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Part 1Q:
Bridges and bridged networks

AMENDMENT 2: YANG data model

Télécommunications et échange entre systèmes informatiques — Exigences pour les réseaux locaux et métropolitains —

Partie 1Q: Ponts et réseaux pontés

AMENDEMENT 2

Reference number
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IEEE Std 802.1Qcp™-2018
(Amendment to
IEEE Std 802.1Q™-2018)

IEEE Standard for
Local and metropolitan area networks—

Bridges and Bridged Networks—

Amendment 30: YANG Data Model

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Approved 14 June 2018

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Abstract: A YANG data model in support of configuration and operational status information for a subset of Bridging capabilities is provided in this amendment to IEEE Std 802.1Q™-2018.

Keywords: Bridged Local Area Networks, IEEE 802®, IEEE 802.1Q™, IEEE 802.1Qcp™, local area networks (LANs), MAC Bridges, metropolitan area networks, Virtual Bridged Local Area Networks (virtual LANs), YANG

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Introduction

This introduction is not part of IEEE Std 802.1Qcp-2018, IEEE Standard for Local and metropolitan area networks—Bridges and Bridged Networks—Amendment 30: YANG Data Model.

This amendment to IEEE Std 802.1Q-2018 specifies a YANG data model that provides configuration and operational status reporting for IEEE 802.1Q Two-Port MAC Relay, Customer VLAN Bridges, and Provider Bridges.

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

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IEEE Standard for
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Bridges and Bridged Networks—

Amendment 30: YANG Data Model

(This amendment is based on IEEE Std 802.1Q™-2018)

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

Editing instructions are shown in ***bold italic***. Four editing instructions are used: change, delete, insert, and replace. ***Change*** is used to make corrections in existing text or tables. The editing instruction specifies the location of the change and describes what is being changed by using ~~strikethrough~~ (to remove old material) and underscore (to add new material). ***Delete*** removes existing material. ***Insert*** adds new material without disturbing the existing material. Insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. ***Replace*** is used to make changes in figures or equations by removing the existing figure or equation and replacing it with a new one. Editing instructions, change markings, and this NOTE will not be carried over into future editions because the changes will be incorporated into the base standard.[1]

1. Overview

1.3 Introduction

Insert the following item after j) Defines SMIv2 (IETF STD 58) Management Information Based (MIB) modules for the management of VLAN Bridge capabilities including spanning tree protocols and Provider Bridges, renumbering as necessary:

k) Define YANG configuration and operational state models (Clause 48) in support of Two-Port MAC Relays, Customer VLAN Bridges, and Provider Bridges.

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

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2. Normative references

Insert the following references in alphanumeric order:

IEEE Std 802d™-2017, IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture—Amendment 1: Allocation of Uniform Resource Name (URN) Values in IEEE 802® Standards.

IETF RFC 8343 (proposed standard), A YANG Data Model for Interface Management, March 2018.

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4. Abbreviations

Insert the following abbreviations in alphanumeric order in Clause 4:

NETCONF Network Configuration Protocol

YANG Yet Another Next Generation[2]

[2]YANG is best viewed as a name, not an acronym.

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5. Conformance

5.4 VLAN Bridge component requirements

5.4.1 VLAN Bridge component options

Insert the following item w) after v) Support SMIv2 MIB modules for the management of VLAN Bridge capabilities (Clause 17), renumbering as necessary:

w) Support YANG modules for the management of VLAN Bridge capabilities (Clause 48);

5.13 MAC Bridge component requirements

5.13.1 MAC Bridge component options

Insert the following item h) after g) Support SMIv2 MIB modules for the management of MAC Bridge capabilities (Clause 17), renumbering as necessary:

h) Support YANG modules for the management of MAC Bridge capabilities (Clause 48);

5.16 TPMR conformance

5.16.1 TPMR options

Insert the following item d) after c) Support remote management using the TPMR MIB module defined in 17.7.11, renumbering as necessary:

d) Support remote management using the TPMR YANG module defined in 48.4.2.

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8. Principles of Bridge operation

Change the text of 8.12 as follows:

8.12 Bridge Management Entity

~~In order to facilitate interoperable management of Bridges by remote means (as opposed to management via some kind of management console attached directly to the Bridge), it is recommended that SNMP should be the protocol that is used, in conjunction ith the SMIv2 MIB modules specified in Clause 17.~~

Remote management capabilities (as opposed to management via a console or other device attached directly to a Bridge) are modeled as performed by a Bridge Management Entity supported by a protocol stack as described in 8.13.7. To facilitate interoperable remote management, the Bridge Management Entity should use either the SMIv2 MIB modules specified in Clause 17 with SNMP or the YANG modules specified in Clause 48 with a network configuration protocol, e.g., NETCONF, RESTCONF.

8.13 Addressing

Change the text of 8.13.7 as follows:

8.13.7 Bridge Management Entities

~~The recommended protocol for remote Bridge management is SNMP, which typically uses IP as a network layer protocol; however,~~ Network configuration and management protocols typically use IP as a network layer protocol. SNMP can also be supported directly over an IEEE 802 LAN, as specified in IETF RFC 4789. ~~If implemented, the~~ The management protocol stack and address used shall be supported by a single LLC Entity attached to a Bridge Port. The Port should be a Management Port for the Bridge, as described in 8.3 and Figure 8-8, but may be a Port attached to a LAN, as described in 8.13.9, Figure 8-21, and Figure 8-22.

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12. Bridge management

12.10 Bridge VLAN managed objects

Change the first paragraph of 12.10.1 as follows:

12.10.1 Bridge VLAN Configuration managed object

The Bridge VLAN Configuration managed object models operations that modify, or inquire about, the overall configuration of the Bridge's VLAN resources. There is a single Bridge VLAN Configuration managed object per Bridge Component.

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Insert a new Clause 48 after Clause 47 as follows:

48. YANG Data Model

This clause specifies YANG data models that provide control and status monitoring of IEEE 802.1Q Bridges. Specifically,

a) Two-Port MAC Relays,
b) Customer VLAN bridges, and
c) Provider bridges.

The YANG bridge data management models are derived from UML models specified in 48.3. The UML models are based on Clause 12.

NOTE 1—OMG UML 2.5 [B78] conventions together with C++ language constructs are used in this clause as a representation to convey model structure and relationships.

NOTE 2—The MIB modules specified in Clause 17 were also derived from Clause 12. Consequently, the capabilities and structure of the YANG data models should closely aligned with that represented by the MIBs. However the YANG data model has not been derived from the MIB, and there has been no attempt to include data or modeling constructs that might appear in the MIB but not in the information model.

48.1 YANG Framework

This clause has been developed according to the YANG guidelines published in IETF RFC 6087 [B68] as applicable to IEEE standards.

The YANG framework applies hierarchy in the following areas:

1) The uniform resource name (URN), as specified in IEEE Std 802d. The structure of the URN is such that ieee is the root (i.e., name-space identifier), followed by the standard, then the working group developing the standard.
2) The YANG objects form a hierarchy of configuration and operational data structures that define the YANG model. These hierarchical relationships are described in 48.3.

The general YANG framework hierarchy is illustrated in Figure 48-1.

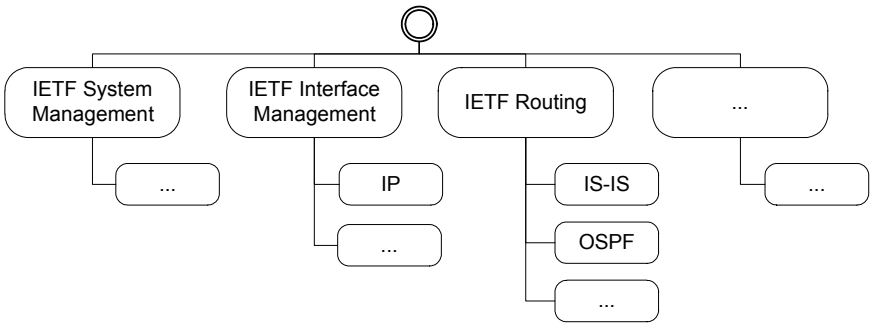


Figure 48-1—General YANG hierarchy

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Network interfaces are central to the management of protocols supported over said interface. Thus, it is important to establish a common data model for how interfaces are identified, configured, and monitored. The IETF Interface Management model (IETF RFC 8343) defines a generic YANG data model for the management of network interfaces. Consequently, IEEE 802.1Q Bridge Ports augment the generic interfaces data model defined by the IETF Interface Management model (IETF RFC 8343).

In addition, a high level YANG object is defined to support IEEE 802.1Q Bridge YANG models. An "IEEE 802.1Q Bridge" YANG model is introduced, which can be augmented by the various IEEE 802.1Q Bridge models.

The YANG hierarchical structure that incorporates the IEEE 802.1Q YANG models supported by this standard is represented in Figure 48-2.

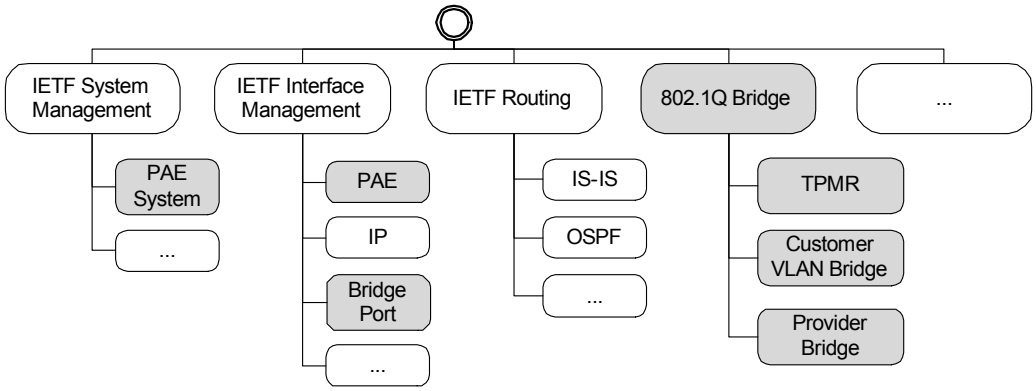


Figure 48-2—YANG root hierarchy with IEEE 802.1Q YANG modules

48.2 Security considerations

The YANG modules defined in this clause are designed to be accessed via a network configuration protocol, e.g., NETCONF protocol (IETF RFC 6536 [B71]). In the case of NETCONF, the lowest NETCONF layer is the secure transport layer and the mandatory to implement secure transport is SSH (IETF RFC 6242 [B70]). The NETCONF access control model provides the means to restrict access for particular NETCONF users to a preconfigured subset of all available NETCONF protocol operations and content.

It is the responsibility of a system's implementor and administrator to ensure that the protocol entities in the system that support NETCONF, and any other remote configuration protocols that make use of these YANG modules, are properly configured to allow access only to those principals (users) that have legitimate rights to read or write data nodes. This standard does not specify how the credentials of those users are to be stored or validated.

48.2.1 Security considerations of the ieee802-dot1q-bridge and ieee802-dot1q-vlan-bridge YANG modules

There are a number of management objects defined in the ieee802-dot1q-bridge and ieee802-dot1q-vlan-bridge YANG modules that are configurable (i.e., read-write) and/or operational (i.e., read-only). Such objects may be considered sensitive or vulnerable in some network environments. A network configuration protocol, such as NETCONF (IETF RFC 6241 [B69]), can support protocol operations that can edit or delete YANG module configuration data (e.g., edit-config, delete-config, copy-config). If this is done in a non-secure environment without proper protection, then negative effects on the network operation is possible.

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The following objects in the ieee802-dot1q-bridge and ieee802-dot1q-vlan-bridge YANG modules can be manipulated to interfere with the operation of VLANs and priority classes. This could, for example, be used to force a reinitialization of state machines, thus causing network instability, or to change the forwarding and filtering policies. Another possibility would be for an attacker to override established policy on Port priorities, thus giving a user (or an attacker) unauthorized preferential treatment.

interfaces/interface/bridge-port

interfaces/interface/bridge-port/priority-regeneration

bridges/bridge/component/traffic-class-enabled

bridges/bridge/component/bridge-vlan/protocol-group-database

interfaces/interface/bridge-port/traffic-class

interfaces/interface/bridge-port/protocol-group-vid-set

a) The configurable object bridges/bridge/component/filtering-database/aging-time controls how fast dynamically learned forwarding information is aged out. Setting this object to a large value may simplify FDB overflow attacks. Setting this object to too small a value may compromise the throughput of the network by causing excessive flooding.
b) The configurable object bridges/bridge/component/filtering-database/filtering-entries/entry-type provides a filtering mechanism controlling which Ports frames originating from a specific source may be forwarded to. Write access to this table can be used to turn provisioned filtering off or to add filters to prevent rightful use of the network.

Some of the readable data in this YANG module may be considered sensitive or vulnerable in some network environments. It is thus important to control all types of access (e.g., including NETCONF get, get-config operations) to these objects and possibly to even encrypt the values of these objects when sending them over the network. These tables and objects and their sensitivity/vulnerability are described as follows:

— The object bridges/bridge/component/capabilities could be used by an attacker to determine which attacks might be useful to attempt against a given device.
— The readable objects defined in the ieee802-dot1q-bridge and ieee802-dot1q-vlan-bridge modules provide information about the topology of a bridged network and the attached active stations. The addresses listed in the bridges/bridge/component/filtering-database/filtering-entries usually reveal information about the manufacturer of the MAC hardware, which can be useful information for mounting other specific attacks.
— The readable objects defined in the ieee802-dot1q-bridge and ieee802-dot1q-vlan-bridge modules provide information about the topology of a bridged network and the attached active stations. In some networks, information about attached active stations can be considered personal identifying information about the user of the station. Unauthorized use of this object can be considered a privacy threat.

48.2.2 Security considerations of the ieee802-dot1q-tpmr YANG module

There are a number of management objects defined in the ieee802-dot1q-tpmr YANG module that are configurable (i.e., read-write) and/or operational (i.e., read-only). Such objects may be considered sensitive or vulnerable in some network environments. A network configuration protocol, such as NETCONF (IETF RFC 6241 [B69]), can support protocol operations that can edit or delete YANG module configuration data (e.g., edit-config, delete-config, copy-config). If this is done in a non-secure environment without proper protection, then negative effects on the network operation is possible.

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The following objects in the ieee802-dot1q-tpmr YANG module could be manipulated to interfere with the operation of MAC status propagation on a TPMR port and, for example, be used to cause network instability:

interfaces/interface/bridge-port/mac-status-propagation/link-notify
interfaces/interface/bridge-port/mac-status-propagation/link-notify-wait
interfaces/interface/bridge-port/mac-status-propagation/link-notify-retry
interfaces/interface/bridge-port/mac-status-propagation/mac-notify
interfaces/interface/bridge-port/mac-status-propagation/mac-notify-time
interfaces/interface/bridge-port/mac-status-propagation/mac-recover-time

48.2.3 Security considerations of the ieee802-dot1q-pb YANG module

There are a number of management objects defined in the ieee802-dot1q-pb YANG module that are configurable (i.e., read-write) and/or operational (i.e., read-only). Such objects may be considered sensitive or vulnerable in some network environments. A network configuration protocol, such as NETCONF (IETF RFC 6241 [B69]), can support protocol operations that can edit or delete YANG module configuration data (e.g., edit-config, delete-config, copy-config). If this is done in a non-secure environment without proper protection, then negative effects on the network operation is possible.

The following objects in the ieee802-dot1q-pb YANG module can be manipulated to interfere with the operation of VLANs. This could, for example, be used to force a reinitialization of state machines, thus causing network instability, or to change the forwarding and filtering policies.

interfaces/interface/bridge-port
interfaces/interface/bridge-port/cvid-registration
interfaces/interface/bridge-port/service-priority-regeneration

48.3 IEEE 802.1Q YANG model

The YANG data models are based on the management model outline in Clause 12. A UML representation of the management model is provided in the following subclauses.

48.3.1 Interface Management (IETF RFC 8343) Model

The Interface Management YANG model is augmented by the IEEE 802.1Q YANG models, and specifically the Bridge Port. As such, it is useful to have a UML representation. The UML representation of the Interface Management (IETF RFC 8343) model is illustrated in Figure 48-3.[3]

[3] The representation of the Interface YANG model is completely derived from IETF RFC 8343.

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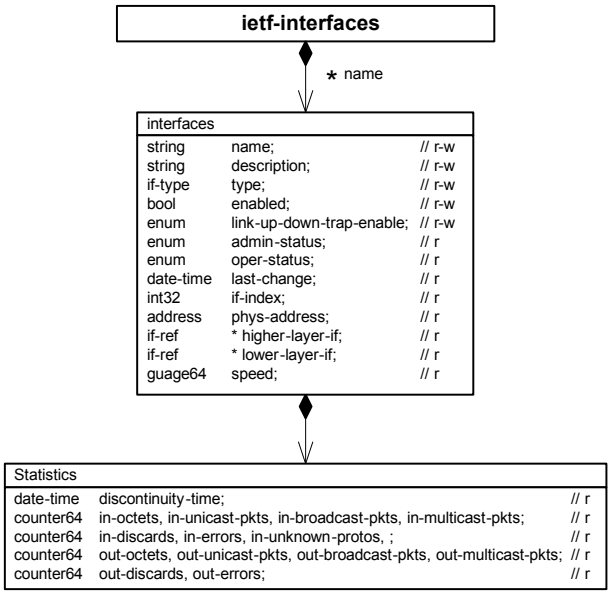


Figure 48-3—UML YANG interface management model

48.3.2 Generic IEEE 802.1Q-2018 bridge model

Based upon the bridge management outlined in Clause 12, the generic IEEE 802.1Q bridge model represented in a UML form is illustrated in Figure 48-4.

A Bridge Port represents the service access points to the Bridge's MAC Relay Entity and the interface stack that supports that service access point. Refer to 8.2.

The interface stack associated with the Bridge Port can be such that when it is initially created (a) the underlying MAC entity along with the bridge port data are associated with the same Interface, or (b) the underlying MAC entity is associated with a separate Interface from that of the bridge port Interface. In the later model, the bridge port Interface is the higher layer interface of the underlying MAC entity Interface.

The bridge port interfaces associated with this generic model, is shown in Figure 48-5.

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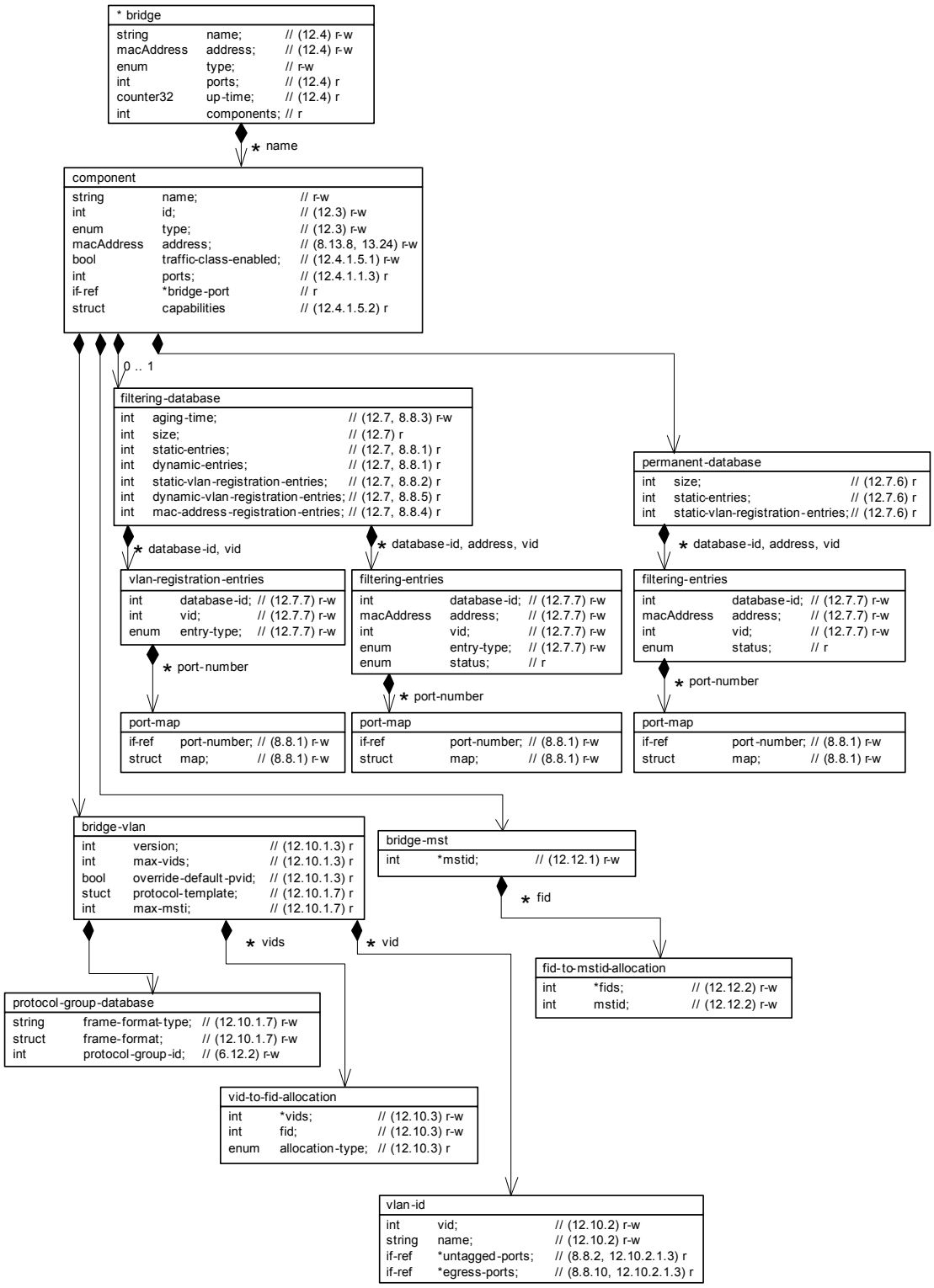
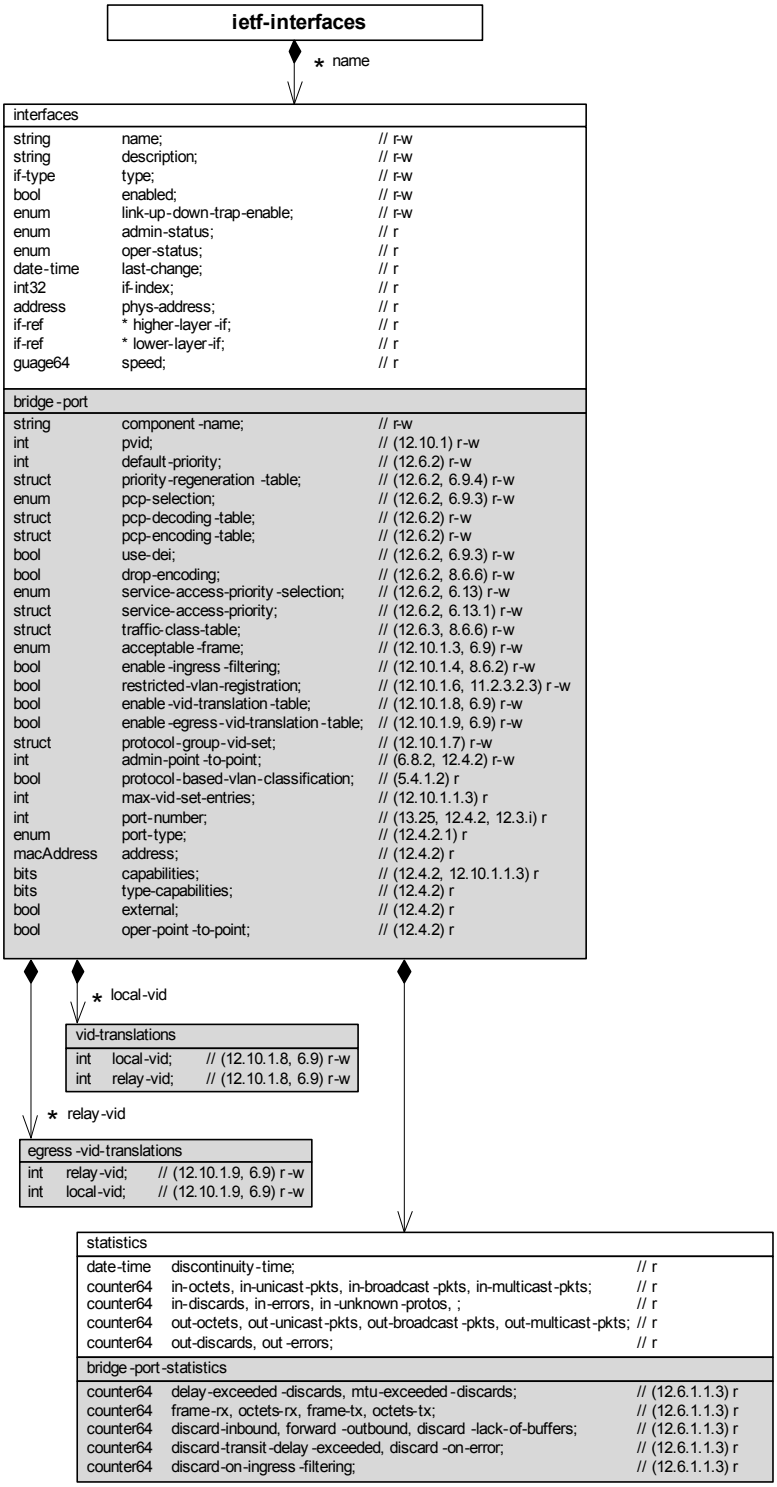


Figure 48-4—Generic IEEE 802.1Q bridge mode

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NOTE—Items shaded in gray indicate extension provided by the IEEE 802.1Q YANG models.

Figure 48-5—Bridge port model

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Each Bridge Port (3.25) is associated with one Interface. The *higher-layer-if* and *lower-layer-if* attributes provide the interface stacking relationships of the Bridge Port. For example, an Aggregator (as defined by IEEE Std 802.1AX) Interface could be a Bridge Port. The *lower-layer-if* attributes associated with the Aggregator would point to the Aggregation Ports, thus forming the interface staking relationship of the Bridge Port.

Each Bridge Port is uniquely identified by a Port Number (*port-number*). A port number has no mandatory relationship to an Interface index (if-index).

48.3.2.1 Two-Port MAC Relay model

The Two-Port MAC Relay (TPMR) bridge UML data model is a subset of the generic IEEE 802.1Q bridge illustrated in Figure 48-4. A TPMR:

— Supports only 2 bridge ports.
— Supports a “VLAN-unaware” bridge component.
— Does not support any “bridged VLAN” object.
— Does not support a “filtering database” object.
— Provides extensions to the “bridge port.”

The TPMR model is illustrated in Figure 48-6.

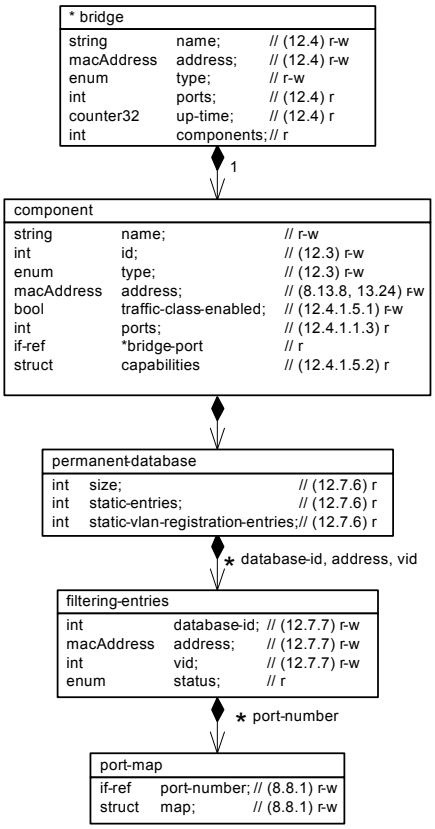


Figure 48-6—TPMR model

NOTE—The bridge type would be *two-port-mac-relay-bridge* and the component type would be *d-bridge-component* (which denotes a VLAN unaware component). The number of ports associated with the component must be 2.

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