P802.1Qdy/D1.2
March 2, 2024
(Amendment to IEEE Std 802.1Q-2022 as amended by IEEE Std 802.1Qcz-2023, IEEE Std 802.1Qcw-2023, IEEE Std 802.1Qcj-2023, P802.1Qdj/D2.2, and P802.1Qdx/D2.0)

Draft Standard for Local and Metropolitan Area Networks—

Bridges and Bridged Networks

Amendment 40: YANG for the Multiple Spanning Tree Protocol

Prepared by the
Time-Sensitive Networking (TSN) Task Group of IEEE 802.1

Sponsor

LAN/MAN Standards Committee of the IEEE Computer Society

This and the following cover pages are not part of the draft. They provide revision and other information for IEEE 802.1 Working Group members and will be updated as convenient. **New participants: Please read these cover pages**, they contain information that should help you contribute effectively to this standards development project. The Introduction to the current draft should be useful to all readers.

The text proper of this draft begins with the Title page.

This document is a draft amendment to IEEE Std 802.1Q-2022 as updated by published and draft amendments (if, and as, noted on the Title page), and may include (in addition to the main subject of the amendment, as per the PAR) the agreed or proposed resolution of Maintenance items and technical and editorial corrections, to the description of existing functionality(see below).

These cover pages provide an Introduction to the current draft, an introduction to Participation in 802.1 standards development, a summary of the PAR (Project Authorization Request) and CSD,for this project, and a general discussion of Draft development.

These cover pages will be replaced for SA Ballot by a briefer version providing information for that ballot, with space for commentary on, and hyperlinks to, changes that occur in SA Ballot.

Introduction to the current draft[1]

This draft, P802.1Qdy/D1.2, has been prepared for Working Group recirculation ballot. It incorporates the resolution of comments received on the Working Group Ballot of P802.1Qdy/D1.0:

https://www.ieee802.org/1/files/private/dy-drafts/d1/802-1Qdy-d1-0-dis-v01.pdf

Major changes made in this draft include:

— The Title of the amendment, as shown in the frontmatter and on the first cover page was (in D1.0) not the title of the approved project, but had been abbreviated to ‘YANG for Multiple Spanning Trees’. This was not noted in the WG ballot, but since there has been no decision to revise the PAR and using a different title would fail MEC (editorial coordination) and delay moving to SA Ballot this has been simply corrected.

— the YANG modules were restructured based on:
https://www.ieee802.org/1/files/public/docs2024/dy-mittelberger-rstp-mstp-YANG-0124-v01.pdf

— Clause 17 (MIB) changes are no longer included, following the WG decision in comment resolution to not revise the MIB. The Abstract and the brief Introduction that form part of the front matter of the standard (on the reverse of the title page, and immediately prior to the Table of Contents respectively) were not noted specifically in ballot comment resolution, but have been also updated to remove references to MIB changes. Note that although the PAR Scope of the Project includes updating the MIB to match the YANG capabilities, the IEEE process only requires that the content of the project remain within its scope, rather than filling out the entire possible scope. The MIB changes were not a specific requirement of the CSD.

— Clause 5 (Conformance) has been added, to reflect the availability of YANG for MSTP.

Minor editorial changes, not noted specifically in WG Ballot comment resolution, made in this draft include:

— Additions to the Keywords following the Abstract, including “VLANs” among other terms essential to the use of Multiple Spanning Trees, and also including “IEEE 802.1Qdy™ ” consistent with pre-publication editorial practice for recent amendments.

—

Maintenance items and technical and editorial corrections

This draft does not include proposed or agreed resolutions of maintenance items for the base standard.

This draft does not include any technical corrections to the base standard beyond the project subject matter.

This draft does not include any editorial corrections to the base standard beyond the project subject matter.

YANG modules

The YANG modules specified by this standard are attached to the draft pdf as plain text (UTF-8) .yang files.

[1]The whole or parts of the introduction, possibly updated, to past drafts may be retained at the Editor’s discretion, with the most recent introduction first. The introduction to each draft may solicit input on specific subjects.

Sources

This draft, P802.1Qdy/D1.2, has been prepared from a set of Framemaker files with conditional text that supports the production of an amendment draft and a preliminary rollup of that amendment draft into the text of the base standard, IEEE Std 802.1Q-2022 as amended by prior amendments.

These sources were based on those for P802.1Q-2022-Rev/D1.0, with further amendment by the text of the published and in-process amendments (at the time of preparation of this draft). Further changes (not included in the printed text of this amendment) may have been made to those sources as part of an ongoing program of making the 802.1Q Framemaker sources consistent. Further drafts of P802.1Q-2022-Rev should be based on this (or a successor) source set, and not those for D1.0.

This particular amendment does not depend on the in-process amendments (P802.1Qdj and P802.1Qdx) and should be unaffected by any changes made to those amendments as part of SA Ballot, with the minor exception of possible (though unlikely) changes to clause numbering.

For a description of the use of conditional text and other FrameMaker and IEEE Std 802.1Q Style considerations applicable to this draft see the EDITOR-PLEASE-READ-ME file in the FrameMaker books used to generate this draft.

Participation in 802.1 standards development

All participants in IEEE 802.1 activities should be aware of the Working Group Policies and Procedures, and their obligations under the IEEE Patent Policy, the IEEE Standards Association (SA) Copyright Policy, and the IEEE SA Participation Policy. For information on these policies see 1.ieee802.org/rules/ and the slides presented at the beginning of each of our Working Group and Task Group meeting.

The IEEE SA PAR (Project Authorization Request) and CSD (Criteria for Standards Development established by IEEE 802) are summarized in these cover pages and links are provided to the full text of both PAR and CSD. As part of the IEEE 802® process, the text of the PAR and CSD of each project is reviewed regularly to ensure their continued validity. A vote of “Approve” on this draft is also an affirmation by the voter that the PAR and CSD for this project are still valid.

Comments on this draft are encouraged. NOTE: All issues related to IEEE standards presentation style, formatting, spelling, etc. are routinely handled between the 802.1 Editor and the IEEE Staff Editors prior to publication, after balloting and the process of achieving agreement on the technical content of the standard is complete. Readers are urged to devote their valuable time and energy only to comments that materially affect either the technical content of the document or the clarity of that technical content. Comments should not simply state what is wrong, but also what might be done to fix the problem.

Full participation in the work of IEEE 802.1 requires attendance at IEEE 802 meetings. Information on 802.1 activities, working papers, and email distribution lists etc. can be found on the 802.1 Website:

http://ieee802.org/1/

Use of the email distribution list is not presently restricted to 802.1 members, and the working group has a policy of considering comments from all who are interested and willing to contribute to the development of the draft. Individuals not attending meetings have helped to identify sources of misunderstanding and ambiguity in past projects. The email lists exist primarily to allow the members of the working group to develop standards, and are not a general forum. All contributors to the work of 802.1 should familiarize themselves with the IEEE patent policy and anyone using the email distribution list will be assumed to have done so. Information can be found at http://standards.ieee.org/db/patents/

Comments on this draft may be sent to the 802.1 email exploder, to the Editors, or to the Chairs of the 802.1 Working Group and Time-Sensitive Networking (TSN) Task Group.

Martin Mittelberger Editor, P802.1Qdy Email:martin.mittelberger@siemens.com	Mick Seaman Editor, IEEE Std 802.1Q Email:mickseaman@gmail.com
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All participants in IEEE standards development have responsibilities under the IEEE patent policy and should familiarize themselves with that policy, see
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PAR (Project Authorization Request) and CSD

Extracts from the PAR, as approved by IEEE NesCom 21st September, 2023:

https://development.standards.ieee.org/myproject-web/public/view.html#pardetail/10988

and the CSD (Criteria for Standards Development):

https://mentor.ieee.org/802-ec/dcn/23/ec-23-0149-00-ACSD-p802-1qdy.pdf

follow. The Scope and Purpose of the base standard remains unchanged from IEEE Std 802.1Q-2022.

PAR Scope of the Project:

This amendment specifies YANG modules that enable configuration and status reporting for bridges and bridge components for the Multiple Spanning Tree Protocol (MSTP). This amendment addresses MSTP requirements arising from industrial automation networks, updating existing managed objects and updating the existing Management Information Base (MIB) to match the capabilities of the YANG modules.

PAR Need for the Project:

YANG (RFC 7950) is a formalized data modeling language that is widely accepted and can be used to simplify network configuration. The ability to manage the Multiple Spanning Tree Protocol via YANG modules is needed for compatibility with modern network management systems. Industrial automation networks require parameter value ranges that can differ from those currently supported.

PAR Possible registration activity related to this project:

The YANG Data Model will be assigned a Uniform Resource Name (URN) based on the IEEE Registration Authority (RA) URN tutorial and IEEE Std 802d.

CSD Broad market potential [extract]:

The proposed amendment will support the use of YANG, which has broad industry support in networks that use IEEE Std 802.1Q. Both IEEE Std 802.1Q and YANG are already supported and used by multiple vendors, network providers, and network users. There is a wide interest in the industry to manage the Multiple Spanning Tree Protocol (MSTP) via YANG. Furthermore, industrial automation networks require parameter value ranges that can differ from those currently supported.

CSD Economic feasibility [extract]:

a) Management using YANG utilizes a balance between end station and infrastructure capabilities; the balance will be similar to that for existing management methods.

b) The cost factors will be similar to those of existing management methods.

c) This project extends the YANG capabilities of IEEE Std 802.1Q to MSTP as a step towards a complete YANG management solution. This helps to eliminate multiple management platforms, thus reduces installation cost.

d) This project extends the YANG capabilities of IEEE Std 802.1Q to manage MSTP as a step towards a complete YANG management solution. This helps to eliminate multiple management platforms, thus reduces operational cost.

Draft development

During the early stages of draft development, 802.1 editors have a responsibility to attempt to craft technically coherent drafts from the resolutions of ballot comments and from the other discussions that take place in the working group meetings. Preparation of drafts often exposes inconsistencies in editor's instructions or exposes the need to make choices between approaches that were not fully apparent in the meeting. Choices and requests by the editors' for contributions on specific issues will be found in the editors' Introduction to the current draft and at appropriate points in the draft.

Any text with a Cyan background (as in this sentence) is temporary, with conditional tag 'Editor comment', inserted by the Editors to solicit comment, suggest a future change, or act simply as an aide memoire.Text can also highlighted to be draw it to the readers' attention, using conditional tag 'Editor highlight'. In both these case conditional tagging helps location, and eventual removal, of text or highlighting and can control whether or not it is displayed.

The ballot comments received on each draft, and the editors' proposed and final disposition of comments on working group drafts, are part of the audit trail of the development of the standard and are available, along with all the revisions of the draft on the 802.1 website (for address see above).

During the early stages of draft development the proposed text can be moved around a great deal, and even minor rearrangement can lead to a lot of 'change', not all of which is noteworthy from the point of the reviewer, so the use of automatic change bars is not very effective. In early drafts change bars may be omitted or applied manually, with a view to drawing the readers attention to the most significant areas of change. Readers interested in viewing every change are encouraged to use Adobe Acrobat to compare the document with their selected prior draft. Note that the FrameMaker change bar feature is useless when it comes to indicating changes to Figures.

This draft has been prepared from a set of Framemaker files with conditional text that supports the production of an amendment draft and a preliminary roll up of that amendment draft into the text of the base standard, i.e. IEEE Std 802.1Q as of the last Revision as amended by prior amendments (usually as of the close of their successful SA ballots) as noted on the Title Page and the first Cover Page. The editor may make preliminary roll ups available to check consistency with the base standard and cross-references to text that does not appear in this amendment. Roll ups may also be recorded as part of the approved P802.1Q Revision project.

For a description of the use of conditional text and other FrameMaker and IEEE Std 802.1Q Style considerations applicable to this draft see the EDITOR-PLEASE-READ-ME file in the FrameMaker books used to generate these drafts.

There are generally multiple amendments under development at any time, and while they will add or amend different clauses in the base standard, there are some clauses (notably Clauses 12, 48, and the PICS Annexes that all are likely to change). They need to be fully integrated before or during SA Ballot, and complete that ballot in serial order to avoid future problems.

Records of participants in the development of the standard are added after SA Ballot, as part of pre-publication editing by IEEE Staff.

P802.1Qdy/D1.2
March 2, 2024

(Amendment to IEEE Std 802.1Q-2022 as amended by IEEE Std 802.1Qcz-2023, IEEE Std 802.1Qcw-2023, IEEE Std 802.1Qcj-2023, P802.1Qdj/D2.2, and P802.1Qdx/D2.0)

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Sponsor
LAN/MAN Standards Committee
of the
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IEEE Standards Department
445 Hoes Lane
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Abstract: This amendment to IEEE Std 802.1Q-2022 as amended by IEEE Std 802.1Qcz-2023, IEEE Std 802.1Qcw-2023, IEEE Std 802.1Qcj-2023, IEEE Std 802.1Qdj-2024, and IEEE Std 802.1Qdx-2024 addresses Multiple Spanning Tree Protocol (MSTP) requirements arising from industrial automation networks. It specifies YANG for bridge and bridge component RSTP and MSTP configuration and status reporting.

Keywords: Bridged Network, IEEE 802.1Q™, IEEE 802.1Qdy™, LAN, local area network, MAC Bridge, metropolitan area network, MSTP, Multiple Spanning Tree Protocol, MIB, Rapid Spanning Tree Protocol, RSTP, Virtual Bridged Network, virtual LAN, VLAN Bridge,YANG.

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PDF: ISBN 978-X-XXX-XXX-X STDXXXXX
Print: ISBN 978-X-XXX-XXX-X STDPDXXXXX

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[1] Available at: https://development.standards.ieee.org/myproject-web/public/view.html#landing.
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[3] Available at: https://ieeexplore.ieee.org/browse/standards/collection/ieee.
[4] Available at: https://standards.ieee.org/standard/index.html.
[5] Available at: https://standards.ieee.org/about/sasb/patcom/materials.html.

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Participants

<<The following lists will be updated in the usual way prior to publication>>

At the time this standard was submitted to the IEEE-SA Standards Board for approval, the IEEE 802.1 Working Group had the following membership:

Glenn Parsons, *Chair*
Jessy V. Rouyer, *Vice Chair*
János Farkas, *Chair, Time-Sensitive Networking Task Group*
Craig Gunther, *Vice Chair, Time-Sensitive Networking Task Group*
Martin Mittelberger, *Editor*

<<TBA>>

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

<<TBA>>

When the IEEE-SA Standards Board approved this standard on XX Month 20xx, it had the following membership:

<<TBA>>

<<TBA>>

*Member Emeritus

Introduction

This introduction is not part of IEEE Std 802.1Qdy™-2024, IEEE Standard for Local and metropolitan area networks— Bridges and Bridged Networks—Amendment 40: YANG for Multiple Spanning Trees.

IEEE Std 802.1Qdy™-2024: YANG for Multiple Spanning Trees addresses requirements arising from industrial automation networks, specifying YANG for bridge and bridge component MSTP configuration and status reporting.

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

Secretary, IEEE-SA Standards Board
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Figures

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IEEE Standard for
Local and metropolitan area networks—

Bridges and Bridged Networks

Amendment 40: YANG for the Multiple Spanning Tree Protocol

[This amendment is based on IEEE Std 802.1Q™-2022 as amended by IEEE Std 802.1Qcz™-2023, IEEE Std 802.1Qcw™-2023, IEEE Std 802.1Qcj™-2023, IEEE Std 802.1Qdj™-2024, and IEEE Std 802.1Qdx™-2024.]

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

The editing instructions are shown in ***bold italics***. 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. Deletions and 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.

5. Conformance

5.4.1.1 Multiple Spanning Tree (MST) operation (optional)

Insert new list item q) after item p) in 5.4.1.1 as follows:

q) Support YANG modules for the management of MSTP (48.6.24).

13. Spanning tree protocols

13.25 State machine timers

Change Table 13-5 and the following NOTE as follows:

Table 13-5—Timer and related parameter values

Parameter	Default	Permitted range	Interoperability recommendations
Migrate Time	3.0	—[a]	—[a]
(Bridge) Hello Time	2.0	—[a]	—[a]
Bridge Max Age	20.0	6.0–40.0	20.0
Bridge Forward Delay	15.0	4.0–30.0	15.0
Transmit Hold Count	6	1–10	6
Max Hops	20	6–~~40~~100	—

All times are in seconds. —[a] Not applicable, value is fixed.

NOTE—Changes to Bridge Forward Delay do not affect reconfiguration times, unless the network includes Bridges that do not conform to this revision of this standard. Changes to Bridge Max Age can have an effect, as it is possible for old information to persist in loops in the physical topology for a number of "hops" equal to the value of Max Age in seconds, and thus exhaust the Transmit Hold Count in small loops. The IEEE Std 802.1Qdy amendment to this standard increased the permitted range of Max Hops to allow a spanning tree to provide initial and remedial connectivity in extended ring topologies whenever physical connectivity is possible. Once configured such networks are not expected to depend on spanning tree for failure protection.

48. YANG Data Models

48.2 IEEE 802.1Q YANG models

Insert 48.2.14 and 48.2.15 as follows:

48.2.14 Rapid Spanning Tree Protocol (RSTP) model

The RSTP model augments the VLAN Bridge component model (48.2.1, Figure 48-4) and the Interface management model for Bridge Ports (48.2.1, Figure 48-5) with nodes common to both RSTP and MSTP. These nodes control the configuration of the CST (and the CIST, when augmented by the Multiple Spanning Trees model, 48.2.15) and report on protocol operation. The RSTP model is illustrated in Figure 48-24.

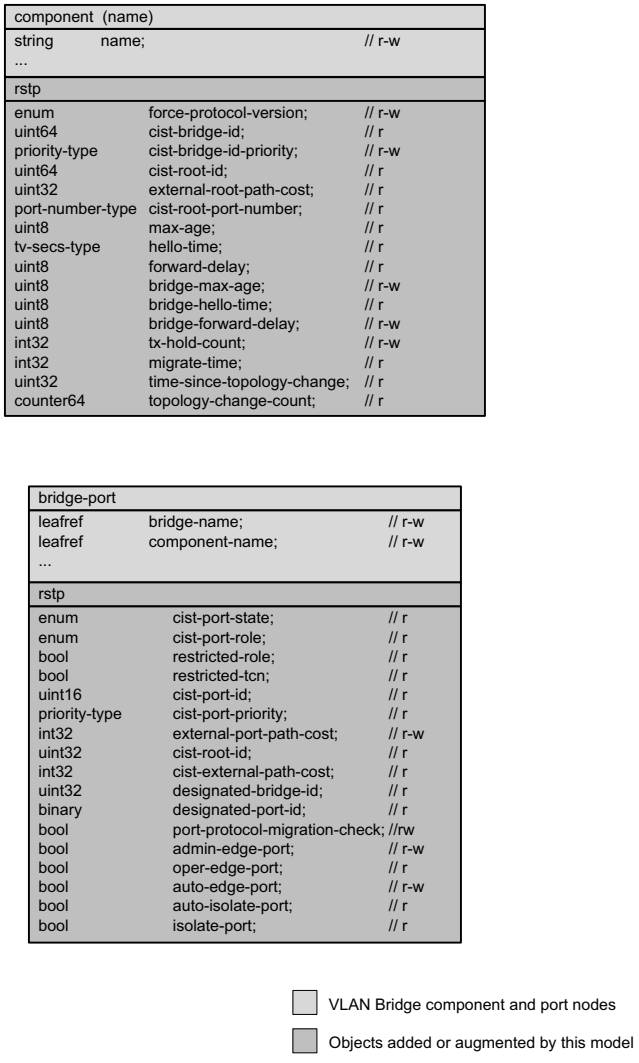

Figure 48-24—RSTP model

48.2.15 Multiple Spanning Tree Protocol (MSTP) model

The Multiple Spanning Tree Protocol model augments the bridge-mst container of the VLAN Bridge components model (48.2.1) and the RSTP model (48.2.14) with nodes for MSTP. These nodes control the configuration of the CIST and MSTIs and the assignment of VLANs and VIDs to MSTIs (8.9) within MST Regions. They also report on MSTP protocol operation. The Multiple Spanning Tree Protocol model is illustrated in Figure 48-25.

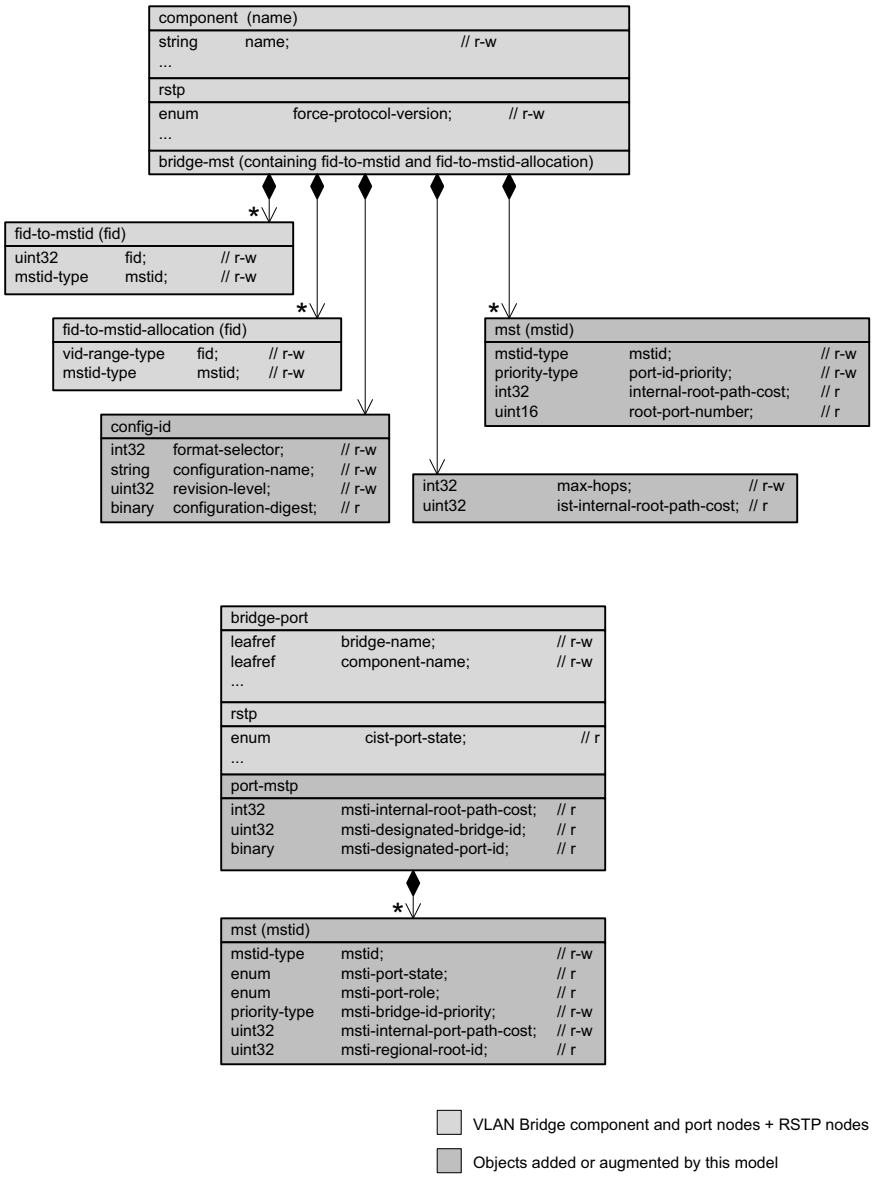

Figure 48-25—MSTP model

48.3 Structure of the YANG models

Insert the following row(s) at the end of Table 48-1 as follows (unchanged rows not shown):

Table 48-1—Summary of the YANG modules

Module	References	Managed functionality	Initial YANG specification Notes
ieee802-dot1q-rstp	48.5.26, 48.6.26	8.4, 8.7, 8.8, 8.10 Clause 13	IEEE Std 802.1Qdy Augments Bridge components and Bridge Ports with RSTP parameters.
ieee802-dot1q-mstp	48.5.27, 48.6.27	8.4, 8.7, 8.8, 8.8, 8.9, 8.10 Clause 13	IEEE Std 802.1Qdy Augments Bridge components, Bridge Ports, and the ieee802-dot1q-rstp module with MSTP parameters.

Insert 48.3.14 and 48.3.15 after 48.3.13 (inserted by IEEE Std 802.1Qdx-2024) as follows:

48.3.14 RSTP model

A bridge implementing the RSTP model (48.2.14) implements the YANG modules in Table 48-13.

Table 48-13—RSTP model YANG modules

YANG module
ieee802-types
ieee802-dot1q-types
ieee802-dot1q-bridge
ieee802-dot1q-rstp

48.3.15 MSTP model

A bridge implementing the MSTP model (48.2.15) implements the YANG modules in Table 48-14.

Table 48-14—MSTP model YANG modules

YANG module
ieee802-types
ieee802-dot1q-types
ieee802-dot1q-bridge
ieee802-dot1q-rstp
ieee802-dot1q-mstp

48.4 Security considerations

Insert 48.4.14 and 48.4.15 after 48.4.13 (inserted by IEEE Std 802.1Qdx-2024) as follows:

48.4.14 Security considerations of the RSTP model

All writeable nodes in the ieee802-dot1q-rstp YANG module could be manipulated to interfere with basic networking connectivity.

See 48.4.1 for related ieee802-dot1q-bridge YANG model security considerations.

48.4.15 Security considerations of the Multiple Spanning Trees model

All writeable nodes in the ieee802-dot1q-mstp YANG module could be manipulated to interfere with basic networking connectivity.

See 48.4.1 for related ieee802-dot1q-bridge YANG model security considerations.

48.5 YANG schema tree definitions

A simplified graphical representation of the data model is used in this document. The meaning of the symbols in these diagrams is as follows:

- Brackets "[" and "]" enclose list keys.
- Abbreviations before data node names: "rw" means configuration (read-write), and "ro" means state data (read-only).
- Symbols after data node names: "?" means an optional node, "!" means a presence container, and "*" denotes a list and leaf-list.
- Parentheses enclose choice and case nodes, and case nodes are also marked with a colon (":").
- Ellipsis ("...") stands for contents of subtrees that are not shown.

Insert 48.5.26 and 48.5.27 after 48.5.25 (inserted by IEEE Std 802.1Qdx-2024) as follows:

48.5.26 Schema for the ieee802-dot1q-rstp YANG module

```
module: ieee802-dot1q-rstp

  augment /dot1q:bridges/dot1q:bridge/dot1q:component:
    +--rw rstp!
       +--rw force-protocol-version?       enumeration
       +--ro cist-bridge-id?               uint64
       +--rw cist-bridge-id-priority?      dot1qtypes:priority-type
       +--ro cist-root-id?                 uint64
       +--ro external-root-path-cost?      uint32
       +--ro cist-root-port-number?        dot1qtypes:port-number-type
       +--ro max-age?                      uint8
       +--ro hello-time?                   rt-types:timer-value-seconds16
       +--ro forward-delay?                uint8
       +--rw bridge-max-age?               uint8
       +--ro bridge-hello-time?            uint8
       +--rw bridge-forward-delay?         uint8
       +--rw tx-hold-count?                int32
       +--ro migrate-time?                 int32
       +--ro time-since-topology-change?   uint32
       +--ro topology-change-count?        yang:counter64
  augment /if:interfaces/if:interface/dot1q:bridge-port:
    +--rw rstp!
       +--ro cist-port-state?                 enumeration
       +--ro cist-port-role?                  enumeration
       +--ro restricted-role?                 boolean
       +--ro restricted-tcn?                  boolean
       +--ro cist-port-id?                    uint16
       +--rw cist-port-priority?              dot1qtypes:priority-type
       +--rw external-port-path-cost?         int32
       +--ro cist-root-id?                    uint32
       +--ro cist-external-path-cost?         int32
       +--ro designated-bridge-id?            uint32
       +--ro designated-port-id?              binary
       +--rw port-protocol-migration-check?   boolean
       +--rw admin-edge-port?                 boolean
       +--ro oper-edge-port?                  boolean
       +--rw auto-edge-port?                  boolean
       +--rw auto-isolate-port?               boolean
       +--ro isolate-port?                    boolean

```

48.5.27 Schema for the ieee802-dot1q-mstp YANG module

```
module: ieee802-dot1q-mstp

  augment /dot1q:bridges/dot1q:bridge/dot1q:component/dot1q:bridge-mst:
    +--rw mst-config-id!
    |  +--rw format-selector?        int32
    |  +--rw configuration-name?     string
    |  +--rw revision-level?         uint32
    |  +--ro configuration-digest?   binary
```

```
   +--rw bridge-mstp!
      +--rw max-hops?                      int32
      +--ro ist-internal-root-path-cost?   uint32
      +--rw mst* [mstid]
         +--rw mstid                       uint16
         +--rw port-id-priority?           dot1qtypes:priority-type
         +--ro internal-root-path-cost?    uint32
         +--ro root-port-number?           dot1qtypes:port-number-type
augment /if:interfaces/if:interface/dot1q:bridge-port:
   +--rw port-mstp!
      +--rw mst* [mstid]
      |  +--rw mstid                            uint16
      |  +--ro msti-port-state?                 enumeration
      |  +--ro msti-port-role?                  enumeration
      |  +--rw msti-bridge-id-priority?         dot1qtypes:priority-type
      |  +--rw msti-internal-port-path-cost?    uint32
      |  +--ro msti-regional-root-id?           uint32
      +--ro msti-internal-root-path-cost?    int32
      +--ro msti-designated-bridge-id?       uint32
      +--ro msti-designated-port-id?         binary
```

48.6 YANG modules[6] [7] [8]

Insert 48.6.26 after 48.6.25 (inserted by IEEE Std 802.1Qdx-2024) as follows::

48.6.26 The ieee802-dot1q-rstp YANG module

```
module ieee802-dot1q-rstp {
  yang-version 1.1;
  namespace "urn:ieee:std:802.1Q:yang:ieee802-dot1q-rstp";
  prefix rstp;

  import ietf-yang-types {
    prefix yang;
  }
  import ietf-interfaces {
    prefix if;
  }
  import ietf-routing-types {
    prefix rt-types;
  }
  import ieee802-dot1q-types {
    prefix dot1qtypes;
  }
  import ieee802-dot1q-bridge {
    prefix dot1q;
  }

  organization
    "IEEE 802.1 Working Group";
  contact
    "WG-URL: http://www.ieee802.org/1/
     WG-EMail: stds-802-1-l@ieee.org

     Contact: IEEE 802.1 Working Group Chair
     Postal: C/O IEEE 802.1 Working Group
             IEEE Standards Association
             445 Hoes Lane
             Piscataway, NJ 08854
             USA

     E-mail: stds-802-1-chairs@ieee.org";
  description
    "This module provides management of 802.1Q Bridge components that
     support the Rapid Spanning Tree Algorithm and Protocol (RSTP).

     Copyright (C) IEEE (2024).

     This version of this YANG module is part of IEEE Std 802.1Q; see the
     standard itself for full legal notices.";

  revision 2024-02-26 {
    description
      "Published as part of IEEE Std 802.1Qdy-2024.

       The following reference statement identifies each referenced IEEE
       Standard as updated by applicable amendments.";
    reference
      "IEEE Std 802.1Q Bridges and Bridged Networks:
       IEEE Std 802.1Q-2022, IEEE Std 802.1Qcz-2023, IEEE Std 802.1Qcw-2023,
       IEEE Std 802.1Qcj-2023, IEEE Std 802.1Qdj-2024, IEEE Std 802.1Qdx-2024,
       IEEE Std 802.1Qdy-2024.";
  }
```

[6] Copyright release for YANG: Users of this standard may freely reproduce the YANG modules contained in this standard so that they can be used for their intended purpose.

[7] An ASCII version of each YANG module is attached to the PDF of this standard and can also be obtained from the IEEE 802.1 Website at https://1.ieee802.org/yang-modules/.

[8] References in this standard's YANG module definitions are not clickable, as each module has been incorporated unchanged after development and verification using YANG tools.

```
augment "/dot1q:bridges/dot1q:bridge/dot1q:component" {
  description
    "Augment Bridge with RSTP configuration.";
  reference
    "13.24, 13.25, and 13.26 of IEEE Std 802.1Q.";
  container rstp {
    presence "The presence of this container indicates that RSTP is supported";
    leaf force-protocol-version {
      type enumeration {
        enum emulate-stp {
          value 0;
        }
        enum withdrawn {
          value 1; // previously assigned to IEEE Std 802.1G-1996 (withdrawn)
        }
        enum rstp-rapid-spanning-tree-protocol {
          value 2;
        }
        enum rstp-mstp {
          value 3;
        }
        enum rstp-spb {
          value 4;
        }
      }
      default "rstp-rapid-spanning-tree-protocol";
      config true;
      description
        "By default RSTP will provide rapid reconfiguration,
        but will interoperate with Bridges using STP as specified in
        IEEE Std 802.1D (now withdrawn). Force Protocol Version can
        force emulation of aspects of STP behavior, slowing reconfiguration
        and ageing of FDB entries. Force Protocol Version can be configured
        to enable MSTP and SPB behavior (if implemented) - interoperability
        with Bridges that support only RSTP or STP will be maintained.";
      reference
        "13.7.2 and item a) of 13.26 of IEEE Std 802.1Q.";
    }
    leaf cist-bridge-id {
      type uint64;
      config false;
      description
        "The Bridge Identifier used by this Bridge for the CIST. Eight
        octets with the four most significant bits of the first encoding the
        manageable cist-bridge-id-priority, the next twelve bits being zero,
        and last six ocets encoding the Bridge Address.";
      reference
        "13.26.2, 14.1.2, and item e) in 13.26 of IEEE Std 802.1Q.";
    }
    leaf cist-bridge-id-priority {
      type dot1qtypes:priority-type;
      config true;
      description
        "The priority component of this Bridge's Bridge Identifier for the
        CIST, encoded in the four most-significant bits of the first octet
        of the eight octet Bridge Identifier.

        The value of this object MUST be retained across reinitializations
        of the management system.";
      reference
        "13.26.2, 14.2.5, and item e) in 13.26 of IEEE Std 802.1Q.";
    }
    leaf cist-root-id {
      type uint64;
      config false;
      description
        "The CIST Root Identifier, i.e. the Bridge Identifier of the
        Common and Internal Spanning Tree calculated by RSTP and of the
        logical continuation of that connectivity calculate by MSTP, as
        determined by this node.";
      reference
```

```
        "13.9, 14.1.2, and item f) in 13.26 of IEEE Std 802.1Q.";
    }
    leaf external-root-path-cost {
      type uint32;
      config false;
      description
        "The External Root Path Cost (MSTP) or Root Path Cost (RSTP)
        calculated by this Bridge after the addition of the receiving
        Port Path Cost.";
      reference
        "13.9, 13.10, 13.5.3, and item i) in 13.26 of IEEE Std 802.1Q.";
    }
    leaf cist-root-port-number {
      type dot1qtypes:port-number-type;
      config false;
      description
        "The port number  of the Root Port for the RSTP and for the CIST
        Root Port (MSTP), i.e. the Port Identifier for the port that offers
        the lowest cost path from this Bridge to the (CIST) Root.";
      reference
        "13.4, 13.5, 13.26.9, and item h) in 13.26 of IEEE Std 802.1Q.";
    }
    leaf max-age {
      type uint8;
      units "seconds";
      config false;
      description
        "For the CIST, the whole seconds (most-significant octet) part of
        the maximum age of the spanning tree information (Max Age) currently
        used by this Bridge. Set to the bridge-max-age if the Bridge is the
        CIST Root, and to the whole seconds part of the value received on
        the CIST Root Port otherwise.";
      reference
        "13.15, 13.20, 13.25, item l) in 13.28, and item g) in 13.26 of
        IEEE Std 802.1Q.";
    }
    leaf hello-time {
      type rt-types:timer-value-seconds16;
      units "seconds";
      config false;
      description
        "The interval (Hello Time) between the periodic transmission of
        Configuration Bridge PDUs on Designated Ports. Set to
        bridge-hello-time if the Bridge is currently acting as the CIST Root,
        and to the value received on the CIST Root Port otherwise.";
      reference
        "Table 13-5, 13.25.3, and 13.28.11 of IEEE Std 802.1Q.";
    }
    leaf forward-delay {
      type uint8;
      units "seconds";
      config false;
      description
        "If a Port is using STP rather than RSTP, either as a result of
        setting force-protocol-version to be less than 2 or because STP BPDUs
        have been received, this Forward Delay parameter determines the time
        spent in the Listening and Learning Port States when transitioning
        from Discarding to Forwarding, and also controls rapid ageing of FDB
        entries after a topology change. Set to bridge-forward-delay if the
        Bridge is currently acting as the CIST Root, and to the whole seconds
        part of the value received on the CIST Root Port otherwise. If RSTP,
        MSTP, or SPB is used, Port State transitions and FDB flushing are
        rapid and not controlled by this parameter.";
      reference
        "Table 13-5, 13.25.2, 13.28.10, and item g) in 13.26.4 of
        IEEE Std 802.1Q.";
    }
    leaf bridge-max-age {
      type uint8 {
        range "6..40";
      }
      default "20";
```

```
        units "seconds";
        config true;
        description
          "The value of the whole seconds part of Max Age when this Bridge is
          acting as the CIST Root. The fractional part, conveyed in the
          less-significant octet of each BPDU's Max Age field, will be zero.

          The value of this object MUST be retained across reinitializations
          of the management system.";
        reference
          "Table 13-5, 13.26.4, and item g) in 13.26 of IEEE Std 802.1Q.";
      }
      leaf bridge-hello-time {
        type uint8;
        default "2";
        units "seconds";
        config false;
        description
          "The value that this Bridge uses for HelloTime when acting as the
          CIST Root.";
        reference
          "Table 13-5, 13.25.3, and 13.28.11 of IEEE Std 802.1Q.";
      }
      leaf bridge-forward-delay {
        type uint8 {
          range "4..30";
        }
        default "15";
        units "seconds";
        config true;
        description
          "The value of the whole seconds part of Message Age when this
          Bridge is acting as the CIST Root. The fractional part, conveyed in
          the less-significant octet of each BPDU's Max Age field, will be
          zero.

          The value of this object MUST be retained across reinitializations
          of the management system.";
        reference
          "Table 13-5, 13.26.4, and item g) in 13.26 of IEEE Std 802.1Q.";
      }
      leaf tx-hold-count {
        type int32 {
          range "1..10";
        }
        default "6";
        config true;
        description
          "Limits the rate of BPDU transmission. If the variable txCount
          (which is incremented on each transmission and decremented once a
          second) reaches TxHoldCount, transmission is delayed.

           The value of this object MUST be retained across
           reinitializations of the management system.";
        reference
          "Table 13-5, 13.27.75, 13.26.12, and item b) in 13.26 of
          IEEE Std 802.1Q.";
      }
      leaf migrate-time {
        type int32;
        default "3";
        units "seconds";
        config false;
        description
          "Management can force the transmission of RST (or MST or SPT) BPDUs
          for MigrateTime to check that all STP Bridges have been removed
          from a specified port's attached LAN, so RST/MST/SPT BPDU
          transmission can persist. Fixed value of 3 seconds.";
        reference
          "Table 13-5, 13.27.38,  and item c) in 13.26 of IEEE Std 802.1Q.";
      }
      leaf time-since-topology-change {
```

```
        type uint32;
        units "seconds";
        config false;
        description
          "The time (in seconds) since the Topology Change timer, tcWhile, for
          any port on this Bridge was last running - i.e. since
          Topology Change Notification (TCN) Messages were last transmitted.";
        reference
          "13.25.9 of IEEE Std 802.1Q.";
      }
      leaf topology-change-count {
        type yang:counter64;
        units "topology change count";
        config false;
        description
          "The number of times (since the management entity was last
          reset or initialized) that at least one port's Topology Change timer
          (tcWhile) has been non-zero.

          Discontinuities in the value of the counter can occur at
          re-initialization of the management system, and at other times as
          indicated by the value of 'discontinuity-time'.";
        reference
          "13.25.9 of IEEE Std 802.1Q.";
      }
    }
  }

  augment "/if:interfaces/if:interface/dot1q:bridge-port" {
    description
      "Augment Bridge Port with RSTP configuration";
  reference
      "13.24, 13.25, and 13.27 of IEEE Std 802.1Q.";
    container rstp {
      presence "The presence of this container indicates that RSTP is supported";
      leaf cist-port-state {
        type enumeration {
          enum discarding {
            value 1;
          }
          enum learning {
            value 2;
          }
          enum forwarding {
            value 3;
          }
        }
        config false;
        description
          "The port's Port State, summarizing the application of learning to
          received frames, and the forwarding of relayed frames, for all frames
          (for RSTP) or for frames assigned to the CIST (for MSTP). The
          Port State is Discarding if both learning and forwarding are both
          false, Learning if only learning, and Forwarding if both learning and
          forwarding are true. The Discarding state encompasses all reasons for
          not forwarding, including MAC_Operational false (if:oper-status not
          up) and MAC_Enabled false (if:admin-status not up).";
        reference
          "8.4, 13.4, item aw) and item ba) in 13.27 of IEEE Std 802.1Q.";
      }
      leaf cist-port-role {
        type enumeration {
          enum disabled-port {
            value 1;
          }
          enum root-port {
            value 2;
          }
          enum designated-port {
            value 3;
          }
          enum alternate-port {
```

```
            value 4;
          }
          enum backup-port {
            value 5;
          }
        }
        config false;
        description
          "The port's Port Role for the CIST. Disabled Port, Root Port,
          Designated Port, Alternate Port, or Backup Port.";
        reference
          "13.4, 13.5, 13.12, 13.24, 13.27.66, and item bn) in 13.27 of
          IEEE Std 802.1Q.";
      }
      leaf restricted-role {
        type boolean;
        default "false";
        config false;
        reference
          "13.20, 13.27.65, 13.29.34, 16.2, 16.3, 26.5, 27.6, 27.20,
          item t) in 13.27 of IEEE Std 802.1Q.";
      }
      leaf restricted-tcn {
        type boolean;
        default "false";
        config false;
        reference
          "13.20, 13.27.64, 13.29.25, 16.2, 16.3, item s) in 13.27 of
          IEEE Std 802.1Q.";
      }
      leaf cist-port-id {
        type uint16;
        config false;
        description
          "The Port Identifier used by this Bridge Port for the CIST. Two
          octets with the four most-significant bits of the first encoding the
          manageable cist-port-id-priority, and the next twelve bits encoding
          the port's port-number.";
        reference
          "13.27.46, 14.1.2, item bd) in 13.27 of IEEE Std 802.1Q.";
      }
      leaf cist-port-priority {
        type dot1qtypes:priority-type;
        config true;
        description
          "The priority component of this Port's Port Identifier for the
          CIST, encoded in the four most-significant bits of the first octet
          of the two octet Port Identifier.

          The value of this object MUST be retained across reinitializations
          of the management system.";
        reference
          "13.27.47, 14.2.7, and item be) in 13.27 of IEEE Std 802.1Q.";
      }
      leaf external-port-path-cost {
        type int32 {
          range "0..200000000";
        }
        config true;
        description
          "The administratively assigned value for the port's contribution to
          the External Root Path Cost for the Bridge, when the port is the
          CST Root Port (for RSTP and MSTP) or the CIST Master Port (for MSTP
          and ISIS-SPB).

          The value of this object MUST be retained across reinitializations
          of the management system.";
        reference
          "13.27.25, Table 13-4, and item g) of 13.27 of IEEE Std 802.1Q.";
      }
      leaf cist-root-id {
        type uint32;
```

```
        config false;
        description
          "The CIST Root Identifier in Configuration BPDUs transmitted by the
          Designated Bridge for the attached LAN.";
        reference
          "13.27.20, 13.10, and item ar) in 13.27 of IEEE Std 802.1Q.";
      }
      leaf cist-external-path-cost {
        type int32;
        config false;
        description
          "The External Path Cost advertised in BPDUS by the Designated Bridge
           for the attached LAN.";
        reference
          "27.6, 14.1.2, 13.27.20, and item ar) in 13.27 of IEEE Std 802.1Q.";
      }
      leaf designated-bridge-id {
        type uint32;
        config false;
        description
          "The Bridge Identifier of the Bridge that this port considers to be
          the Designated Bridge for the attached LAN.";
        reference
          "13.27.20, 13.10, and item ar) in 13.27 of IEEE Std 802.1Q.";
      }
      leaf designated-port-id {
        type binary {
          length "2";
        }
        config false;
        description
          "The Port Identifier of the Bridge Port that this port considers to
          be the Designated Port for the attached LAN.";
        reference
          "13.27.20, 13.10, and item ar) in 13.27 of IEEE Std 802.1Q.";
      }
      leaf port-protocol-migration-check {
        type boolean;
        config true;
        description
          "Writing true(1) to port-protocol-migration-check (mcheck)
          forces transmission of RST (or MST or SPT) BPDUs for migrate-time to
          check that all STP Bridges have been removed from the port's attached
          LAN, so RST/MST/SPT BPDU transmission can persist. Has no effect if
          force-protocol-version is emulate-stp(0) or withdrawn(1). Always
          returns false(2) when read.";
        reference
          "13.27.38, 13.32, and item j) in 13.27 of IEEE Std 802.1Q.";
      }
      leaf admin-edge-port {
        type boolean;
        default "false";
        config true;
        description
          "Set if the port is to be identified as an Edge Port immediately
          on initialization without a delay to detect other Bridges attached
          to the LAN. Recommended default false(2). The operational value,
          oper-edge-port, will become false(2) if a BPDU has been received.

          The value of this object MUST be retained across reinitializations
          of the management system.";
        reference
          "13.33, and item a) in 13.27 of IEEE Std 802.1Q.";
      }
      leaf oper-edge-port {
        type boolean;
        config false;
        description
          "Set if the port is currently identified as an Edge Port.
          Initialized to the value of admin-edge-port, and controlled by the
          Bridge Detection state machine.";
        reference
```

```
          "13.33, and item l) in 13.27 of IEEE Std 802.1Q.";
      }
      leaf auto-edge-port {
        type boolean;
        default "true";
        config true;
        description
          "Administratively set true(1) to allow the value of oper-edge-port
          is to be maintained automatically, with continuous  monitoring of
          the presence or absence of other Bridges attached to the LAN.

          The value of this object MUST be retained across reinitializations
          of the management system.";
        reference
          "13.33, 13.27.18, and item c) in 13.27 of IEEE Std 802.1Q.";
      }
      leaf auto-isolate-port {
        type boolean;
        default "false";
        config true;
        description
          "Administratively set true(1) to allow automatic setting of
          isolate-port, causing a Designated Port to transition to Discarding
          if both admin-edge-port and auto-edge-port are false, but the other
          Bridge presumed attached to the same point-to-point LAN appears
          unable to transmit BPDUs, indicating failure of a Spanning Tree
          Protocol Entity or of transmission and/or reception.

          The value of this object MUST be retained across reinitializations
          of the management system.";
        reference
          "13.23, 13.27.19, 13.33, and item d) in 13.27 of IEEE Std 802.1Q.";
      }
      leaf isolate-port {
        type boolean;
        config false;
        description
          "Set by the Bridge Detection state machine when the Spanning Tree
          Protocol Entity of a neighboring Bridge has apparently failed.";
        reference
          "13.23, 13.27.27, 13.33, and item i) in 13.27 of IEEE Std 802.1Q.";
      }
    }
  }
}
```

Insert 48.6.27 as follows:

48.6.27 The ieee802-dot1q-mstp YANG module

```
module ieee802-dot1q-mstp {
  yang-version 1.1;
  namespace "urn:ieee:std:802.1Q:yang:ieee802-dot1q-mstp";
  prefix mstp;

  import ietf-interfaces {
    prefix if;
  }
  import ieee802-dot1q-types {
    prefix dot1qtypes;
  }
  import ieee802-dot1q-bridge {
    prefix dot1q;
  }
  import ieee802-dot1q-rstp {
    prefix rstp;
  }

  organization
    "IEEE 802.1 Working Group";
  contact
    "WG-URL: http://www.ieee802.org/1/
     WG-EMail: stds-802-1-l@ieee.org

     Contact: IEEE 802.1 Working Group Chair
     Postal: C/O IEEE 802.1 Working Group
             IEEE Standards Association
             445 Hoes Lane
             Piscataway, NJ 08854
             USA

     E-mail: stds-802-1-chairs@ieee.org";
  description
    "This module provides management of 802.1Q Bridge components that
     support the Multiple Spanning Tree Algorithm and Protocol (MSTP).

     Copyright (C) IEEE (2024).

     This version of this YANG module is part of IEEE Std 802.1Q; see the
     standard itself for full legal notices.";

  revision 2024-02-26 {
    description
      "Published as part of IEEE Std 802.1Qdy-2024.

       The following reference statement identifies each referenced IEEE
       Standard as updated by applicable amendments.";
    reference
      "IEEE Std 802.1Q Bridges and Bridged Networks:
       IEEE Std 802.1Q-2022, IEEE Std 802.1Qcz-2023, IEEE Std 802.1Qcw-2023,
       IEEE Std 802.1Qcj-2023, IEEE Std 802.1Qdj-2024, IEEE Std 802.1Qdx-2024,
       IEEE Std 802.1Qdy-2024.";
  }

  augment "/dot1q:bridges/dot1q:bridge/dot1q:component/dot1q:bridge-mst" {
    when "../rstp:rstp";

    description
      "Augment RSTP-capable Bridge component with MSTP configuration and
      management.";
    reference
      "13.24, 13.25, and 13.26 of IEEE Std 802.1Q.";

    container mst-config-id {
      presence "The presence of this container indicates that MSTP is supported";
      description
        "Containing the MST Configuration Identifier of a Bridge.";
```

```
      reference
        "Item d) in 13.26.";
      leaf format-selector {
        type int32 {
          range "0";
        }
        config true;
        description
          "In an MSTP Bridge, the MST Configuration Identifier's
          Configuration Identifier Format Selector. This has a value of 0
          indicating the format specified in IEEE Std 802.1Q.";
        reference
          "Item a) in 13.8 of IEEE Std 802.1Q.";
      }
      leaf configuration-name {
        type string {
          length "32";
        }
        config true;
        description
          "The Configuration Name in the MST Configuration Identifier.";
        reference
          "Item b) in 13.8:2 of IEEE Std 802.1Q.";
      }
      leaf revision-level {
        type uint32 {
          range "0..65535";
        }
        config true;
        description
          "The Revision Level in the MST Configuration Identifier.";
        reference
          "Item c) in 13.8 of IEEE Std 802.1Q.";
        }
      leaf configuration-digest {
        type binary {
          length "16";
        }
        config false;
        description
        "The Configuration Digest in the MST Configuration Identifier.";
        reference
          "Item d) in 13.8 of IEEE Std 802.1Q.";
      }
    }

    container bridge-mstp {
      presence "The presence of this container indicates that MSTP is supported";
      description
        "Per-Bridge configuration and management parameters for the IST
         and each MSTI in an MST Region.";
      reference
        "Clause 13, 13.26 of IEEE Std 802.1Q.";
      leaf max-hops {
        type int32 {
          range "6..100";
        }
        default "20";
        config true;
        description
          "In an MSTP Bridge, the MaxHops parameter for the IST, also used
          for each of the MSTIs.

          The value of this object MUST be retained across reinitializations
          of the management system.";
        reference
          "Clause 13, Table 13-5, 13.26.4, item g) in 13.26 of
          IEEE Std 802.1Q.";
      }
      leaf ist-internal-root-path-cost {
        type uint32;
        config false;
```

```
        description
          "The Internal Root Path Cost for the IST calculated by this
          Bridge after the addition of the Internal Port Path Cost for the
          Root Port (or Master Port) for this IST (MSTID 0) or MST.";
        reference
          "13.9, 13.10, 13.5.3, 13.26.10 and item i) in 13.26 of
          IEEE Std 802.1Q.";
      }
      list mst {
        key "mstid";
        description
          "Per-Bridge configuration and management parameters for each MST,
          with an MSTID in the range allocated for MSTP configuration.";
        reference
          " ";
        leaf mstid {
          type uint16 {
            range "1..4091";
          }
            description
              "MSTIDs allocated for use by MSTP (1..4091) to identify MSTIs.
              Other MSTIDs in the 12-bit range are reserved [for use in
              the MST Configuration Table, whose configuration is identified
              by the Configuration Digest in the MST Configuration Identifier
               (mst-config-id/configuration-digest)] for the CIST-MSTID,
              SPBM-MSTID, SPBV-MSTID, TE-MSTID, and SPVID-Poll-MSTID.";
            reference
              "8.4, 8.6.1, 8.9.3, 13.2.1 of IEEE Std 802.1Q.";
        }
        leaf port-id-priority {
          type dot1qtypes:priority-type;
          config true;
          description
            "The priority component of this Bridge Port's Port Identifier for
            the MSTI, encoded in the four most-significant bits of octet 15 of
            the MSTI Configuration Message.

            The value of this object MUST be retained across reinitializations
            of the management system.";
          reference
            "13.26.3, 13.11, 14.4.1, and
            item f) in 13.26 of IEEE Std 802.1Q."; //!!
        }
        leaf internal-root-path-cost {
          type uint32;
          config false;
          description
            "The Internal Root Path Cost for this MSTI calculated by this
            Bridge after the addition of the Internal Port Path Cost for the
            Root Port (or Master Port) for this MSTI.";
          reference
            "13.9, 13.10, 13.5.3, 13.26.10 and item i) in 13.26 of
            IEEE Std 802.1Q.";
        }
        leaf root-port-number {
          type dot1qtypes:port-number-type;
          config false;
          description
            "The port number  of the Root Port for this MSTI.";
          reference
          "13.4, 13.5, 13.26.9, and item h) in 13.26 of IEEE Std 802.1Q.";//!!
        }
      }
    }
  }
  augment "/if:interfaces/if:interface/dot1q:bridge-port" {
    when "rstp:rstp";
    description
      "Augment RSTP Bridge Port with MSTP configuration";
    reference
      "13.24, 13.25, and 13.27 of IEEE Std 802.1Q.";
    container port-mstp {
```

```
      presence "The presence of this container indicates that MSTP is supported";
      description
        "Per-Bridge Port configuration and management parameters for the IST
         and each MSTI in an MST Region.";
      list mst {
        key "mstid";
        description
          "Per-Bridge Port configuration and management parameters for each MST,
          with an MSTID in the range allocated for MSTP configuration.";
        reference
          " ";
        leaf mstid {
          type uint16 {
            range "1..4091";
            }
            description
              "MSTIDs allocated for use by MSTP (1..4091) to identify MSTIs.";
            reference
              "8.4, 8.6.1, 8.9.3, 13.2.1 of IEEE Std 802.1Q.";
        }
        leaf msti-port-state {
          type enumeration {
            enum discarding {
              value 1;
            }
            enum learning {
              value 2;
            }
            enum forwarding {
              value 3;
            }
          }
          config false;
          description
            "The port's Port State, summarizing the application of learning to
            received frames, and the forwarding of relayed frames, for frames
            assigned to this MSTI.";
          reference
            "8.4, 13.4, item aw) and item ba) in 13.27 of IEEE Std 802.1Q.";
        }
        leaf msti-port-role {
          type enumeration {
            enum disabled-port {
              value 1;
            }
            enum root-port {
              value 2;
            }
            enum designated-port {
              value 3;
            }
            enum alternate-port {
              value 4;
            }
            enum backup-port {
              value 5;
            }
            enum master-port {
              value 6;
            }
          }
          config false;
          description
            "The port's Port Role for the MSTI. Disabled Port, Root Port,
            Designated Port, Alternate Port, Backup Port, or Master Port.";
          reference
            "13.4, 13.5, 13.12, 13.24, 13.27.66, and item bn) in 13.27 of
            IEEE Std 802.1Q.";//!!
        }
        leaf msti-bridge-id-priority {
          type dot1qtypes:priority-type;
          config true;
```

```
          description
            "The priority component of this Bridge's Bridge Identifier for the
            MSTI, encoded in the four most-significant bits of octet 14 of the
            MSTU Configuration Message.

            The value of this object MUST be retained across reinitializations
            of the management system.";
          reference
            "13.26.3, 13.11, 14.4.1, and item f) in 13.26 of IEEE Std 802.1Q.";
        }
        leaf msti-internal-port-path-cost {
          type uint32;
          config true;
          description
            "The Internal Port Path Cost for this Bridge Port and MSTI.";
          reference
            "Item b) of 13.2.1, and item ay) in 13.26 of IEEE Std 802.1Q.";
        }
        leaf msti-regional-root-id {
        type uint32;
        config false;
        description
          "The MSTI Regional Root Identifier in Configuration BPDUs transmitted
          by the  Designated Bridge for the attached LAN and this MSTI.";
        reference
          "13.27.20, 13.10, and item ar) in 13.27 of IEEE Std 802.1Q.";
        }
      }
      leaf msti-internal-root-path-cost {
        type int32;
        config false;
        description
          "The MSTI Internal Path Cost advertised in BPDUS by the Designated
          Bridge for the attached LAN and this MSTI.";
        reference
          "27.6, 14.4.1, 13.27.20, 14.4.1, and item ar) in 13.27 of
          IEEE Std 802.1Q."; //!!
      }
      leaf msti-designated-bridge-id {
        type uint32;
        config false;
        description
          "The Bridge Identifier of the Bridge that this port considers to be
          the Designated Bridge for the attached LAN and this MSTI.";
        reference
          "13.27.20, 13.10, and item ar) in 13.27 of IEEE Std 802.1Q.";
      }
      leaf msti-designated-port-id {
        type binary {
          length "2";
        }
        config false;
        description
          "The Port Identifier of the Bridge Port that this port considers to
          be the Designated Port for the attached LAN and this MSTI.";
        reference
          "13.27.20, 13.10, and item ar) in 13.27 of IEEE Std 802.1Q.";
      }
    }
  }
}
```

Annex A

(normative)

PICS proforma—Bridge implementations[9]

A.47 YANG

Insert the following rows at the end of the table in A.47 (unchanged rows not shown):

Item	Feature	Status	References	Support
YANG-RSTP	Is the *ieee802-dot1q-rstp* module supported?	RSTP:O	48.6.26	Yes [ ] No [ ] N/A [ ]
YANG-MSTP	Is the *ieee802-dot1q-mstp* module supported?	MSTP:O	48.6.27	Yes [ ] No [ ] N/A [ ]

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