVRP, and shall be capable of maintaining current state information for all attributes in the range of possible values.

12. Bridge Management

12.2 Managed objects

Change the first sentence in the second paragraph as follows:

The managed resources of a MAC Bridge are those of the Processes and Entities established in 8.3~~ of this standard and IEEE Std 802.1D, 12.2~~.

Change list items f) through h) as shown:

f) ~~GARP~~MRP ~~P~~participants (Clause 10~~12 of IEEE Std 802.1D~~);
g) ~~GVRP~~ MVRP participants (12.10, Clause 11);
h) ~~GMRP~~ MMRP participants (12.11, Clause 10~~10 of IEEE Std 802.1D~~);

Insert the following paragraph at the end of the subclause, following the NOTE:

Some data elements that are represented by the managed objects specified in this clause are required to be persistent across re-initializations or re-booting of the system within which the objects are implemented. For example, it may be desirable for changes in configuration parameters to persist across such events. Where such a requirement exists, this is indicated in the specification by marking the object concerned with the keyword *“Persistent”*.

12.3 Data types

Change list item h) as shown:

h) ~~GARP~~MRP Time Interval, an Unsigned value representing a positive integral number of centiseconds, for all ~~GARP~~MRP protocol timeout parameters.

12.7 The Filtering Database

Change list item d), as shown:

d) The ~~Group~~ MAC Address Registration Entries (12.7.4)

12.7.1.1.3 Outputs

Change list item g) as shown:

g) If Extended Filtering Services are supported, Number of ~~Group~~ MAC Address Registration Entries—the number of ~~Group~~ MAC Address Registration Entries (8.8.4) currently in the Filtering Database~~;~~.

Change the title of Subclause 12.7.4, as shown:

12.7.4 A ~~Group~~ MAC Address Registration Entry

Change the initial two paragraphs of 12.7.4, as shown:

A ~~Group~~ MAC Address Registration Entry object models the operations that can be performed on a single ~~Group~~ MAC Address Registration Entry in the Filtering Database. The set of ~~Group~~ MAC Address Registration Entry objects within the Filtering Database changes only as a result of ~~GARP~~MMRP protocol exchanges.

A ~~Group~~ MAC Address Registration Entry object supports the following operations:

12.7.5 A VLAN Registration Entry

Change the initial paragraph, as shown:

A VLAN Registration Entry object models the operations that can be performed on a single VLAN Registration Entry in the Filtering Database. The set of VLAN Registration Entry objects within the Filtering Database changes under management control and also as a result of ~~GARP~~MVRP protocol exchanges.

12.7.7.3.1 Purpose

Change the text of 12.7.7.3.1 as shown:

To read a Filtering Entry, ~~Group~~ MAC Address Registration Entry, or VLAN Registration Entry from the Filtering or Permanent Databases.

Change subclause 12.9 and its subclauses, as shown:

12.9 ~~GARP~~MRP Entities

The operation of ~~GARP~~MRP is described in Clause 10~~12 of IEEE Std 802.1D~~.

The objects that comprise this managed resource are

a) The ~~GARP~~MRP Timer objects (12.9.1)~~;~~.
b) The ~~GARP~~MRP Attribute Type objects (12.9.2)~~;~~.
c) The ~~GARP~~MRP state machine objects (12.9.3).
d) The Periodic state machine objects (12.9.4).

12.9.1 The ~~GARP~~MRP Timer object

The ~~GARP~~MRP Timer object models the operations that can be performed upon, or inquire about, the current settings of the timers used by the ~~GARP~~MRP protocol on a given Port. The management operations that can be performed on the ~~GARP~~MRP Participant are

a) Read ~~GARP~~MRP Timers (12.9.1.1)~~;~~.
b) Set ~~GARP~~MRP Timers (12.9.1.2).

NOTE—The ~~GARP~~MRP timer values modeled by this object are the values used to initialize timer instances that are used within the ~~GARP~~MRP state machines, not the timer instances themselves. Hence, there is a single ~~GARP~~MRP Timer object per Port, regardless of whether the Bridge supports single or multiple spanning trees.

12.9.1.1 Read ~~GARP~~MRP Timers

12.9.1.1.1 Purpose

To read the current ~~GARP~~MRP Timers for a given Port.

12.9.1.1.2 Inputs

a) The Port identifier.

12.9.1.1.3 Outputs

a) Current value of JoinTime—Centiseconds, *Persistent*. (10.7.4.1 and 10.7.11~~12.10.2.1 and 12.12.1 of IEEE Std 802.1D~~);.
b) Current value of LeaveTime—Centiseconds, *Persistent*. (10.7.4.2 and 10.7.11~~12.10.2.2 and 12.12.1 of IEEE Std 802.1D~~);.
c) Current value of LeaveAllTime—Centiseconds, *Persistent*. (10.7.4.3 and 10.7.11~~12.10.2.3 and 12.12.1 of IEEE Std 802.1D~~).

12.9.1.2 Set ~~GARP~~MRP Timers

12.9.1.2.1 Purpose

To set new values for the ~~GARP~~MRP Timers for a given Port.

12.9.1.2.2 Inputs

a) The Port identifier;.
b) New value of JoinTime—Centiseconds (10.7.4.1 and 10.7.11~~12.10.2.1 and 12.12.1 of IEEE Std 802.1D~~);.
c) New value of LeaveTime—Centiseconds (10.7.4.2 and 10.7.11~~12.10.2.2 and 12.12.1 of IEEE Std 802.1D~~);.
d) New value of LeaveAllTime—Centiseconds (10.7.4.3 and 10.7.11~~12.10.2.3 and 12.12.1 of IEEE Std 802.1D~~).

12.9.1.2.3 Outputs

None.

12.9.2 The ~~GARP~~MRP Attribute Type object

The ~~GARP~~MRP Attribute Type object models the operations that can be performed upon, or inquire about, the operation of ~~GARP~~MRP for a given Attribute Type (10.8.2.2~~12.10.2.1 and 12.12.1 of IEEE Std 802.1D~~). The management operations that can be performed on a ~~GARP~~MRP Attribute Type are

a) Read ~~GARP~~MRP Applicant Controls (12.9.2.1);.
b) Set ~~GARP~~MRP Applicant Controls (12.9.2.2).

12.9.2.1 Read ~~GARP~~MRP Applicant Controls

12.9.2.1.1 Purpose

To read the current values of the ~~GARP~~MRP Applicant Administrative control parameters (10.7.3~~12.9.2 of IEEE Std 802.1D~~) associated with all ~~GARP~~MRP Participants for a given Port, ~~GARP~~MRP Application and Attribute Type.

12.9.2.1.2 Inputs

a) The Port identifier;.
b) The ~~GARP~~MRP Application address (Table 10-1~~Table 12-1 of IEEE Std 802.1D~~);.
c) The Attribute Type (10.8.2.2~~12.11.2.5 of IEEE Std 802.1D~~).

12.9.2.1.3 Outputs

a) The current Applicant Administrative Control Value, *Persistent*. (10.7.3~~12.9.2 of IEEE Std 802.1D~~)~~;~~.
b) Failed Registrations—Count of the number of times that this ~~GARP~~MRP Application has failed to register an attribute of this type due to lack of space in the Filtering Database, *Persistent*. (12.10.1.6).

12.9.2.2 Set ~~GARP~~MRP Applicant Controls

12.9.2.2.1 Purpose

To set new values for the ~~GARP~~MRP Applicant Administrative control parameters (10.7.3~~12.9.2 of IEEE Std 802.1D~~) associated with all ~~GARP~~MRP Participants for a given Port, ~~GARP~~MRP Application and Attribute Type.

12.9.2.2.2 Inputs

a) The Port identifier~~;~~.
b) The ~~GARP~~MRP Application address (Table 10-1~~Table 12-1 of IEEE Std 802.1D~~)~~;~~.
c) The Attribute Type (10.8.2.2~~12.11.2.5 of IEEE Std 802.1D~~) associated with the state machine~~;~~.
d) The desired Applicant Administrative Control Value (10.7.3~~12.9.2 of IEEE Std 802.1D~~).

12.9.2.2.3 Outputs

None.

12.9.3 The ~~GARP~~MRP state machine object

The ~~GARP~~MRP state machine object models the operations that can be performed upon, or inquire about, the operation of ~~GARP~~MRP for a given state machine.

The management operation that can be performed on a ~~GARP~~MRP state machine is Read ~~GARP~~MRP State.

12.9.3.1 Read ~~GARP~~MRP State

12.9.3.1.1 Purpose

To read the current value of an instance of a ~~GARP~~MRP state machine.

12.9.3.1.2 Inputs

a) The Port identifier~~;~~.
b) The ~~GARP~~MRP Application address (Table 10-1~~Table 12-1 of IEEE Std 802.1D~~)~~;~~.
c) The ~~GIP~~MAP Context (10.3.1~~12.3.4 of IEEE Std 802.1D~~)~~;~~.
d) The Attribute Type (10.8.2.2~~12.11.2.2 of IEEE Std 802.1D~~) associated with the state machine~~;~~.
e) The Attribute Value (10.8.2.5~~12.11.2.6 of IEEE Std 802.1D~~) associated with the state machine.

12.9.3.1.3 Outputs

a) Applicant state—the value of the current state ~~value~~ of the ~~combined~~ Applicant ~~and Registrar~~ state machine for the attribute (Table 10-3~~Table 12-6 of IEEE Std 802.1D~~)~~;~~.
b) Registrar state—the value of the current state of the Registrar state machine for the attribute (Table 10-4).

c) Optionally, Originator address—the MAC Address of the originator of the most recent ~~GARP PDU~~ MRPDU that was responsible for causing a state change in this state machine (10.8~~12.9.1 of IEEE Std 802.1D~~).

12.9.4 Periodic state machine objects

The Periodic state machine object models the operations that can be performed upon, or inquire about, the operation of the Periodic state machine for a given Port.

The management operations that can be performed on a Periodic state machine are Read Periodic state machine State and Set Periodic state machine state.

12.9.4.1 Read Periodic state machine state

12.9.4.1.1 Purpose

To enquire whether a particular Periodic state machine is enabled or disabled.

12.9.4.1.2 Inputs

a) The Port identifier.

12.9.4.1.3 Outputs

a) The Port identifier.
b) The state of the Periodic state machine. This can take either of the values “enabled” or “disabled”.

12.9.4.2 Set Periodic state machine state

12.9.4.2.1 Purpose

To enable or disable a particular Periodic state machine.

12.9.4.2.2 Inputs

a) The Port identifier.
b) The desired state of the Periodic state machine. This can take either of the values “enabled” or “disabled”.

12.9.4.2.3 Outputs

None.

12.10 Bridge VLAN managed objects

12.10.1 Bridge VLAN Configuration managed object

12.10.1.6 Notify VLAN registration failure

12.10.1.6.1 Purpose

Change the initial paragraph as shown:

To notify a manager that ~~GVRP~~MVRP (11.2.3) has failed to register a given VLAN owing to lack of resources in the Filtering Database for the creation of a Dynamic VLAN Registration Entry (8.8.5), or owing to the Restricted_VLAN_Registration parameter being set to TRUE.

12.10.1.6.3 Outputs

Change the initial list item as shown:

a) The VID of the VLAN that ~~GVRP~~MVRP failed to register;

12.10.3 The VLAN Learning Constraints managed object

12.10.3.10 Notify Learning Constraint Violation

12.10.3.10.1 Purpose

Change the NOTE as follows:

NOTE—As indicated in 8.8.7.3, a single change in configuration, such as the registration of a new VID by ~~GVRP~~MVRP or the addition of a new learning constraint, can give rise to more than one violation being notified, depending upon the set of learning constraints currently configured in the Bridge.

Change subclause 12.11 and its subclauses as shown:

12.11 ~~GMRP~~MMRP entities

The following managed objects define the semantics of the management operations that can be performed upon the operation of ~~GMRP~~MMRP in a Bridge:

a) The ~~GMRP~~MMRP Configuration managed object (12.10.1).

12.11.1 ~~GMRP~~MMRP Configuration managed object

The ~~GMRP~~MMRP Configuration managed object models operations that modify, or enquire about, the overall configuration of the operation of ~~GMRP~~MMRP. There is a single ~~GMRP~~MMRP Configuration managed object per Bridge.

The management operations that can be performed on the ~~GMRP~~MMRP Configuration managed object are as follows:

a) Read ~~GMRP~~MMRP Configuration (12.11.1.1)~~;~~.
b) Notify ~~Group~~ MAC Address registration failure (12.11.1.2)~~;~~.
c) Configure Restricted_~~Group~~MAC_Address_Registration parameters (12.11.1.3).

12.11.1.1 Read ~~GMRP~~MMRP Configuration

12.11.1.1.1 Purpose

To obtain general ~~GMRP~~MMRP configuration information from a Bridge.

12.11.1.1.2 Inputs

None.

12.11.1.1.3 Outputs

a) For each Port:
   1) The Port number~~;~~.
   2) The state of the Restricted_~~Group~~MAC_Address_Registration parameter, *Persistent*. (10.12.2.3~~10.3.2.3 in IEEE Std 802.1D~~), TRUE or FALSE.

12.11.1.2 Notify ~~Group~~ MAC address registration failure

12.11.1.2.1 Purpose

To notify a manager that ~~GMRP~~MMRP has failed to register a given ~~Group~~ MAC Address owing either to lack of resources in the Filtering Database for the creation of a ~~Group~~ MAC Address Registration Entry (8.8.4) or to the Restricted_MAC_Address_Registration parameter.

12.11.1.2.2 Inputs

None.

12.11.1.2.3 Outputs

a) The MAC address ~~of the Group~~ that ~~GMRP~~MMRP failed to register;
b) The Port number of the Port on which the registration request was received.
c) The reason for the failure:
   1) Lack of Resources; or
   2) Registration Restricted.

12.11.1.3 Configure Restricted_~~Group~~MAC_Address_Registration parameters

12.11.1.3.1 Purpose

To configure the Restricted_~~Group~~MAC_Address_Registration parameter (10.12.2.3~~10.3.2.3 in IEEE Std 802.1D~~) associated with one or more Ports.

12.11.1.3.2 Inputs

a) For each Port to be configured, a Port number and the value of the Restricted_~~Group~~MAC_Address_Registration parameter. The permissible values of this parameter are (as defined in 10.12.2.3~~10.3.2.3 in IEEE Std 802.1D~~) ~~as follows~~:
   1) TRUE;
   2) FALSE.

12.11.1.3.3 Outputs

None.

13. The Multiple Spanning Tree Protocol (MSTP)

Change NOTE 2 as shown:

NOTE 2—Although the active topology determined by STP, RSTP, and MSTP fully connects the components of a Bridged Local Area Network, filtering (~~GVRP~~MVRP etc.) can restrict frames to a subset of the active topology where some VLANs are not present throughout.

13.21 State machine timers

Change the first sentence as shown:

~~Each of the state machine timers are as specified in 17.17 of IEEE Std 802.1D.~~The following state machine timers are as specified in 17.17 of IEEE Std 802.1D.

Insert the following text after item h)

The following state machine timer is additional to those specified in 17.17 of IEEE Std 802.1D. One instance per-Port shall be implemented for the CIST and one per-Port for each MSTI.

i) tcDetected. The Topology Change timer for MRP application usage. New messages are sent while this timer is running (see 10.2).

13.24 Per-Port variables

Change list item s) and the following NOTE, and insert NOTE 2, as shown:

s) fdbFlush. A Boolean. Set by the topology change state machine to instruct the filtering database to remove entries for this Port, immediately if rstpVersion (17.20.9 of IEEE Std 802.1D) is TRUE, or by rapid ageing (17.19.1 of IEEE Std 802.1D) if stpVersion (17.20.10 of IEEE Std 802.1D) is TRUE. Reset by the filtering database once the entries are removed if rstpVersion is TRUE, and immediately if stpVersion is TRUE. ~~In addition to the definition of fdbFlush contained in IEEE Std 802.1D, setting~~ Setting the fdbFlush variable does not result in ~~flushing~~ removal of filtering database entries in the case that the Port is an Edge Port (i.e., operEdge is TRUE). The filtering database removes entries only for those VLANs that have a fixed registration (see 10.7.2) on any Port of the Bridge that is not an Edge Port.

NOTE 1—It will be necessary to update the definition of this variable in a future revision of IEEE Std 802.1D to reflect this ~~additional constraint~~revised definition.

NOTE 2—If MVRP is in use, the topology change notification and flushing mechanisms defined in MRP (Clause 10) and MVRP (11.2.5) are responsible for filtering entries in the Filtering Database for VLANs that are dynamically registered using MVRP (i.e., for which there is no fixed registration in the Bridge on non-Edge Ports).

13.26 State machine procedures

Insert the following text and list item before the last paragraph of 13.26:

The following procedures are not described in IEEE Std 802.1D:

ae) newTcDetected()

Insert a new subclause 13.26.5, re-numbering the existing subclause 13.26.5 and subsequent subclauses accordingly:

13.26.5 newTcDetected()

If the value of tcDetected is zero and sendRSTP is TRUE, this procedure sets the value of tcDetected to HelloTime plus one second. The value of HelloTime is taken from the CIST's portTimes parameter (13.24.13) for this Port.

If the value of tcDetected is zero and sendRSTP is FALSE, this procedure sets the value of tcDetected to the sum of the Max Age and Forward Delay components of rootTimes.

Otherwise the procedure takes no action.

Change 13.36 and Figure 13-21 as shown:

13.36 Topology Change state machine

The Topology Change state machine for each tree shall implement the function specified by the state diagram contained in Figure 13-21 and the attendant definitions contained in 13.21 through 13.26.

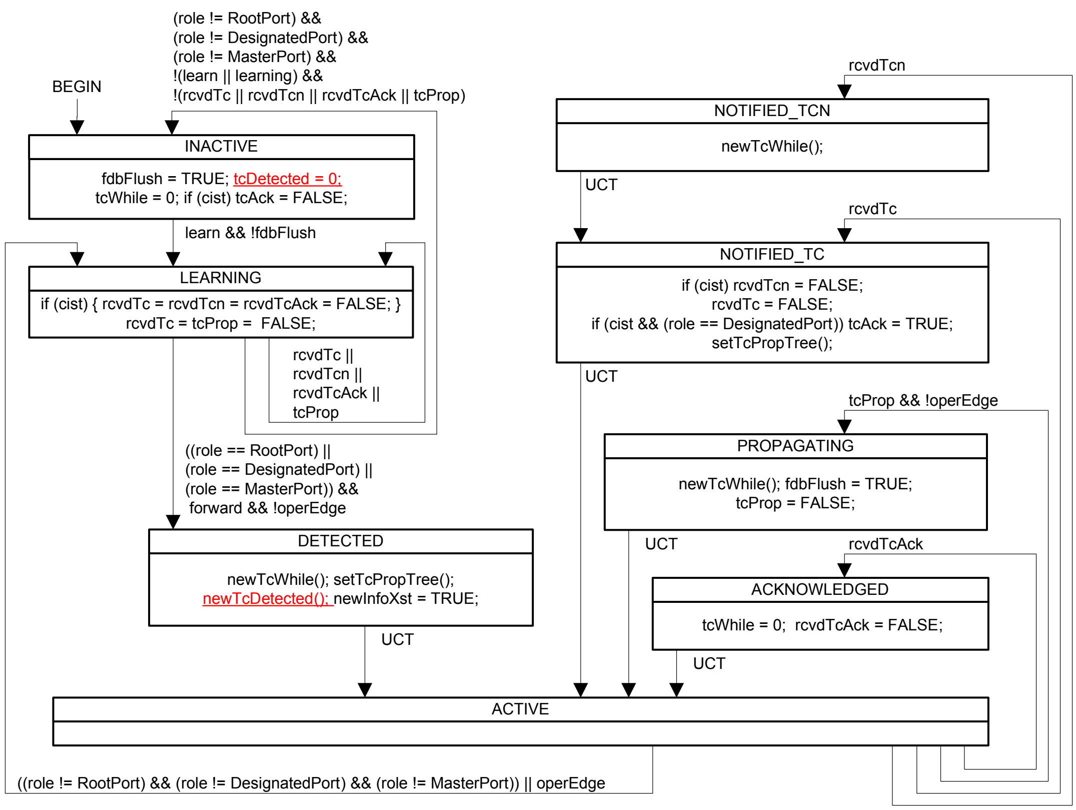

Figure 13-21—Topology Change state machine

NOTE—The variable tcDetected maintained by this state machine is used by the topology change mechanisms in MRP (Clause 10).

Insert a new Clause 17 heading and NOTE as shown:

17. Management protocol

NOTE—At the time of publication of this standard, MIB modules for management of various aspects of VLAN Bridge operation, including object definitions for MRP, MMRP, and MVRP were under development as part of project P802.1ap.

Annex A

(normative)

PICS proforma—Bridge implementations[6]

A.3.4.1 Conditional items

Change the third paragraph of A.3.4.1 as shown:

A conditional symbol is of the form "**pred:** S" where **pred** is a predicate as described in A.3.4.2 below, and S is a status symbol, M or ~~θ~~O.

Change the heading for A.4 as shown:

A.4 PICS proforma for IEEE Std 802.1Q—Bridge implementations

Change the table in A.5 as shown:

A.5 Major capabilities

Item	Feature	Status	References	Support
	If the implementation is an end station implementation, mark "N/A" and continue at Annex I.			N/A [ ]
MAC	Do the implementations of MAC Technologies and support of the MAC Internal Sublayer Service conform to MAC standards as specified in 6.4 and 6.5? (If support of a specific MAC technology is claimed any PICS Proforma(s) required by the Standard specifying that technology shall also be completed.)	M	A.6 6.4, 6.5, {D}6.4, {D}6.5.	Yes [ ]
LLC	Is a class of LLC supporting Type 1 operations supported on all Bridge Ports in conformance with IEEE Std 802.2? (The PICS Proforma required by IEEE Std 802.2 shall also be completed.)	M	8.2, 8.3, 8.13, {D}7.2, {D}7.3, {D}7.12. IEEE Std 802.2	Yes [ ]
RLY	Does the implementation relay and filter frames as specified?	M	8.5, 8.6, 8.7, 6.8, 8.8, A.7 {D}7.2, {D}7.5, {D}7.6, {D}7.7.	Yes [ ]
BFS	Does the implementation maintain the information required to make frame filtering decisions and support Basic Filtering Services?	M	A.8 {D}7.1, {D}7.5, {D}7.8, {D}7.9.	Yes [ ]
ADDR	Does the implementation conform to the provisions for addressing?	M	A.9 {D}7.12	Yes [ ]

[6]*Copyright release for PICS proformas:* Users of this standard may freely reproduce the PICS proforma in this annex so that it can be used for its intended purpose and may further publish the completed PICS.

A.5 Major capabilities *(continued)*

Item	Feature	Status	References	Support
RSTP	Is the Rapid Spanning Tree Protocol implemented?	O.1	5, A.10, {D}9, {D}17	Yes [ ]
BPDU	Are transmitted BPDUs encoded and received BPDUs validated as specified?	M	A.11 {D}9, {D}17.21.19, {D}17.21.20, {D}17.21.21.	Yes [ ]
IMP	Are the required implementation parameters included in this completed PICS?	M	A.12 {D}7.9	Yes [ ]
PERF	Are the required performance parameters included in this completed PICS? (Operation of the Bridge within the specified parameters shall not violate any of the other conformance provisions of this standard.)	M	A.13 {D}16	Yes [ ]
MGT	Is management of the Bridge supported?	O	A.14 {D}14	Yes [ ] No [ ]
RMGT	Is a remote management protocol supported?	MGT:O	A.15 {D}5.2	Yes [ ] No [ ]
TC	Are multiple Traffic Classes supported for relaying frames?	O	A.16 {D}7.7.3, {D}7.7.4.	Yes [ ] No [ ]
EFS	Are Extended Filtering Services supported for relaying and filtering frames?	O	A.17 ~~{D}7.12~~ 6.12	Yes [ ] No [ ]
~~GMRP~~	~~Is the GARP Multicast Registration Protocol (GMRP) implemented?~~	~~EFS:M~~	~~A.18 {D}10~~	~~Yes [ ]~~ ~~N/A[ ]~~
~~GARP~~	~~Is the Generic Attribute Registration Protocol (GARP) implemented in support of the GMRP Application?~~	~~M~~	~~{D}12 A.19~~	~~Yes [ ]~~
MMRP	Is the operation of the Multiple MAC Registration Protocol (MMRP) supported?	EFS:M	5.4.1, A.20	Yes [ ] No [ ]
VLAN	Does the implementation support the ability to insert tag headers into, modify tag headers in, and remove tag headers from relayed frames?	M	5.4, 6.1, 6.6, 6.7, 8.6, 6.8, 9	Yes [ ]
VTR	Does the implementation support a VLAN translation table?	O	6.7	Yes [ ] No [ ]
~~GVRP~~	~~Does the implementation support the ability to perform automatic configuration and management of VLAN topology information by means of GVRP on all Ports?~~	~~M~~	~~5.4, 11, A.22~~	~~Yes [ ]~~
MVRP	Is automatic configuration and management of VLAN topology using MVRP supported?	M	5.4, A.21	Yes [ ]

A.5 Major capabilities *(continued)*

Item	Feature	Status	References	Support
MRP	Is the Multiple Attribute Registration Protocol (MRP) implemented in support of MRP Applications?	MMRP:M MVRP:M	10 A.20, A.21, A.22	Yes [ ]
MRP1	Does the MRP implementation support operation of the Full Participant?	MRP:O.1	10 A.22	Yes [ ] No [ ]
MRP2	Does the MRP implementation support operation of the Full Participant, point-to-point subset?	MRP:O.1	10 A.22	Yes [ ] No [ ]
MSTP	Is the Multiple Spanning Tree protocol implemented?	O.1	5, 7, 8.4, 8.6.1, 8.8.7, 8.9, 8.10, 8.13.7, 11.2.3.4, 11.3.1, 13, 14, ~~A.20~~A.18	Yes [ ] No [ ]
VMGT	Does the implementation support VLAN management operations?	MGT:O	5.4.1, 12.10.2, 12.10.3	Yes [ ] No [ ]
CB	Can the Bridge be configured to operate as a C-VLAN Bridge, recognizing and using C-TAGs?	O.2	5.7	Yes [ ]
PB	Can the Bridge be configured to operate as a Provider Bridge, recognizing and using S-TAGs?	O.2	5.8	Yes [ ]
PEB	Can the Bridge be configured to operate as a Provider Edge Bridge with one or more Ports operating as a Customer Edge Ports?	PB:O	5.8.2	Yes [ ]
PB-2	State which Ports support the following values for the Provider Bridge Port Type: — Provider Network Port; — Customer Network Port; — Customer Edge Port.	PB:M	5.8	 Ports: _____ Ports: _____ Ports: _____

Change the table in A.17 as shown:

A.17 Extended Filtering Services

Item	Feature	Status	References	Support
EFS-1	Can Group Registration Entries be created, updated and removed from the Filtering Database by ~~GMRP~~MMRP?	EFS:M	8.8, 8.8.4, 10~~,~~ ~~{D}10~~	Yes [ ] N/A[ ] ~~N/A[ ]~~
EFS-2	Can a Static Filtering Entry be created with an address specification that represents a Group Address, or All Group Addresses, or All Unregistered Group Addresses, and with a control element for each Port that specifies unconditional forwarding, or unconditional filtering, or the use of dynamic or default group filtering information?	EFS:M	8.8.2	Yes [ ] N/A[ ] ~~N/A[ ]~~
EFS-3	Can a Static Filtering Entry be created with an address specification that represents an Individual Address and with a control element for each Port that specifies unconditional forwarding, or unconditional filtering?	M	8.8.2	Yes [ ]
EFS-4	Can a Static Filtering Entry be created with an address specification that represents an Individual Address and with a control element for each Port that specifies unconditional forwarding, or unconditional filtering, or the use of dynamic filtering information?	EFS:O	8.8.2	Yes [ ] No [ ] ~~N/A[ ]~~ N/A[ ]

Delete A.18, A.19, and A.22, renumbering A.20 and A.21 as A.18 and A.19.

Insert new A.20 through A.22, as shown:

A.20 MMRP

Item	Feature	Status	References	Support
	If MMRP is not supported, mark N/A and continue at A.21			N/A [ ]
MMRP1	Does the implementation support the exchange of MMRPDUs, using the generic MRPDU format defined in 10.8 to exchange MMRP-specific information, as defined in 10.12?	M	5.4.1.3, 10.8, 10.12	Yes [ ]
MMRP2	Is the MMRP Application supported as defined in 10.12?	M	5.4.1.3, 10.12	Yes [ ]
MMRP3	Does the implementation propagate registration information in accordance with the operation of MAP for the Base Spanning Tree Context, as specified in 10.3.1?	M	5.4.1.3, 10.3.1	Yes [ ]
MMRP4	Does the implementation forward, filter, or discard MAC frames carrying any MRP Application address as the destination MAC address in accordance with the requirements of 8.13.6?	M	5.4.1.3, 8.13.6	Yes [ ]
MMRP5	Is the MAP Context Identifier used to identify a VLAN Context equal to the VID used to identify the corresponding VLAN?	M	10.12.1.1	Yes [ ]

A.20 MMRP *(continued)*

Item	Feature	Status	References	Support
MMRP6	Is the set of Ports of a Bridge defined to be part of the active topology for a given VLAN Context as specified in 10.12.1.1?	M	10.12.1.1	Yes [ ]
MMRP7	Is the group MAC address used as the destination address for MRPDUs destined for MMRP Participants the group MAC address identified in Table 10-1 as “Customer and Provider Bridge MMRP address”?	M	10.12.1.3	Yes [ ]
MMRP8	Is the EtherType used for MRPDUs destined for MMRP Participants the MMRP EtherType identified in Table 10-2?	M	10.12.1.4, Table 10-2	Yes [ ]
MMRP9	Does the ProtocolVersion used for the implementation of MMRP take the hexadecimal value 0x00?	M	10.12.1.5	Yes [ ]
MMRP10	Are the Attribute Type values used in the implementation as specified in 10.12.1.6?	M	10.12.1.6	Yes [ ]
MMRP11	Does the implementation encode the values in FirstValue fields in accordance with the definition in 10.12.1.7?	M	10.12.1.7	Yes [ ]
MMRP12	Is management of the Restricted_MAC_Address_Registration control parameter supported?	O	10.12.2	Yes [ ] No [ ]
MMRP13	If management of the Restricted_MAC_Address_Registration control parameter is not supported, is the value of this parameter FALSE for all Ports?	¬MMRP12:M	10.12.2	Yes [ ] N/A [ ]
MMRP14	Does the implementations maintain state information for all attribute values that support the Group service requirement registration?	M	10.10.2	Yes [ ]
MMRP15	Is the implementation capable of supporting any attribute value in the range of possible values that can be registered using Group membership and individual MAC address registration?	M	10.12.4	Yes [ ]
MMRP16	State the number of Group membership and individual MAC address state values that can be supported on each Port.	M	10.12.4	Number______

A.21 MVRP

Item	Feature	Status	References	Support
	If MVRP is not supported, mark N/A and continue at A.22			N/A [ ]
MVRP1	Does the implementation support the exchange of MMRPDUs, using the generic MRPDU format defined in 11.2 to exchange MMRP-specific information, as defined in 10.12?	M	5.4.2, 10.8, 11.2	Yes [ ]
MVRP2	Is the MMRP Application supported as defined in 11.2?	M	5.4.2, 11.2	Yes [ ]
MVRP3	Does the implementation propagate registration information in an MST Bridge, in accordance with the operation of MAP for multiple Spanning Tree Contexts, as specified in 11.2.3.1.2?	MSTP:M	5.4.2, 11.2.3.1.2	Yes [ ] N/A [ ]
MVRP4	Does the implementation propagate registration information in an SST Bridge, in accordance with the operation of MAP for the Base Spanning Tree Context, as specified in 10.3.1?	¬MSTP:M	5.4.2, 10.3.1	Yes [ ] N/A [ ]

A.21 MVRP *(continued)*

Item	Feature	Status	References	Support
MVRP5	Does the implementation forward, filter or discard MAC frames carrying any MRP Application address as the destination MAC address in accordance with the requirements of 8.13.6?	M	5.4.2, 8.13.6	Yes [ ]
MVRP6	If a VID translation table is in use, does the implementation translate VIDs in MVRPDUs as specified in 11.2.4?	VTR:M	11.2.4	Yes [ ]
MVRP7	Is the group MAC address used as the destination address for MRPDUs destined for MVRP Participants as defined in 11.2.3.1.3?	M	11.2.3.1.3	Yes [ ]
MVRP8	Is the EtherType used for MRPDUs destined for MVRP Participants the MVRP EtherType identified in Table 10-2?	M	11.2.3.1.4, Table 10-2	Yes [ ]
MVRP9	Does the ProtocolVersion used for the implementation of MVRP take the hexadecimal value 0x00?	M	11.2.3.1.5	Yes [ ]
MVRP10	Are the Attribute Type values used in the implementation as specified in 11.2.3.1.6?	M	11.2.3.1.6	Yes [ ]
MVRP11	Does the implementation encode the values in FirstValue fields in accordance with the definition in 11.2.3.1.7?	M	11.2.3.1.7	Yes [ ]
MVRP12	Is the implementation of MVRP capable of supporting all attribute values in the range of possible values that can be registered using MVRP?	M	11.2.6	Yes [ ]
MVRP13	Is the implementation capable of maintaining current state information for all attributes in the range of possible values?	M	11.2.6	Yes [ ]

A.22 MRP

Item	Feature	Status	References	Support
MRP3	Does the implementation of MRP meet all of the requirements for interoperability stated in 10.5 that apply to Bridge operation?	M	10.5	Yes [ ]
MRP4	Does the implementation support the operation of the complete Applicant state machine?	MRP1:M	10.7, 10.7.7	Yes [ ] N/A [ ]
MRP5	Does the implementation support the operation of the point-to-point subset of the Applicant state machine?	MRP2:M	10.7, 10.7.7	Yes [ ] N/A [ ]
MRP6	Does the implementation support the operation of the Registrar state machine?	M	10.7, 10.7.8	Yes [ ]
MRP7	Does the implementation support the operation of the LeaveAll state machine?	M	10.7, 10.7.9	Yes [ ]
MRP8	Does the implementation support the operation of the PeriodicTransmission state machine?	M	10.7, 10.7.10	Yes [ ]

Annex E

(informative)

Interoperability considerations

Change E.5, its title and content, as shown:

E.5 Heterogeneous networks: ~~intermixing 802.1Q Bridges with IEEE Std 802.1D Bridges~~GARP and MRP issues

E.5.1 GMRP/MMRP: Intermixing IEEE 802.1Q Bridges with IEEE 802.1D Bridges

The specification in this standard for the use of ~~GMRP~~MMRP in VLANs (10.9~~10.2~~) makes use of VLAN-tagged frames to signal the ~~GIP~~MAP Context that applies to the registration information carried in ~~GMRP PDUs~~ MMRPDUs. ~~Devices~~ IEEE Std 802.1D has not been updated to replace GARP with MRP[7]; however, such support would necessarily involve the IEEE 802.1D Bridge transmitting MMRP frames untagged, as an IEEE 802.1D Bridge neither generates nor decodes IEEE 802.1Q tag headers. IEEE 802.1D Bridges that implement ~~GMRP~~MMRP as specified in ~~IEEE Std 802.1D~~Clause 10 will therefore regard ~~such~~ tagged MMRP frames as badly formed~~ GMRP frames~~, and will ~~therefore~~ discard them on receipt. Using an IEEE 802.1D Bridge to interconnect two or more LAN regions containing IEEE 802.1Q devices that implement ~~GMRP~~MMRP will therefore prevent ~~GMRP~~MMRP attribute propagation between the IEEE 802.1Q regions, with attendant effects upon the forwarding behavior of both the IEEE 802.1D and IEEE 802.1Q Bridges in the LAN. This configuration can be made to work if the IEEE ~~Std~~ 802.1D Bridge is statically configured with the following:

a) An All Groups entry in the Filtering Database, specifying Registration Fixed on all Ports, and
b) The ~~GMRP~~MMRP Protocol Administrative Control parameters set to disable ~~GMRP~~MMRP on all Ports.

As the Bridge no longer supports the ~~GMRP~~MMRP application, it will forward ~~GMRP PDUs~~ MMRPDUs on all Ports that are in Forwarding. The effect of this is to configure the IEEE ~~Std~~ 802.1D Bridge to behave in the same manner as an ISO/IEC 10038 Bridge.

Placing IEEE 802.1D Bridges around the periphery of an IEEE 802.1Q-based network works correctly, as long as, for a given IEEE 802.1D Bridge, the IEEE 802.1Q Bridges connected to the same segment(s) are configured to untag any VLANs that are relevant to the ~~GMRP~~MMRP operation of the IEEE 802.1D Bridge. The IEEE 802.1D Bridge generates untagged ~~GMRP~~MMRP frames, which the IEEE 802.1Q Bridges classify according to the value of the PVID for the reception Port; in a simple configuration of the IEEE 802.1Q Bridges, the Ports that connect to the IEEE 802.1D Bridge are configured for the PVID VLAN to be untagged on egress.

NOTE 1—There may be situations where more complex configurations are required, in which VLANs other than the PVID are configured untagged in order to maintain the correct IEEE ~~Std~~ 802.1D Bridge filtering behavior.

NOTE 2—For bridges that make VLAN assignments on untagged frames according to Port-and-Protocol-based classification rules, special care is necessary in configuration: since ~~GMRP~~MMRP does not carry information about the particular protocol for which ~~the~~ Group membership is intended, it must be taken to apply to all protocols for which untagged traffic is carried on a particular link. Therefore, the VLAN indicated by a port's PVID is used to carry the

[7]It is anticipated that this will happen at some point in the future.

~~GMRP~~MMRP frames associated with all of the VLANs which are members of the VID Set of that Port; in addition, the PVID must be configured to egress untagged on any other bridge port where any of the set of VIDs also egresses untagged and requires ~~GMRP~~MMRP operation beyond that egress port.

The effect of this type of configuration is that all registrations propagated by a given IEEE ~~Std~~ 802.1D Bridge on a given (Port-based or Port-and-Protocol-based) VLAN are seen by all other IEEE 802.1D Bridges served by IEEE 802.1Q Bridges for which that VLAN is configured for untagged egress. The filtering behavior of the IEEE Std 802.1D Bridges is therefore governed only by the behavior of other devices (both IEEE 802.1D and IEEE 802.1Q) that are attached to the same VLAN.

E.5.2 Intermixing IEEE 802.1Q Bridges that implement MRP with IEEE 802.1Q Bridges that pre-date MRP

If IEEE 802.1Q Bridges that implement GARP, or were implemented prior to the existence of MRP, are intermixed with IEEE 802.1Q Bridges that implement MRP, then it must be assumed that the non-MRP Bridges will forward or filter MRP frames in accordance with the rules that apply to the group MAC addresses used for propagation of the following MRP frames:

a) MRP frames with a destination address defined in Table 10-1 will be forwarded by pre-MRP bridges.
b) MRP frames with a destination address defined in Table 8-1 will be filtered by all bridges.
c) MRP frames with any other destination address will be forwarded or filtered in accordance with the state of the filtering database in the bridge concerned.

In the case of MVRP information propagation in Provider Bridges, this leads to some consequences:

d) Any Customer Bridge that is placed within a network of Provider Bridges will not forward MVRP frames generated by the Provider Bridges; propagation of MVRP information through the network of Provider Bridges will therefore be incorrect.
e) Any Provider Bridge that does not implement MRP that is placed within a network of Provider Bridges will forward MVRP frames as ordinary multicast data, but will not affect the information contained in those frames; propagation of MVRP information through the network of Provider Bridges may therefore be incorrect.

Insert new Annex I, as shown:

Annex I

(normative)

PICS proforma—End station implementations[8]

I.1 Introduction

The supplier of a protocol implementation which is claimed to conform to this standard shall complete the following Protocol Implementation Conformance Statement (PICS) proforma.

A completed PICS proforma is the PICS for the implementation in question. The PICS is a statement of which capabilities and options of the protocol have been implemented. The PICS can have a number of uses, including use

a) By the protocol implementor, as a checklist to reduce the risk of failure to conform to the standard through oversight.
b) By the supplier and acquirer—or potential acquirer—of the implementation, as a detailed indication of the capabilities of the implementation, stated relative to the common basis for understanding provided by the standard PICS proforma.
c) By the user—or potential user—of the implementation, as a basis for initially checking the possibility of interworking with another implementation (note that, while interworking can never be guaranteed, failure to interwork can often be predicted from incompatible PICSs).
d) By a protocol tester, as the basis for selecting appropriate tests against which to assess the claim for conformance of the implementation.

I.2 Abbreviations and special symbols

I.2.1 Status symbols

M	mandatory
O	optional
O.n	optional, but support of at least one of the group of options labeled by the same numeral n is required
X	prohibited
pred:	conditional-item symbol, including predicate identification: see I.3.4
¬	logical negation, applied to a conditional item's predicate

I.2.2 General abbreviations

N/A	not applicable
PICS	Protocol Implementation Conformance Statement

[8] *Copyright release for PICS proformas:* Users of this standard may freely reproduce the PICS proforma in this annex so that it can be used for its intended purpose and may further publish the completed PICS.

I.3 Instructions for completing the PICS proforma

I.3.1 General structure of the PICS proforma

The first part of the PICS proforma, implementation identification and protocol summary, is to be completed as indicated with the information necessary to identify fully both the supplier and the implementation.

The main part of the PICS proforma is a fixed-format questionnaire, divided into several subclauses, each containing a number of individual items. Answers to the questionnaire items are to be provided in the rightmost column, either by simply marking an answer to indicate a restricted choice (usually Yes or No), or by entering a value or a set or range of values. (Note that there are some items where two or more choices from a set of possible answers can apply; all relevant choices are to be marked.)

Each item is identified by an item reference in the first column. The second column contains the question to be answered; the third column records the status of the item—whether support is mandatory, optional, or conditional: see also I.3.4 below. The fourth column contains the reference or references to the material that specifies the item in the main body of this standard, and the fifth column provides the space for the answers.

A supplier may also provide (or be required to provide) further information, categorized as either Additional Information or Exception Information. When present, each kind of further information is to be provided in a further subclause of items labelled *Ai* or *Xi,* respectively, for cross-referencing purposes, where *i* is any unambiguous identification for the item (e.g., simply a numeral). There are no other restrictions on its format and presentation.

A completed PICS proforma, including any Additional Information and Exception Information, is the Protocol Implementation Conformation Statement for the implementation in question.

NOTE—Where an implementation is capable of being configured in more than one way, a single PICS may be able to describe all such configurations. However, the supplier has the choice of providing more than one PICS, each covering some subset of the implementation's configuration capabilities, in case that makes for easier and clearer presentation of the information.

I.3.2 Additional information

Items of Additional Information allow a supplier to provide further information intended to assist the interpretation of the PICS. It is not intended or expected that a large quantity will be supplied, and a PICS can be considered complete without any such information. Examples might be an outline of the ways in which a (single) implementation can be set up to operate in a variety of environments and configurations, or information about aspects of the implementation that are outside the scope of this standard but that have a bearing upon the answers to some items.

References to items of Additional Information may be entered next to any answer in the questionnaire, and may be included in items of Exception Information.

I.3.3 Exception information

It may occasionally happen that a supplier will wish to answer an item with mandatory status (after any conditions have been applied) in a way that conflicts with the indicated requirement. No pre-printed answer will be found in the Support column for this: instead, the supplier shall write the missing answer into the Support column, together with an *Xi* reference to an item of Exception Information, and shall provide the appropriate rationale in the Exception item itself.

An implementation for which an Exception item is required in this way does not conform to this standard.

NOTE—A possible reason for the situation described previously is that a defect in this standard has been reported, a correction for which is expected to change the requirement not met by the implementation.

I.3.4 Conditional status

I.3.4.1 Conditional items

The PICS proforma contains a number of conditional items. These are items for which both the applicability of the item itself, and its status if it does apply—mandatory or optional—are dependent upon whether or not certain other items are supported.

Where a group of items is subject to the same condition for applicability, a separate preliminary question about the condition appears at the head of the group, with an instruction to skip to a later point in the questionnaire if the "Not Applicable" answer is selected. Otherwise, individual conditional items are indicated by a conditional symbol in the Status column.

A conditional symbol is of the form "**pred:** S" where **pred** is a predicate as described in I.3.4.2 below, and S is a status symbol, M or O.

If the value of the predicate is true (see I.3.4.2), the conditional item is applicable, and its status is indicated by the status symbol following the predicate: the answer column is to be marked in the usual way. If the value of the predicate is false, the "Not Applicable" (N/A) answer is to be marked.

I.3.4.2 Predicates

A predicate is one of the following:

a) An item-reference for an item in the PICS proforma: the value of the predicate is true if the item is marked as supported, and is false otherwise.
b) A predicate-name, for a predicate defined as a Boolean expression constructed by combining item-references using the Boolean operator OR: the value of the predicate is true if one or more of the items is marked as supported.
c) The logical negation symbol "¬" prefixed to an item-reference or predicate-name: the value of the predicate is true if the value of the predicate formed by omitting the "¬" symbol is false, and vice versa.

Each item whose reference is used in a predicate or predicate definition, or in a preliminary question for grouped conditional items, is indicated by an asterisk in the Item column.

I.3.4.3 References to the text of IEEE Std 802.1D

Many of the tables in the PICS Proforma refer to the text of IEEE Std 802.1D (ANSI/IEEE Std 802.1D). A short form reference, of the form {D}X, is used in the "References" columns of these tables to denote references to clauses, subclauses or tables in IEEE Std 802.1D, where X is the clause, subclause or table identifier.

I.4 PICS proforma for IEEE Std 802.1Q—End station implementations

I.4.1 Implementation identification

Supplier	
Contact point for queries about the PICS	
Implementation Name(s) and Version(s)	
Other information necessary for full identification—e.g., name(s) and version(s) of machines and/or operating system names	

NOTE 1—Only the first three items are required for all implementations; other information may be completed as appropriate in meeting the requirement for full identification.

NOTE 2—The terms Name and Version should be interpreted appropriately to correspond with a supplier's terminology (e.g., Type, Series, Model).

I.4.2 Protocol summary, IEEE Std 802.1Q

Identification of protocol specification	IEEE Std 802.1Q-2005, IEEE Standards for Local and metropolitan area networks—Virtual Bridged Local Area Networks
Identification of amendments and corrigenda to the PICS proforma which have been completed as part of the PICS	Amd. : Corr. : Amd. : Corr. :
Have any Exception items been required? (See A.3.3: the answer Yes means that the implementation does not conform to IEEE Std 802.1Q)	No [ ] Yes [ ]

Date of Statement	

I.5 Major capabilities

Item	Feature	Status	References	Support
MMRP	Is the operation of MMRP supported?	O.1	5.9.1, I.6	Yes [ ] No [ ]
MVRP	Is automatic configuration and management of VLAN topology using MVRP supported?	O.1	5.9.1, I.7	Yes [ ] No [ ]
MRP	Is the Multiple Attribute Registration Protocol (MRP) implemented in support of MRP Applications?	M	10 I.6, I.7, I.8	Yes [ ]
SPRU	Does the implementation support Source Pruning?	EMRP:O	5.9, 10.10.3, 11.2.1.1	Yes[ ] No [ ]
MRP1	Does the MRP implementation support operation of the Full Participant?	SPRU:O.2 ¬SPRU:O.3	10 I.8	Yes [ ] No [ ]
MRP2	Does the MRP implementation support operation of the Full Participant, point-to-point subset?	SPRU:O.2 ¬SPRU:O.3	10 I.8	Yes [ ] No [ ]
MRP3	Does the MRP implementation support operation of the Applicant-Only Participant?	¬SPRU:O.3	10 I.8	Yes [ ] No [ ]
MRP4	Does the MRP implementation support operation of the Simple-Applicant Participant, point-to-point subset?	¬SPRU:O.3	10 I.8	Yes [ ] No [ ]

I.6 MMRP

Item	Feature	Status	References	Support
	If MMRP is not supported, mark N/A and continue at I.7			N/A [ ]
MMRP1	Does the implementation support the exchange of MMRPDUs, using the generic MRPDU format defined in 10.8 to exchange MMRP-specific information, as defined in 10.12,?	M	5.4.1.3, 10.8, 10.12	Yes [ ]
MMRP2	Is the MMRP Application supported as defined in 10.12?	M	5.4.1.3, 10.12	Yes [ ]
MMRP5	Is the MAP Context Identifier used to identify a VLAN Context equal to the VID used to identify the corresponding VLAN?	M	10.12.1.1	Yes [ ]
MMRP7	Is the group MAC address used as the destination address for MRPDUs destined for MMRP Participants the group MAC address identified in Table 10-1 as “Customer and Provider Bridge MMRP address”?	M	10.12.1.3	Yes [ ]
MMRP8	Is the EtherType used for MRPDUs destined for MMRP Participants the MMRP EtherType identified in Table 10-2?	M	10.12.1.4, Table 10-2	Yes [ ]

I.6 MMRP *(continued)*

Item	Feature	Status	References	Support
MMRP9	Does the ProtocolVersion used for the implementation of MMRP take the hexadecimal value 0x00?	M	10.12.1.5	Yes [ ]
MMRP10	Are the Attribute Type values used in the implementation as specified in 10.12.1.6?	M	10.12.1.6	Yes [ ]
MMRP11	Does the implementation encode the values in FirstValue fields in accordance with the definition in 10.12.1.7?	M	10.12.1.7	Yes []
MMRP12	Is management of the Restricted_MAC_Address_Registration control parameter supported?	O	10.12.2	Yes [ ] No [ ]
MMRP13	If management of the Restricted_MAC_Address_Registration control parameter is not supported, is the value of this parameter FALSE for all Ports?	¬MMRP12:M	10.12.2	Yes [ ] N/A [ ]
MMRP14	Does the implementations maintain state information for all attribute values that support the Group service requirement registration?	SPRU:M	10.10.2	Yes [ ] N/A [ ]
MMRP15	Is the implementation capable of supporting any attribute value in the range of possible values that can be registered using Group membership and individual MAC address registration?	M	10.12.4	Yes [ ]
MMRP16	State the number of Group membership and individual MAC address state values that can be supported on each Port.	M	10.12.4	Number______

I.7 MVRP

Item	Feature	Status	References	Support
	If MVRP is not supported, mark N/A and continue at I.8			N/A [ ]
MVRP1	Does the implementation support the exchange of MMRP-DUs, using the generic MRPDU format defined in 11.2 to exchange MMRP-specific information, as defined in 10.12,?	M	5.4.2, 10.8, 11.2	Yes [ ]
MVRP2	Is the MMRP Application supported as defined in 11.2?	M	5.4.2, 11.2	Yes [ ]
MVRP7	Is the group MAC address used as the destination address for MRPDUs destined for MVRP Participants as defined in 11.2.3.1.3?	M	11.2.3.1.3	Yes [ ]
MVRP8	Is the EtherType used for MRPDUs destined for MVRP Participants the MVRP EtherType identified in Table 10-2?	M	11.2.3.1.4, Table 10-2	Yes [ ]
MVRP9	Does the ProtocolVersion used for the implementation of MVRP take the hexadecimal value 0x00?	M	11.2.3.1.5	Yes [ ]
MVRP10	Are the Attribute Type values used in the implementation as specified in 11.2.3.1.6?	M	11.2.3.1.6	Yes [ ]
MVRP11	Does the implementation encode the values in FirstValue fields in accordance with the definition in 11.2.3.1.7?	M	11.2.3.1.7	Yes [ ]
MVRP12	Is the implementation of MVRP capable of supporting all attribute values in the range of possible values that can be registered using MVRP?	SPRU:M	11.2.6	Yes [ ] N/A [ ]
MVRP13	Is the implementation capable of maintaining current state information for all attributes in the range of possible values?	SPRU:M	11.2.6	Yes [ ] N/A [ ]

I.8 MRP

Item	Feature	Status	References	Support
MRP5	Does the implementation of MRP meet all of the requirements for interoperability stated in 10.5 that apply to end station operation?	M	10.5	Yes [ ]
MRP6	Does the implementation support the operation of the complete Applicant state machine?	MRP1:M	10.7, 10.7.7	Yes [ ] N/A [ ]
MRP7	Does the implementation support the operation of the point-to-point subset of the Applicant state machine?	MRP2:M	10.7, 10.7.7	Yes [ ] N/A [ ]
MRP8	Does the implementation support the operation of the Applicant-Only subset of the Applicant state machine?	MRP3:M	10.7, 10.7.7	Yes [ ] N/A [ ]
MRP9	Does the implementation support the operation of the Simple-Applicant subset of the Applicant state machine?	MRP4:M	10.7, 10.7.7	Yes [ ] N/A [ ]
MRP10	Does the implementation support the operation of the Registrar state machine?	MRP1:M MRP2:M	10.7, 10.7.8	Yes [ ] N/A [ ]
MRP11	Does the implementation support the operation of the LeaveAll state machine?	MRP1:M MRP2:M	10.7, 10.7.9	Yes [ ] N/A [ ]
MRP12	Does the implementation support the operation of the PeriodicTransmission state machine?	M	10.7, 10.7.10	Yes [ ]