IEEE STANDARDS ASSOCIATION IEEE

IEEE Standard for Local and Metropolitan Area Networks—

Bridges and Bridged Networks

Amendment 35: Congestion Isolation

IEEE Computer Society

Sponsored by the
LAN/MAN Standards Committee

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

IEEE Std 802.1Qcz™-2023
(Amendment to
IEEE Std 802.1Q™-2018)

IEEE Std 802.1Qcz™-2023
(Amendment to IEEE Std 802.1Q™-2022)

IEEE Standard for Local and Metropolitan Area Networks—

Bridges and Bridged Networks

Amendment 35: Congestion Isolation

Developed by the

LAN/MAN Standards Committee
of the
IEEE Computer Society

Approved 5 June 2023

IEEE SA Standards Board

Abstract: This amendment to IEEE Std 802.1Q™-2022 specifies protocols, procedures, and managed objects that support the isolation of congesting data flows within data center environments.

Keywords: amendment, Bridged Local Area Networks, congestion, congestion isolation, Data Center Bridging, flow control, IEEE 802.1Q™, IEEE 802.1Qcz™, LANs, Local Area Networks, MAC Bridges, priority, Virtual Bridged Local Area Networks, virtual LANs

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

PDF: ISBN 978-1-5044-9809-8 STD26233
Print: ISBN 978-1-5044-9810-4 STDPD26233

Important Notices and Disclaimers Concerning IEEE Standards Documents

IEEE Standards documents are made available for use subject to important notices and legal disclaimers. These notices and disclaimers, or a reference to this page (https://standards.ieee.org/ipr/disclaimers.html), appear in all standards and may be found under the heading “Important Notices and Disclaimers Concerning IEEE Standards Documents.”

Notice and Disclaimer of Liability Concerning the Use of IEEE Standards Documents

IEEE Standards documents are developed within IEEE Societies and subcommittees of IEEE Standards Association (IEEE SA) Board of Governors. IEEE develops its standards through an accredited consensus development process, which brings together volunteers representing varied viewpoints and interests to achieve the final product. IEEE standards are documents developed by volunteers with scientific, academic, and industry-based expertise in technical working groups. Volunteers are not necessarily members of IEEE or IEEE SA and participate without compensation from IEEE. While IEEE administers the process and establishes rules to promote fairness in the consensus development process, IEEE does not independently evaluate, test, or verify the accuracy of any of the information or the soundness of any judgments contained in its standards.

IEEE makes no warranties or representations concerning its standards, and expressly disclaims all warranties, express or implied, concerning this standard, including but not limited to the warranties of merchantability, fitness for a particular purpose and non-infringement. IEEE Standards documents do not guarantee safety, security, health, or environmental protection, or guarantee against interference with or from other devices or networks. In addition, IEEE does not warrant or represent that the use of the material contained in its standards is free from patent infringement. IEEE Standards documents are supplied “AS IS” and “WITH ALL FAULTS.”

Use of an IEEE standard is wholly voluntary. The existence of an IEEE standard does not imply that there are no other ways to produce, test, measure, purchase, market, or provide other goods and services related to the scope of the IEEE standard. Furthermore, the viewpoint expressed at the time a standard is approved and issued is subject to change brought about through developments in the state of the art and comments received from users of the standard.

In publishing and making its standards available, IEEE is not suggesting or rendering professional or other services for, or on behalf of, any person or entity, nor is IEEE undertaking to perform any duty owed by any other person or entity to another. Any person utilizing any IEEE Standards document, should rely upon their own independent judgment in the exercise of reasonable care in any given circumstances or, as appropriate, seek the advice of a competent professional in determining the appropriateness of a given IEEE standard.

IN NO EVENT SHALL IEEE BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO: THE NEED TO PROCURE SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE PUBLICATION, USE OF, OR RELIANCE UPON ANY STANDARD, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE AND REGARDLESS OF WHETHER SUCH DAMAGE WAS FORESEEABLE.

Translations

The IEEE consensus balloting process involves the review of documents in English only. In the event that an IEEE standard is translated, only the English version published by IEEE is the approved IEEE standard.

Official statements

A statement, written or oral, that is not processed in accordance with the IEEE SA Standards Board Operations Manual shall not be considered or inferred to be the official position of IEEE or any of its committees and shall not be considered to be, nor be relied upon as, a formal position of IEEE. At lectures, symposia, seminars, or educational courses, an individual presenting information on IEEE standards shall make it clear that the presenter's views should be considered the personal views of that individual rather than the formal position of IEEE, IEEE SA, the Standards Committee, or the Working Group. Statements made by volunteers may not represent the formal position of their employer(s) or affiliation(s).

Comments on standards

Comments for revision of IEEE Standards documents are welcome from any interested party, regardless of membership affiliation with IEEE or IEEE SA. However, **IEEE does not provide interpretations, consulting information, or advice pertaining to IEEE Standards documents**.

Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments. Since IEEE standards represent a consensus of concerned interests, it is important that any responses to comments and questions also receive the concurrence of a balance of interests. For this reason, IEEE and the members of its Societies and subcommittees of the IEEE SA Board of Governors are not able to provide an instant response to comments, or questions except in those cases where the matter has previously been addressed. For the same reason, IEEE does not respond to interpretation requests. Any person who would like to participate in evaluating comments or in revisions to an IEEE standard is welcome to join the relevant IEEE working group. You can indicate interest in a working group using the Interests tab in the Manage Profile & Interests area of the IEEE SA myProject system.[1] An IEEE Account is needed to access the application.

Comments on standards should be submitted using the Contact Us form.[2]

Laws and regulations

Users of IEEE Standards documents should consult all applicable laws and regulations. Compliance with the provisions of any IEEE Standards document does not constitute compliance to any applicable regulatory requirements. Implementers of the standard are responsible for observing or referring to the applicable regulatory requirements. IEEE does not, by the publication of its standards, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

Data privacy

Users of IEEE Standards documents should evaluate the standards for considerations of data privacy and data ownership in the context of assessing and using the standards in compliance with applicable laws and regulations.

---

[1] Available at: https://development.standards.ieee.org/myproject-web/public/view.html#landing.

[2] Available at: https://standards.ieee.org/content/ieee-standards/en/about/contact/index.html.

Copyrights

IEEE draft and approved standards are copyrighted by IEEE under U.S. and international copyright laws. They are made available by IEEE and are adopted for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of engineering practices and methods. By making these documents available for use and adoption by public authorities and private users, neither IEEE nor its licensors waive any rights in copyright to the documents.

Photocopies

Subject to payment of the appropriate licensing fees, IEEE will grant users a limited, non-exclusive license to photocopy portions of any individual standard for company or organizational internal use or individual, non-commercial use only. To arrange for payment of licensing fees, please contact Copyright Clearance Center, Customer Service, 222 Rosewood Drive, Danvers, MA 01923 USA; +1 978 750 8400; https://www.copyright.com/. Permission to photocopy portions of any individual standard for educational classroom use can also be obtained through the Copyright Clearance Center.

Updating of IEEE Standards documents

Users of IEEE Standards documents should be aware that these documents may be superseded at any time by the issuance of new editions or may be amended from time to time through the issuance of amendments, corrigenda, or errata. An official IEEE document at any point in time consists of the current edition of the document together with any amendments, corrigenda, or errata then in effect.

Every IEEE standard is subjected to review at least every 10 years. When a document is more than 10 years old and has not undergone a revision process, it is reasonable to conclude that its contents, although still of some value, do not wholly reflect the present state of the art. Users are cautioned to check to determine that they have the latest edition of any IEEE standard.

In order to determine whether a given document is the current edition and whether it has been amended through the issuance of amendments, corrigenda, or errata, visit IEEE Xplore or contact IEEE.[3] For more information about the IEEE SA or IEEE's standards development process, visit the IEEE SA Website.

Errata

Errata, if any, for all IEEE standards can be accessed on the IEEE SA Website.[4] Search for standard number and year of approval to access the web page of the published standard. Errata links are located under the Additional Resources Details section. Errata are also available in IEEE Xplore. Users are encouraged to periodically check for errata.

Patents

IEEE standards are developed in compliance with the IEEE SA Patent Policy.[5]

Attention is called to the possibility that implementation of this standard may require use of subject matter covered by patent rights. By publication of this standard, no position is taken by the IEEE with respect to the existence or validity of any patent rights in connection therewith. If a patent holder or patent applicant has

[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.

filed a statement of assurance via an Accepted Letter of Assurance, then the statement is listed on the IEEE SA Website at https://standards.ieee.org/about/sasb/patcom/patents.html. Letters of Assurance may indicate whether the Submitter is willing or unwilling to grant licenses under patent rights without compensation or under reasonable rates, with reasonable terms and conditions that are demonstrably free of any unfair discrimination to applicants desiring to obtain such licenses.

Essential Patent Claims may exist for which a Letter of Assurance has not been received. The IEEE is not responsible for identifying Essential Patent Claims for which a license may be required, for conducting inquiries into the legal validity or scope of Patents Claims, or determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance, if any, or in any licensing agreements are reasonable or non-discriminatory. Users of this standard are expressly advised that determination of the validity of any patent rights, and the risk of infringement of such rights, is entirely their own responsibility. Further information may be obtained from the IEEE Standards Association.

IMPORTANT NOTICE

Technologies, application of technologies, and recommended procedures in various industries evolve over time. The IEEE standards development process allows participants to review developments in industries, technologies, and practices, and to determine what, if any, updates should be made to the IEEE standard. During this evolution, the technologies and recommendations in IEEE standards may be implemented in ways not foreseen during the standard's development. IEEE standards development activities consider research and information presented to the standards development group in developing any safety recommendations. Other information about safety practices, changes in technology or technology implementation, or impact by peripheral systems also may be pertinent to safety considerations during implementation of the standard. Implementers and users of IEEE Standards documents are responsible for determining and complying with all appropriate safety, security, environmental, health, and interference protection practices and all applicable laws and regulations.

Participants

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*
Paul Congdon, *Editor*

Katsuyuki Akizuki
Konstantinos Alexandris
Venkat Arunarthi
Ralf Assmann
Huajie Bao
Rudy Belliardi
Jeremias Blendin
Christian Boiger
Paul Bottorff
Radhakrishna Canchi
Feng Chen
Abhijit Choudhury
Rodney Cummings
Josef Dorr
Hesham Elbakoury
Anna Engelmann
Thomas Enzinger
Janos Farkas
Donald Fedyk
Norman Finn
Geoffrey Garner
Amrit Gopal
Craig Gunther
Marina Gutierrez
Stephen Haddock
Mark Hantel
Marc Holness
Daniel Hopf
Woojung Huh
Satoko Itaya
Yoshihiro Ito
Michael Karl
Stephan Kehrer
Marcel Kiessling
Gavin Lai
Yizhou Li
Joao Lopes
Lily Lv
Christophe Mangin
Scott Mansfield
Olaf Mater
David McCall
Larry McMillan
Martin Mittelberger
Hiroki Nakano
Takumi Nomura
Donald R Pannell
Dieter Proell
Karen Randall
Maximilian Riegel
Silvana Rodrigues
Atsushi Sato
Frank Schewe
Michael Seaman
Maik Seewald
Ramesh Sivakolundu
Johannes Specht
Marius Stanica
Guenter Steindl
Nemanja Stamenic
Karim Traore
Max Turner
Balazs Varga
Ganesh Venkatesan
Tongtong Wang
Karl Weber
Leon Wessels
Ludwig Winkel
Jordon Woods
Takahiro Yamaura
Uwe Zeier
Nader Zein
William Zhao
Helge Zinner

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

Robert Aiello
Thomas Alexander
Christian Boiger
Vern Brethour
William Byrd
Paul Cardinal
Juan Carreon
Pin Chang
Paul Congdon
Charles Cook
Donald Fedyk
Avraham Freedman
Craig Gunther
Marek Hajduczenia
Marco Hernandez
David Hess
Hyeong Ho Ho
Werner Hoelzl
Seung-Ho Hong
Yasuhiro Hyakutake
Raj Jain
Pranav Jha
Lokesh Kabra
Piotr Karocki
Randy Kelsey
Stuart Kerry
Evgeny Khorov
Yongbum Kim
David Kornbau
Glen Kramer
Christophe Mangin
Scott Mansfield
Roger Marks
Brett McClellan
Jonathon McLendon
Michael Montemurro
Satoshi Obara
Glenn Parsons
Bansi Patel
Arumugam Paventhan
Rick Pimpinella
Clinton Powell
Dieter Proell
Alon Regev
Maximilian Riegel
Robert Robinson
Benjamin Rolfe
Jessy V. Rouyer
Peter Saunderson
Eugene Stoudenmire
Gerald Stueve
David Tepen
Max Turner
Mark-Rene Uchida
James Van De Ligt
John Vergis
Stephen Webb
Karl Weber
Scott Willy
Peter Wu
Yu Yuan
Oren Yuen

When the IEEE SA Standards Board approved this standard on 5 June 2023, it had the following membership:

David J. Law, *Chair*
Ted Burse, *Vice Chair*
Gary Hoffman, *Past Chair*
Konstantinos Karachalios, *Secretary*

Sara R. Biyabani	Joseph S. Levy	Paul Nikolich
Doug Edwards	Howard Li	Annette D. Reilly
Ramy Ahmed Fathy	Johnny Daozhuang Lin	Robby Robson
Guido R. Hiertz	Gui Lin	Lei Wang
Yousef Kimiagar	Xiaohui Liu	F. Keith Waters
Joseph L. Koepfinger*	Kevin W. Lu	Karl Weber
Thomas Koshy	Daleep C. Mohla	Philip B. Winston
John D. Kulick	Andrew Myles	Don Wright

*Member Emeritus

Introduction

This introduction is not part of IEEE Std 802.1Qcz™-2023, IEEE Standard for Local and metropolitan area networks—Bridges and Bridged Networks—Amendment 35: Congestion Isolation.

IEEE Std 802.1Qcz™-2023—Amendment 35: Congestion Isolation specifies protocols, procedures, and managed objects that support the isolation of congesting data flows within data center environments. Congestion isolation capable systems identify flows creating congestion, adjust transmission selection for packets of those flows, and signal to neighbors. This mechanism reduces head-of-line blocking for non-congesting flows sharing a traffic class in lossless networks. Congestion Isolation is intended to be used with higher layer protocols that utilize end-to-end congestion control in order to reduce packet loss and latency.

Contents

Figures

Tables

IEEE Standard for
Local and Metropolitan Area Networks—

Bridges and Bridged Networks

Amendment 35:
Congestion Isolation

(This amendment is based on IEEE Std 802.1Q™-2022.)

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. [6]

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

1. Overview

1.3 Introduction

Insert new text at the end of 1.3 as follows:

This standard specifies protocols, procedures, and managed objects that support the isolation of congesting data flows within data center environments. This is achieved by enabling systems to individually identify flows creating congestion, isolate those flows to the congesting queue, and signal to neighbors. This mechanism reduces head-of-line blocking for non-congesting flows sharing the same traffic class. Congestion Isolation is used with higher layer protocols that utilize end-to-end congestion control in order to reduce packet loss and latency. To this end, it:

ct) Defines a means for VLAN-aware Bridges that support congestion isolation to identify flows that are creating congestion.

cu) Defines a means for adjusting transmission selection for frames of congesting flows.

cv) Provides a means for discovering peer VLAN-aware Bridges and stations that support congestion isolation.

cw) Defines a means for signaling congestion isolation to supporting peer Bridges and stations.

cx) Defines a means for recognizing a system’s level and port orientation within the topology relative to the edge.

2. Normative references

Insert the following references into Clause 2 in alphanumeric order:

IEEE Std 802.1CS™, IEEE Standard for Local and Metropolitan Area Networks—Link-local Registration Protocol.[7, 8]

IETF RFC 768 (STD0006), User Datagram Protocol, August 1980.[9]

IETF RFC 791 (STD0005), Internet Protocol—DARPA Internet Program Protocol Specification, September 1981.

IETF RFC 3168, The Addition of Explicit Congestion Notification (ECN) to IP, September 2001.

IETF RFC 3232, Assigned Numbers: RFC 1700 is Replaced by an On-line Database, January 2002.

IETF RFC 6335, Internet Assigned Numbers Authority (IANA) Procedures for the Management of the Service Name and Transport Protocol Port Number Registry, August 2011.

IETF RFC 8200 (STD0086), Internet Protocol, Version 6 (IPv6) Specification, July 2017.

[7] The IEEE standards or products referred to in Clause 2 are trademarks owned by The Institute of Electrical and Electronics Engineers, Incorporated.
[8] IEEE publications are available from The Institute of Electrical and Electronics Engineers (https://standards.ieee.org/).
[9] IETF RFCs are available from the Internet Engineering Task Force (https://www.ietf.org/).

3. Definitions

Insert the following definitions in the appropriate collating sequence, renumbering accordingly:

3.1 congesting flow: A sequence of frames the end-to-end congestion controlled higher layer protocol treats as belonging to a single flow that is experiencing congestion within a congestion isolation aware system.

3.2 congestion isolation aware system: A Bridge component conforming to the congestion isolation provisions of this standard.

3.3 Congestion Isolation Message (CIM): A message transmitted by a congestion isolation aware system, conveying congesting flow information used by the upstream peer congestion isolation aware system.

3.4 Congestion Isolation Point (CIP): A Virtual Local Area Network (VLAN) Bridge or end station Port function that monitors a set of queues for congesting flows, isolates congesting flows to a congesting queue, and can generate Congestion Isolation Messages.

4. Abbreviations

Insert the following abbreviations into Clause 4, in the appropriate collating sequence:

CI	Congestion Isolation
CIM	Congestion Isolation Message
CIP	Congestion Isolation Point

5. Conformance

5.4 VLAN Bridge component requirements

5.4.1 VLAN Bridge component options

Insert new list item ag) at the end of the lettered list in 5.4.1 as follows:

ag) Support for Congestion Isolation (CI) operation (5.4.7).

5.4.1.6 ETS Bridge requirements

Insert new list item a) at the beginning of the lettered list in 5.4.1.6 as follows, renumbering all subsequent items:

a) Support the ETS algorithm (8.6.8.3).

Insert 5.4.7 after 5.4.6 as follows:

5.4.7 VLAN Bridge requirements for congestion isolation (optional)

A VLAN-aware Bridge implementation that conforms to the provisions of this standard for congestion isolation in Clause 49 shall:

a) Support, on one or more Ports, the creation of at least one Congestion Isolation Point (49.3.1).
b) Support Explicit Congestion Notification (ECN) as defined by IETF RFC 3168 and associated updates along with Active Queue Management (AQM) as described in 49.2.1.
c) Support per-stream classification and metering for CI as specified in 8.6.5.2.3.
d) Support, at each Congestion Isolation Point, the variables and procedures of the Congestion Isolation Protocol (49.4).
e) Support the ability to configure the variables controlling the operation of Congestion Isolation (12.33.1), the CI Peer Table (12.33.2), the CI Stream Table (12.33.3), and each CIP (12.33.4).
f) Conform to the required capabilities of IEEE Std 802.1AB.
g) Support the use of the Congestion Isolation TLV in LLDP (D.2.15).

A VLAN Bridge implementation that conforms to the provisions of this standard for congestion isolation may:

h) Support the monitoring of more than one queue on a Bridge Port (49.4.1.2.5).
i) Support transmission selection algorithms other than strict priority.
j) Support the de-isolation of congesting flows by means other than the empty status of a congesting queue (49.2.6).
k) Support the Congestion Isolation YANG model (48.3.8).
l) Support Topology Recognition (49.5).

Insert 5.32 after 5.31 as follows:

5.32 End station requirements for congestion isolation

An end station implementation that conforms to the provisions of this standard for congestion isolation in Clause 49 shall:

a) Support Explicit Congestion Notification (ECN) as defined by IETF RFC 3168 and associated updates along with Active Queue Management (AQM) as described in 49.2.1.
b) Support, at each Congestion Isolation Point, the variables and procedures of the Congestion Isolation Protocol (49.4).
c) Conform to the required capabilities of IEEE Std 802.1AB.
d) Support the use of the Congestion Isolation TLV in LLDP (D.2.15).

An end station implementation that conforms to the provisions of this standard for congestion isolation in Clause 49 may:

e) Support transmission selection algorithms other than strict priority.
f) Support the de-isolation of congesting flows by means other than the empty status of a congesting queue (49.2.6).
g) Support the Congestion Isolation YANG model (48.3.8).
h) Support non-relay end station or server functionality of Topology Recognition (49.5).

6. Support of the MAC Service

6.10 Support of the ISS/EISS by PIPs

6.10.1 Data indications

Change the first paragraph of 6.10.1 as follows:

On receipt of an M_UNITDATA.indication primitive from the PIP-ISS, if the PIP is congestion aware (5.4.1.4) and the initial octets of the mac_service_data_unit contain a valid CNM encapsulation, the received frame is processed according to 32.16. If the PIP is congestion isolation aware (5.4.7) and the initial octets of the mac_service_data_unit contain a valid CIM encapsulation (49.4.3), the received frame is processed according to 49.4.2.6. Otherwise, the received frame shall be discarded if:

8. Principles of Bridge operation

8.6 The Forwarding Process

8.6.5 Flow classification and metering

Change the text in 8.6.5 as follows:

The Forwarding Process can apply flow classification and metering to frames that are received on a Bridge Port and have one or more potential transmission ports. Bridge Ports and end stations may support Per-Stream Filtering and Policing (PSFP), Asynchronous Traffic Shaping (ATS) filtering and eligibility time assignment, Congestion Isolation (CI), or the general flow classification rules specified in 8.6.5.1.

NOTE—The general flow classification and metering specification was added to this standard by IEEE Std 802.1Q-2005, PSFP by IEEE Std 802.1Qci-2017, ~~and~~ ATS by IEEE Std 802.1Qcr-2020, and CI by IEEE Std 802.1Qcz-2023.

PSFP ~~and ATS~~, ATS, and CI share common per-stream classification and metering elements, as shown in Figure 8-13. The Stream identification function specified in IEEE Std 802.1CB can be used to associate received frames with these elements.

Change Figure 8-13 as follows:

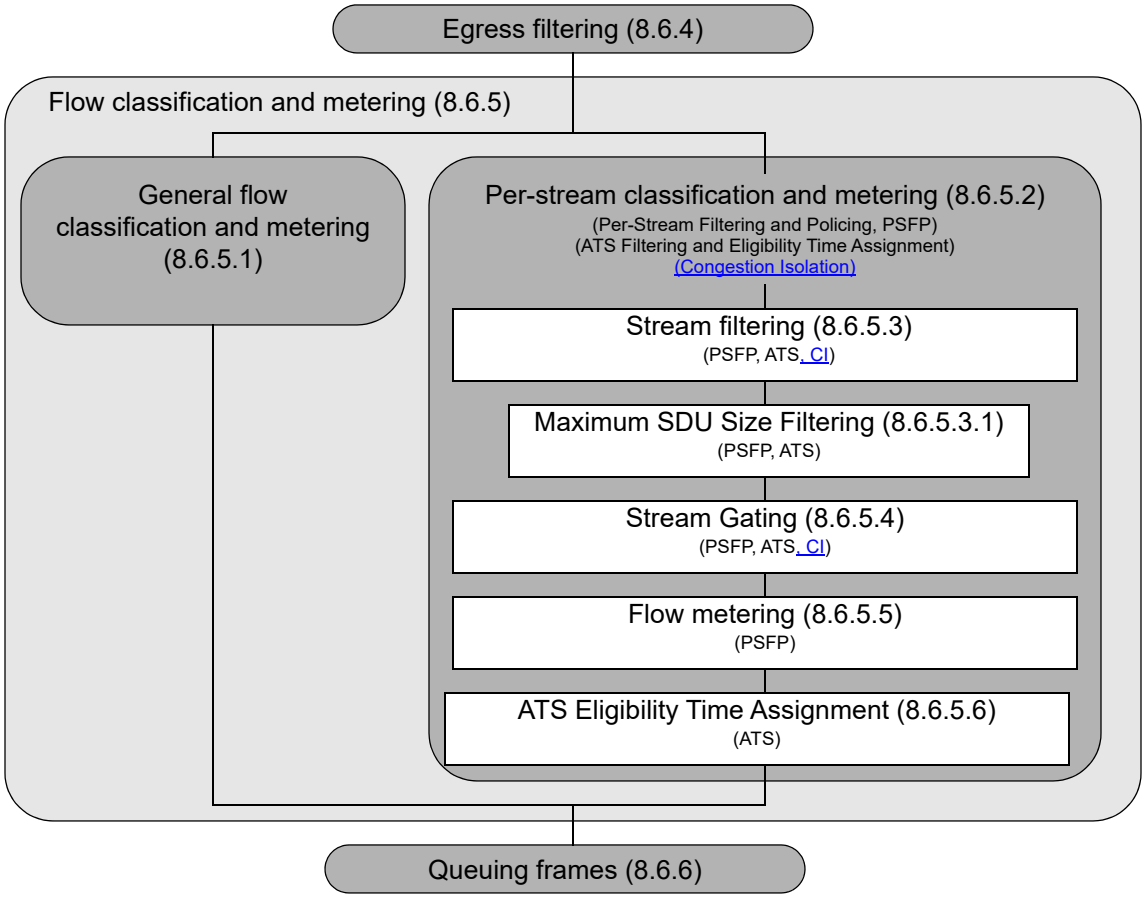


Figure 8-13—Flow classification and metering

8.6.5.2 Per-stream classification and metering

Change the first sentence of 8.6.5.2 as follows:

When Per-Stream Filtering and Policing (PSFP) ~~or Asynchronous Traffic Shaping (ATS)~~, Asynchronous Traffic Shaping (ATS), or Congestion Isolation (CI) is used, filtering and policing decisions for received frames are made, and subsequent queuing (8.6.6) and transmission selection decisions (8.6.8) supported, as follows:

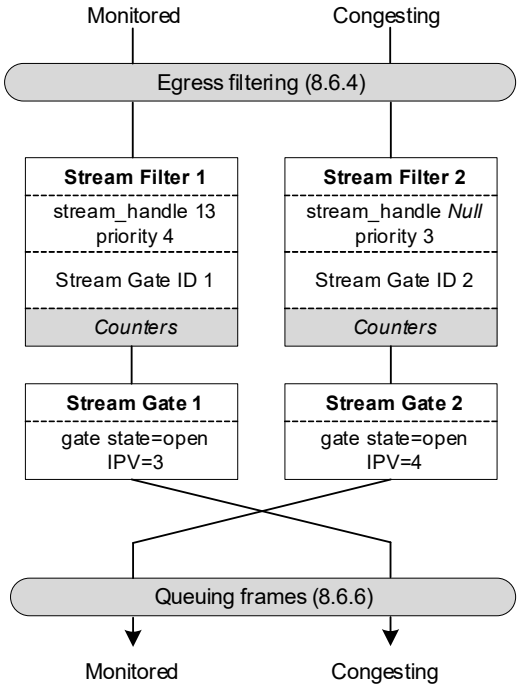
Insert 8.6.5.2.3 after 8.6.5.2.2 as follows:

8.6.5.2.3 CI Support

Each Bridge component or an end station that implements Congestion Isolation supports stream identification and stream gates to allow traffic class modification, with the following:

a) A single Stream Filter Instance Table (8.6.5.3).
b) A single Stream Gate Instance Table (8.6.5.4).

The relationship between stream filters and stream gates for streams subject to CI processing (as identified by the stream filter) is illustrated by Figure 8-15a for a number of streams.



KEY
Stream ID: stream filter instance identifier (8.6.5.3)
Gate ID: stream gate instance identifier (8.6.5.3, 8.6.5.4)

Figure 8-15a—Per-stream classification and assignment for CI

Congestion isolation uses two stream filter instances from the stream filter instance table (8.6.5.3) to select stream gate instances that will modify the priority of flows. One stream filter instance is used to modify the priority of congesting flows from the monitored queue to the congesting queue. The other stream filter instance is used to modify the priority of congesting flows from the congesting queue back to the monitored queue. There are no *filter specifications* used by congestion isolation.

The *stream_handle* and *priority* parameters associated with a received frame select the stream filter instance of congestion isolation for a particular monitored traffic class. The purpose of the stream filter is to select the stream gate instance that will modify the priority of congesting flow frames so they will traverse the congesting queue. The absence of a *stream_handle* and the *priority* parameter associated with a received frame select the stream gate instance that will modify the priority of received frames back to the priority of the monitored queue.

NOTE—Changes to the frame's priority are intended to persist (see 49.2.4 and 49.2.6) by modifying the Priority Code Point (see 6.9.3) or other indicators used to select the traffic class, such as the Differentiated Services Code Point (see IETF RFC 2474). As noted in 6.8.1, modification to a frame will require the FCS to be regenerated. Options for regenerating the FCS are discussed in Annex O.

Congestion isolation uses two stream gate instances from the stream gate instance table (8.6.5.4) to modify the priority of flows. The operational and an administrative *stream gate state* (8.6.10.4, 8.6.10.5, 12.31.3) is set to Open for Congestion Isolation and the *GateClosedDueToInvalidRxEnable* and *GateClosedDueToOctetsExceededEnable* parameters are set to FALSE. The internal priority value (IPV) is used in place of the priority value associated with the frame to determine the frame's traffic class, using the Traffic Class Table as specified in 8.6.6. The *stream gate control list* feature is not used by Congestion Isolation and is set to null.

8.6.5.3 Stream filtering

Change second paragraph and associated list in 8.6.5.3 as follows:

Each stream filter comprises the following:

a) An integer *stream filter identifier*.
b) A *stream_handle* specification, either:
   1) A single value, as specified in IEEE Std 802.1CB.
   2) A wildcard, that matches any *stream_handle*.
   3) If congestion isolation is supported, a null-handle, that matches when no stream_handle is provided.
c) A *priority* specification, either:
   1) A single priority value.
   2) A wildcard value that matches any priority value.
d) Maximum SDU size filtering (8.6.5.3.1) information, comprising:
   1) An integer *Maximum SDU size*, in octets. A value of 0 disables maximum SDU size filtering for this stream filter.
   2) A boolean *StreamBlockedDueToOversizeFrameEnable* parameter.
   3) A boolean *StreamBlockedDueToOversizeFrame* parameter.
e) An integer *stream gate identifier* (8.6.5.4).
f) An integer *flow meter instance identifier* (8.6.5.5).
   If this parameter is absent, frames associated with the stream filter are not subject to flow metering.
g) An integer ATS *scheduler instance identifier* (8.6.5.6).
   If this parameter is absent, frames associated with the stream filter are not subject to ATS scheduling and transmission selection.

8.6.5.4 Stream gating

Change NOTE 1 in 8.6.5.4 as follows:

NOTE 1—The IPV facilitates ATS per-hop delay bound adjustment to satisfy specific networks' end-to-end delay requirements. Annex T (CQF) describes another IPV use case. Another use case is the ability to isolate congesting flows to a congesting flow queue as specified by Congestion Isolation (Clause 49).

8.6.5.5 Flow metering

Insert the following after list item j), renumbering subsequent list items as necessary:

Each frame has a predetermined color for subsequent processing by a flow meter. If this color is determined by the drop_eligible parameter (6.9.1), the color is determined as follows:

k) If the drop_eligible parameter is FALSE, the color is green.
l) If the drop_eligible parameter is TRUE, the color is yellow.

8.6.6 Queuing frames

Change the third to last paragraph of 8.6.6 as follows:

In a congestion-aware Bridge (Clause 30) or a congestion isolation aware Bridge (Clause 49), the act of queuing a frame for transmission on a Bridge Port can result in the Forwarding Process generating a CNM or a CIM. The CNM ~~is~~ and CIM are injected back into the Forwarding Process (8.6.1) as if ~~it~~ they had been received on that Bridge Port.

8.6.8 Transmission selection

Insert 8.6.8.6 after 8.6.8.5 as follows:

8.6.8.6 Enhancements for congestion isolation

A Bridge component or an end station may support enhancements to isolate the frames of congesting flows to a designated congesting traffic class. During the isolation of a congesting flow it may be possible for frames of the same flow to queue in both the congesting and non-congesting traffic class. The transmission gate associated with each monitored non-congesting queue and each congesting queue can be used to meet the ordering requirements of 8.6.6. The state of the transmission gate determines whether or not queued frames can be selected for transmission. For a given queue, the transmission gate can be either *Open* or *Closed* as described in 8.6.8.4.

The need to control the transmission gate depends upon the transmission selection algorithm used and the technique for determining when to return a congesting flow to non-congesting status. Congestion isolation specifies that congesting and non-congesting queues use the same Active Queue Management (AQM) approach and the same transmission selection algorithm. Additionally, the congesting queues have lower priority than the monitored non-congesting queues.

When the transmission selection algorithm is strict priority and the technique for returning a congesting flow to non-congesting status is only when the congesting queue is empty, the state of the transmission gate can be set to *Open*. When the transmission selection algorithm is anything other than strict priority or the technique for returning a congesting flow to non-congesting status allows for congesting frames to exist in the congesting queue during the transition, the state of the transmission gate is controlled by the cipGateControl (49.4.1.4.1) variable. An example implementation of setting cipGateControl to provide transmission gate control for the purposes of ensuring ordering can be seen in Annex X.

Congestion isolation controls the transmission gate of the congesting and non-congesting queues to maintain the order of congesting flow frames. As a consequence, transmission gates used for congestion isolation cannot be used for other purposes.

12. Bridge management

12.1 Management functions

12.1.1 Configuration Management

Insert new item m) at the end of the lettered list in 12.1.1 as follows:

m) The ability to create and delete the functional elements of congestion isolation and to control their operation.

12.2 VLAN Bridge objects

Insert new item s) at the end of the lettered list in 12.2 as follows:

s) The congestion isolation entities (12.33)

12.31 Managed objects for per-stream classification and metering

12.31.1 The Stream Parameter Table

Change 12.31.1 as follows:

There is one Stream Parameter Table per Bridge component. The table contains a set of parameters that supports PSFP (8.6.5.2.1), ~~and~~ ATS (8.6.5.2.2), and CI (8.6.5.2.3), as detailed in Table 12-34. Tables can be created or removed dynamically in implementations that support dynamic configuration of Bridge components.

Table 12-34—The Stream Parameter Table

Name	Data type	Operations supported[a]	Conformance[b]	References
MaxStreamFilterInstances	integer	R	PSFP, ATS, CI	8.6.5.3, 12.31.2
MaxStreamGateInstances	integer	R	PSFP, ATS, CI	8.6.5.4, 12.31.3
MaxFlowMeterInstances	integer	R	PSFP, ats	8.6.5.5, 12.31.4
SupportedListMax	integer	R	PSFP, ats	8.6.5.4, 12.31.4
MaxSchedulerInstances	integer	R	psfp, ATS	8.6.5.4, 12.31.4
MaxSchedulerGroupInstances	integer	R	psfp, ATS	8.6.5.4, 12.31.4

[a] R= Read only access; RW = Read/Write access.
[b] PSFP = Required for Bridge, Bridge component, or end station support of PSFP.
psfp = Optional for Bridge, Bridge component, or end station support of PSFP.
ATS = Required for Bridge or Bridge component support of ATS.
ats = Optional for Bridge or Bridge component support of ATS.
CI = Required for Bridge or Bridge component support of CI.

12.31.2 The Stream Filter Instance Table

Change Table 12-35 as follows:

Table 12-35—Stream Filter Instance Table

Name	Data type	Operations supported[a]	Conformance[b]	References
StreamFilterInstance	integer	R	PSFP, ATS, CI	8.6.5.3
StreamHandleSpec	stream_handle specification	RW	PSFP, ATS, CI	8.6.5.3
PrioritySpec	priority specification	RW	PSFP, ATS, CI	8.6.5.3
MaximumSDUSize	integer	RW	PSFP, ATS	8.6.5.3.1, 12.31.2.5
StreamGateInstanceID	integer	RW	PSFP, ATS, CI	8.6.5.2, 8.6.5.4
FlowMeterInstanceID	integer	RW	PSFP, ats	8.6.5.5, 12.31.2.5
FlowMeterEnable	Boolean	RW	PSFP, ats	
SchedulerInstanceID	integer	RW	psfp, ATS	
SchedulerEnable	Boolean	RW	psfp, ATS	
MatchingFramesCount	counter	R	PSFP, ats, ci	8.6.5.3
PassingFramesCount	counter	R	PSFP, ats	8.6.5.3, 8.6.5.4
NotPassingFramesCount	counter	R	PSFP, ats	8.6.5.3, 8.6.5.4
PassingSDUCount	counter	R	PSFP, ats	8.6.5.3, 8.6.5.3.1
NotPassingSDUCount	counter	R	PSFP, ats	8.6.5.3, 8.6.5.3.1
REDFramesCount	counter	R	PSFP, ats	8.6.5.3
StreamBlockedDueToOversizeFrameEnable	Boolean	RW	PSFP, ATS	8.6.5.3, 8.6.5.3.1
StreamBlockedDueToOversizeFrame	Boolean	RW	PSFP, ATS	8.6.5.3, 8.6.5.3.1

[a] R= Read only access; RW = Read/Write access.

[b] PSFP = Required for Bridge, Bridge component, or end station support of PSFP.
psfp = Optional for Bridge, Bridge component, or end station support of PSFP.
ATS = Required for Bridge or Bridge component support of ATS.
ats = Optional for Bridge or Bridge component support of ATS.
CI = Required for Bridge component or end station support of CI.
ci = Optional for Bridge component or end station support of CI.

12.31.2.2 stream_handle specification data type

Change 12.31.2.2 as follows:

The stream_handle specification data type allows either of the following to be represented:

a) A stream_handle value, represented as an integer
b) The wild card value
c) If congestion isolation is supported, the null-handle value.

12.31.3 The Stream Gate Instance Table

Change Table 12-36 as follows:

Table 12-36—The Stream Gate Instance Table

Name	Data type	Operations supported[a]	Conformance[b]	References
StreamGateInstance	integer	R	PSFP, ATS, CI	8.6.5.4
StreamGateEnabled	Boolean	RW	PSFP, ATS, CI	8.6.9.4.14
StreamGateAdminGateStates	StreamGateStatesValue	RW	PSFP, ATS, CI	8.6.10.4, 12.29.1.2.2
StreamGateOperGateStates	StreamGateStatesValue	R	PSFP, ATS, CI	8.6.10.5, 12.29.1.2.2
StreamGateAdminControlListLength	unsigned integer	RW	PSFP, ats	8.6.9.4.6, 12.31.3.2
StreamGateOperControlListLength	unsigned integer	R	PSFP, ats	8.6.9.4.22, 12.31.3.2
StreamGateAdminControlList	sequence of StreamGateGateControl Entry	RW	PSFP, ats	8.6.9.4.2, 12.31.3.2, 12.31.3.2.2
StreamGateOperControlList	sequence of StreamGateGateControl Entry	R	PSFP, ats	8.6.9.4.18, 12.31.3.2, 12.31.3.2.2
StreamGateAdminCycleTime	RationalNumber	RW	PSFP, ats	8.6.9.4.3, 12.29.1.3
StreamGateOperCycleTime	RationalNumber (seconds)	R	PSFP, ats	8.6.9.4.19, 12.29.1.3
StreamGateAdminCycleTime Extension	Integer (nanoseconds)	RW	PSFP, ats	8.6.9.4.4
StreamGateOperCycleTimeExtension	Integer (nanoseconds)	R	PSFP, ats	8.6.9.4.20
StreamGateAdminBaseTime	PTPtime	RW	PSFP, ats	8.6.9.4.1, 12.29.1.4
StreamGateOperBaseTime	PTPtime	R	PSFP, ats	8.6.9.4.17, 12.29.1.4
StreamGateConfigChange	Boolean	RW	PSFP, ats	8.6.9.4.7
StreamGateConfigChangeTime	PTPtime	R	PSFP, ats	8.6.9.4.9, 12.29.1.4

Table 12-36—The Stream Gate Instance Table *(continued)*

Name	Data type	Operations supported[a]	Conformance[b]	References
StreamGateTickGranularity	Integer (tenths of nanoseconds)	R	PSFP, ats	8.6.9.4.16
StreamGateCurrentTime	PTPtime	R	PSFP, ats	8.6.9.4.10, 12.29.1.4
StreamGateConfigPending	Boolean	R	PSFP, ats	8.6.9.3, 8.6.9.4.8
StreamGateConfigChangeError	Integer	R	PSFP, ats	8.6.9.3.1
StreamGateAdminIPV	IPV	RW	PSFP, ATS, CI	8.6.5.4, 8.6.10.6, 12.31.3.3
StreamGateOperIPV	IPV	RW	PSFP, ats, CI	8.6.5.4, 8.6.10.7, 12.31.3.3
StreamGateGateClosedDueToInvalidRx-Enable	Boolean	RW	PSFP, ats	8.6.5.4
StreamGateGateClosedDueToInvalidRx	Boolean	RW	PSFP, ats	8.6.5.4
StreamGateGateClosedDueToOctetsExceededEnable	Boolean	RW	PSFP, ats	8.6.5.4
StreamGateGateClosedDueToOctetsExceeded	Boolean	RW	PSFP, ats	8.6.5.4

[a] R= Read only access; RW = Read/Write access.

[b] PSFP = Required for Bridge, Bridge component, or end station support of PSFP.
psfp = Optional for Bridge, Bridge component, or end station support of PSFP.
ATS = Required for Bridge or Bridge component support of ATS.
ats = Optional for Bridge or Bridge component support of ATS.
CI = Required for Bridge component or end station support of CI.

Insert 12.33 at the end of Clause 12 as follows:

12.33 Congestion Isolation managed objects

Several variables control the operation of Congestion Isolation in a congestion isolation aware Bridge. The managed objects are as follows:

a) CI entity managed object (12.33.1)
b) CI Peer Table (12.33.2)
c) CI Stream Table (12.33.3)
d) CIP entity managed object (12.33.4)

12.33.1 CI entity managed object

A single instance of the CI entity managed object shall be implemented by a Bridge component or end station that is congestion isolation aware. It comprises all the variables included in the CI entity variables (49.4.1.1) as illustrated in Table 12-42.

Table 12-42—CI entity managed object

Name	Data type	Operations supported[a]	Conformance[b]	References
ciMasterEnable	Boolean	RW	CI	49.4.1.1.1
ciCIMTransmitPriority	unsigned integer [0..7]	R	CI	49.4.1.1.2
ciMaxFlowLife	unsigned integer	R	CI	49.4.1.1.3

[a] R= Read only access; RW = Read/Write access.
[b] CI = Required for Bridge component or end station support of CI.

12.33.2 CI Peer Table

A single instance of the CI Peer Table shall be implemented by a Bridge component or end station that is congestion isolation aware. Each table row contains the parameters needed to assist in the creation of a CIM as illustrated in Table 12-43. There is a row in the table for each port of the Bridge or router that is supporting congestion isolation.

Table 12-43—CI Peer Table entry

Name	Data type	Operations supported[a]	Conformance	References
ciCIMtype	enum{l2, ipv4, ipv6}	R		49.3.6
ciPeerMacAddress	MAC address	R		49.3.6
ciPeerIPv4Address	IPv4 address	R	IETF RFC 791	49.3.6
ciPeerIPv6Address	IPv6 address	R	IETF RFC 8200	49.3.6
ciPeerUDPPort	UDP Port Number	R	IETF RFC 768	49.3.6
ciPeerCIMEncapLen	integer [0..512]	R		49.3.6

[a] R= Read only access; RW = Read/Write access.

12.33.3 CI Stream Table

A single instance of the CI Stream Table (49.3.7) shall be implemented by a Bridge component or end station that is congestion isolation aware. Each table row contains stream management variables associated with a tsnStreamIdEntry object created in the IEEE Std 802.1CB Stream identity table. The variables assist in the processes associated with the isolating and de-isolating of congesting flows. There is a row in the table for each congesting flow as illustrated in Table 12-44.

Table 12-44—CI Stream Table entry

Name	Data type	Operations supported[a]	Conformance[b]	References
ciStreamIdHandle	stream_handle value	R	IEEE Std 802.1CB	49.4.1.5.1
ciCIMCount	integer	RW	CI	49.4.1.5.2
ciCreateTime	sysUpTime (IETF RFC 3418)	R	IETF RFC 3418	49.4.1.5.3
ciStreamCreateMask	2-bit mask	RW	CI	49.4.1.5.4
ciQueueKey	integer	R	CI	49.4.1.5.5
ciDestination_address	MAC address	R	CI	49.4.1.5.6
ciSource_address	MAC address	R	CI	49.4.1.5.7
ciVlan_identifier	12-bit VID	R	CI	49.4.1.5.8
ciMsdu	octet string (size 64..512)	R	CI	49.4.1.5.9

[a] R= Read only access; RW = Read/Write access.
[b] CI = Required for Bridge component or end station support of CI.

12.33.4 CIP entity managed object

There is one Congestion Isolation Point (CIP) managed object for each CIP in a Bridge component or end station that is congestion isolation aware. The CIP managed object comprises some of the variables included in the CIP variables (49.4.1.2) as illustrated in Table 12-45.

Table 12-45—CIP entity managed object

Name	Data type	Operations supported[a]	Conformance[b]	References
cipMacAddress	MAC address	R	CI	49.4.1.2.1
cipIPv4Address	IPv4 address	R	IETF RFC 791	49.4.1.2.2
cipIPv6Address	IPv6 address	R	IETF RFC 8200	49.4.1.2.3
cipCIMUDPPort	UDP Port Number	R	IETF RFC 768	49.4.1.2.4
cipQueueMap[]	array of integers [–8..8]	RW	CI	49.4.1.2.5
cipMinHeaderOctets	integer	RW	CI	49.4.1.2.6
cipMaxCIM	integer	RW	CI	49.4.1.2.7

[a] R= Read only access; RW = Read/Write access.
[b] CI = Required for Bridge component or end station support of CI.

30. Principles of congestion notification

30.1 Congestion notification design requirements

Change item x) in the lettered list in 30.1 as follows:

x) QCN cannot regulate frame transmission by acknowledgments, as does Transmission Control Protocol/Internet Protocol (TCP/IP), see IETF RFC 791 ~~[B18]~~ and IETF RFC 793 [B19].

30.3 Congestion Controlled Flow (CCF)

Change item a) in the lettered list in 30.3 as follows:

a) The frames carrying data for a single User Datagram Protocol (UDP, IETF RFC 768, STD0006 ~~[B17]~~) connection.

46. Time-Sensitive Networking (TSN) configuration

46.2 User/network configuration information

46.2.1 Data types

Change the lettered list in 46.2.1 as follows:

a) Boolean
b) int8, for a signed 8-bit integer
c) int16, for a signed 16-bit integer
d) int32, for a signed 32-bit integer
e) uint8, for an unsigned 8-bit integer
f) uint16, for an unsigned 16-bit integer
g) uint32, for an unsigned 32-bit integer
h) string
i) enumeration, for a collection of named values
j) rational, for a rational number consisting of a uint32 numerator and uint32 denominator
k) mac-address-type, for an IEEE 802 MAC address
l) ipv4-address-type, for an IPv4 address (IETF RFC 791~~[B18]~~)
m) ipv6-address-type, for an IPv6 address (IETF RFC 8200~~[B46]~~)
n) sequence of <X>, for a list of zero or more instances of data type <X> (e.g., sequence of uint32)

46.2.3 Talker

46.2.3.4 DataFrameSpecification

46.2.3.4.4 IPv6-tuple

Change the first sentence in 46.2.3.4.4 as follows:

The IPv6-tuple group specifies fields to identify an IPv6 (RFC 8200~~[B46]~~) Stream.

48. YANG Data Models

48.2 IEEE 802.1Q YANG models

Insert 48.2.8 (including Figure 48-17) after 48.2.7 as follows:

48.2.8 Congestion Isolation (CI) model

The CI model augments the Bridge component model (48.2.1) and the Interface Management model for Bridge ports (48.3.1) by nodes that represent the following managed objects:

a) CI entity managed object (12.33.1)
b) CI Peer Table (12.33.2)
c) CI Stream Table (12.33.3)
d) CIP entity managed object (12.33.4)

The UML representation of the CI model is illustrated in Figure 48-17.

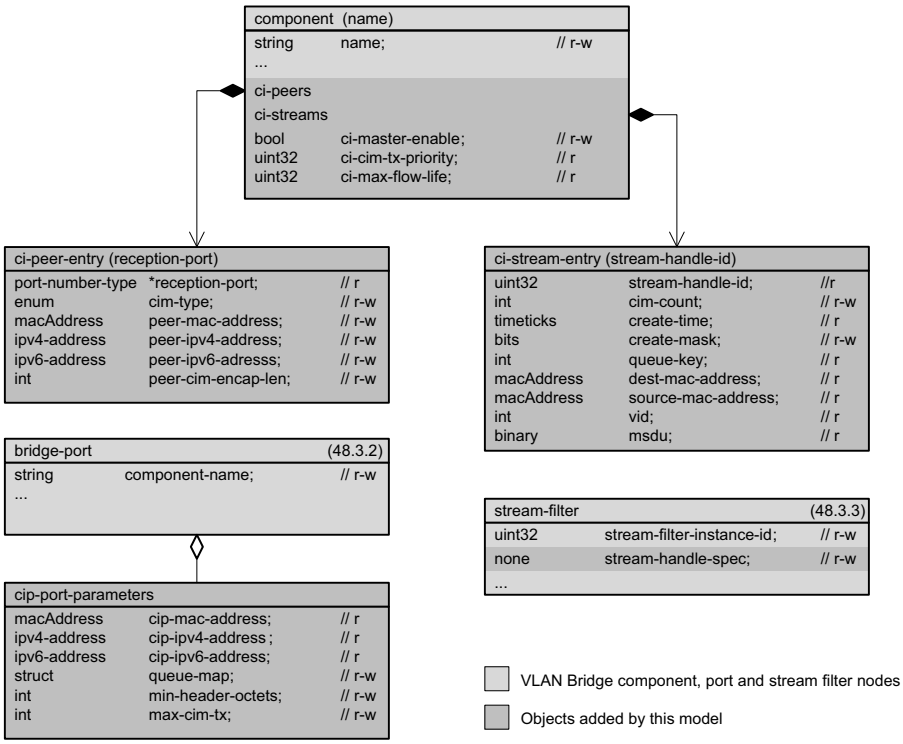


Figure 48-17—Congestion Isolation model

48.3 Structure of the YANG models

Insert a new row for "ieee802-dot1q-stream-filters-gates-bridge" above the row for "ieee802-dot1q-ats", change the row for "ieee802-dot1q-ats", and insert three new rows below it in 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-stream-filters-gates-bridge	48.5.12, 48.6.12	8.6, 8.6.5.3, 8.6.5.4	IEEE Std 802.1Qcz Bridge component augmentation with stream filtering and stream gating capabilities.
ieee802-dot1q-ats	~~48.5.12, 48.6.12~~ 48.5.13, 48.6.13	8.6	IEEE Std 802.1Qcr ATS extensions to ieee802-dot1q-stream-filters-gates and ieee802-dot1q-bridge modules.
ieee802-dot1q-ats-bridge	48.5.14, 48.6.14	8.6	IEEE Std 802.1Qcz Bridge component augmentation with ATS module.
ieee802-dot1q-congestion-isolation	48.5.15, 48.6.15	8.6.5, Clause 49	IEEE Std 802.1Qcz Congestion isolation specific parameters and extensions to the ieee802-dot1q-stream-filters-gates.
ieee802-dot1q-congestion-isolation-bridge	48.5.16, 48.6.16	8.6.5, Clause 49	IEEE Std 802.1Qcz Bridge and Bridge Port extension/augmentation with congestion isolation module.

48.3.7 Asynchronous Traffic Shaping (ATS) model

Change Table 48-7 and Table 48-8 as follows:

Table 48-7—Stream filters and stream gates model YANG modules

YANG module
ieee802-types
ieee802-dot1q-types
ieee802-dot1q-bridge
ieee802-dot1q-stream-filters-gates
ieee802-dot1q-stream-filters-gates-bridge

Table 48-8—ATS model YANG modules

YANG module
ieee802-types
ieee802-dot1q-types
ieee802-dot1q-bridge
ieee802-dot1q-stream-filters-gates
ieee802-dot1q-ats
ieee802-dot1q-ats-bridge

Insert 48.3.8 (including Table 48-9) after 48.3.7 as follows:

48.3.8 Congestion Isolation (CI) model

A system implementing the CI model (48.3.8) implements the YANG modules in Table 48-9.

Table 48-9—CI model YANG modules

YANG module
ieee802-types
ieee802-dot1q-types
ieee802-dot1q-bridge
ieee802-dot1q-stream-filter-gates
ieee802-dot1q-congestion-isolation
ieee802-dot1q-congestion-isolation-bridge

48.4 Security considerations

Insert 48.4.8 after 48.4.7 as follows:

48.4.8 Security considerations of the Congestion Isolation model

There are a number of management objects defined in the ieee802-dot1q-congestion-isolation 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 [B41]), 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 are possible.

The following objects in the ieee802-dot1q-congestion-isolation 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:

bridges/bridge/component/ci-master-enable

bridges/bridge/component/ci-peers/ci-peer-table

bridges/bridge/component/ci-streams

bridges/bridge/component/stream-gates/stream-gate-instance-table

bridges/bridge/component/stream-filters/stream-filter-instance-table

bridges/bridge/component/queue-map

bridges/bridge/component/min-header-octets

bridges/bridge/component/min-cim-tx

48.5 YANG schema tree definitions

48.5.11 Schema for the ieee802-dot1q-stream-filters-gates YANG module

Change 48.5.11 as follows:

This YANG module does not have a YANG schema tree.

```
module: ieee802-dot1q-stream-filters-gates

  augment /dot1q:bridges/dot1q:bridge/dot1q:component:
    +--rw stream-filters
    |  +--rw stream-filter-instance-table* [stream-filter-instance-id]
    |  |  +--rw stream-filter-instance-id                          uint32
    |  |  +--rw (stream-handle-spec)?
    |  |  |  +--:(wildcard)
    |  |  |  |  +--rw wildcard?                                    empty
    |  |  |  +--:(stream-handle)
    |  |  |     +--rw stream-handle                                uint32
    |  |  +--rw priority-spec                                      priority-spec-type
    |  |  +--rw max-sdu-size                                       uint32
    |  |  +--rw stream-blocked-due-to-oversize-frame-enabled?      boolean
    |  |  +--rw stream-blocked-due-to-oversize-frame?              boolean
    |  |  +--rw stream-gate-ref                                    stream-gate-ref
    |  +--ro max-stream-filter-instances?     uint32
    +--rw stream-gates
       +--rw stream-gate-instance-table* [stream-gate-instance-id]
       |  +--rw stream-gate-instance-id     uint32
       |  +--rw gate-enable?                boolean
       |  +--rw admin-gate-states?          gate-state-value-type
       |  +--rw admin-ipv?                  ipv-spec-type
       +--ro max-stream-gate-instances?     uint32
```

Delete the existing 48.5.12 "Schema for the ieee802-dot1q-ats YANG module".

Insert new 48.5.12 "Schema for the ieee802-dot1q-stream-filters-gates-bridge YANG module" after 48.5.11 as follows:

48.5.12 Schema for the ieee802-dot1q-stream-filters-gates-bridge YANG module

```
module: ieee802-dot1q-stream-filters-gates-bridge

  augment /dot1q:bridges/dot1q:bridge/dot1q:component:
    +--rw stream-gates
    |  +--rw stream-gate-instance-table* [stream-gate-instance-id]
    |  |  +--rw stream-gate-instance-id    uint32
    |  |  +--rw gate-enable?               boolean
    |  |  +--rw admin-gate-states?         gate-state-value-type
    |  |  +--rw admin-ipv?                 ipv-spec-type
    |  +--ro max-stream-gate-instances?    uint32
    +--rw stream-filters
       +--rw stream-filter-instance-table* [stream-filter-instance-id]
       |  +--rw stream-filter-instance-id                        uint32
       |  +--rw (stream-handle-spec)?
       |  |  +--:(wildcard)
       |  |  |  +--rw wildcard?                                  empty
       |  |  +--:(stream-handle)
       |  |     +--rw stream-handle                              uint32
       |  +--rw priority-spec
       |  |       priority-spec-type
       |  +--rw max-sdu-size                                     uint32
       |  +--rw stream-blocked-due-to-oversize-frame-enabled?    boolean
       |  +--rw stream-blocked-due-to-oversize-frame?            boolean
       |  +--rw stream-gate-ref                                  leafref
       +--ro max-stream-filter-instances?    uint32
```

Insert new 48.5.13, 48.5.14, 48.5.15, and 48.5.16 after 48.5.12 as follows:

48.5.13 Schema for the ieee802-dot1q-ats YANG module

```
module: ieee802-dot1q-ats
  +--rw stream-gates
  |  +--rw stream-gate-instance-table* [stream-gate-instance-id]
  |  |  +--rw stream-gate-instance-id    uint32
  |  |  +--rw gate-enable?               boolean
  |  |  +--rw admin-gate-states?         gate-state-value-type
  |  |  +--rw admin-ipv?                 ipv-spec-type
  |  +--ro max-stream-gate-instances?    uint32
  +--rw stream-filters
     +--rw stream-filter-instance-table* [stream-filter-instance-id]
     |  +--rw stream-filter-instance-id                        uint32
     |  +--rw (stream-handle-spec)?
     |  |  +--:(wildcard)
     |  |  |  +--rw wildcard?                                  empty
     |  |  +--:(stream-handle)
     |  |     +--rw stream-handle                             uint32
     |  +--rw priority-spec
     |  |       priority-spec-type
     |  +--rw max-sdu-size                                     uint32
     |  +--rw stream-blocked-due-to-oversize-frame-enabled?   boolean
     |  +--rw stream-blocked-due-to-oversize-frame?           boolean
     |  +--rw stream-gate-ref                                  leafref
     |  +--rw schedulers
     |  |  +--rw scheduler-instance-table* [scheduler-instance-id]
     |  |  |  +--rw scheduler-instance-id         uint32
     |  |  |  +--rw committed-information-rate    uint64
     |  |  |  +--rw committed-burst-size          uint32
     |  |  |  +--rw scheduler-group-ref           leafref
     |  |  +--ro max-scheduler-instances?    uint32
     |  +--rw scheduler-groups
     |  |  +--rw scheduler-group-instance-table*
     |  |  |       [scheduler-group-instance-id]
     |  |  |  +--rw scheduler-group-instance-id    uint32
     |  |  |  +--rw max-residence-time             uint32
     |  |  +--ro max-scheduler-group-instances?      uint32
     |  |  +--rw scheduler-timing-characteristics
     |  |     +--ro scheduler-timing-characteristics-table*
     |  |             [reception-port transmission-port]
     |  |        +--ro reception-port
     |  |        |       dot1qtypes:port-number-type
     |  |        +--ro transmission-port
     |  |        |       dot1qtypes:port-number-type
     |  |        +--ro clock-offset-variation-max       uint32
     |  |        +--ro clock-rate-deviation-max         uint32
     |  |        +--ro arrival-recognition-delay-max    uint32
     |  |        +--ro processing-delay-min             uint32
     |  |        +--ro processing-delay-max             uint32
     |  +--rw scheduler
     |     +--rw scheduler-ref?      leafref
     |     +--rw scheduler-enable?   boolean
     +--ro max-stream-filter-instances?    uint32
```

48.5.14 Schema for the ieee802-dot1q-ats-bridge YANG module

```
module: ieee802-dot1q-ats-bridge

  augment /if:interfaces/if:interface/dot1q:bridge-port:
    +--ro discarded-frames-count?   yang:counter64
  augment /dot1q:bridges/dot1q:bridge/dot1q:component:
    +--rw stream-gates
    |  +--rw stream-gate-instance-table* [stream-gate-instance-id]
    |  |  +--rw stream-gate-instance-id    uint32
    |  |  +--rw gate-enable?               boolean
    |  |  +--rw admin-gate-states?         gate-state-value-type
    |  |  +--rw admin-ipv?                 ipv-spec-type
    |  +--ro max-stream-gate-instances?    uint32
    +--rw stream-filters
```

```
      +--rw stream-filter-instance-table* [stream-filter-instance-id]
      |  +--rw stream-filter-instance-id                       uint32
      |  +--rw (stream-handle-spec)?
      |  |  +--:(wildcard)
      |  |  |  +--rw wildcard?                                 empty
      |  |  +--:(stream-handle)
      |  |     +--rw stream-handle                             uint32
      |  +--rw priority-spec
      |  |       priority-spec-type
      |  +--rw max-sdu-size                                    uint32
      |  +--rw stream-blocked-due-to-oversize-frame-enabled?   boolean
      |  +--rw stream-blocked-due-to-oversize-frame?           boolean
      |  +--rw stream-gate-ref                                 leafref
      |  +--rw schedulers
      |  |  +--rw scheduler-instance-table* [scheduler-instance-id]
      |  |  |  +--rw scheduler-instance-id         uint32
      |  |  |  +--rw committed-information-rate    uint64
      |  |  |  +--rw committed-burst-size          uint32
      |  |  |  +--rw scheduler-group-ref           leafref
      |  |  +--ro max-scheduler-instances?    uint32
      |  +--rw scheduler-groups
      |  |  +--rw scheduler-group-instance-table*
      |  |  |       [scheduler-group-instance-id]
      |  |  |  +--rw scheduler-group-instance-id    uint32
      |  |  |  +--rw max-residence-time             uint32
      |  |  +--ro max-scheduler-group-instances?      uint32
      |  |  +--rw scheduler-timing-characteristics
      |  |     +--ro scheduler-timing-characteristics-table*
      |  |              [reception-port transmission-port]
      |  |        +--ro reception-port
      |  |        |       dot1qtypes:port-number-type
      |  |        +--ro transmission-port
      |  |        |       dot1qtypes:port-number-type
      |  |        +--ro clock-offset-variation-max       uint32
      |  |        +--ro clock-rate-deviation-max         uint32
      |  |        +--ro arrival-recognition-delay-max    uint32
      |  |        +--ro processing-delay-min             uint32
      |  |        +--ro processing-delay-max             uint32
      |  +--rw scheduler
      |     +--rw scheduler-ref?      leafref
      |     +--rw scheduler-enable?   boolean
      +--ro max-stream-filter-instances?    uint32
```

48.5.15 Schema for the ieee802-dot1q-congestion-isolation YANG module

```
module: ieee802-dot1q-congestion-isolation
  +--rw stream-gates
  |  +--rw stream-gate-instance-table* [stream-gate-instance-id]
  |  |  +--rw stream-gate-instance-id    uint32
  |  |  +--rw gate-enable?               boolean
  |  |  +--rw admin-gate-states?         gate-state-value-type
  |  |  +--rw admin-ipv?                 ipv-spec-type
  |  +--ro max-stream-gate-instances?    uint32
  +--rw stream-filters
     +--rw stream-filter-instance-table* [stream-filter-instance-id]
     |  +--rw stream-filter-instance-id                       uint32
     |  +--rw (stream-handle-spec)?
     |  |  +--:(wildcard)
     |  |  |  +--rw wildcard?                                 empty
     |  |  +--:(stream-handle)
     |  |  |  +--rw stream-handle                             uint32
     |  |  +--:(null-handle) {congestion-isolation}?
     |  |     +--rw null-handle?                              empty
     |  +--rw priority-spec
     |  |       priority-spec-type
     |  +--rw max-sdu-size                                    uint32
     |  +--rw stream-blocked-due-to-oversize-frame-enabled?   boolean
     |  +--rw stream-blocked-due-to-oversize-frame?           boolean
     |  +--rw stream-gate-ref                                 leafref
     +--ro max-stream-filter-instances?    uint32
```

48.5.16 Schema for the ieee802-dot1q-congestion-isolation-bridge YANG module

```
module: ieee802-dot1q-congestion-isolation-bridge

  augment /dot1q:bridges/dot1q:bridge/dot1q:component:
    +--rw ci-master-enable?        boolean {congestion-isolation-bridge}?
    +--ro ci-cim-tx-priority?      dot1q-types:priority-type
    |       {congestion-isolation-bridge}?
    +--ro ci-max-flow-life?        uint32 {congestion-isolation-bridge}?
    +--rw ci-peers {congestion-isolation-bridge}?
    |  +--rw ci-peer-table* [reception-port]
    |  |  +--rw reception-port        dot1q-types:port-number-type
    |  |  +--rw cim-type?             enumeration
    |  |  +--rw peer-mac-address?     ieee:mac-address
    |  |  +--rw peer-ipv4-address?    inet:ipv4-address
    |  |  +--rw peer-ipv6-address?    inet:ipv6-address
    |  |  +--rw peer-udp-port?        inet:port-number
    |  |  +--rw peer-cim-encap-len?   uint16
    |  +--ro max-ci-peer-entries?   uint32
    +--rw ci-streams {congestion-isolation-bridge}?
    |  +--ro ci-stream-table* [stream-handle-id]
    |  |  +--ro stream-handle-id    uint32
    |  |  +--ro cim-count?          uint16
    |  |  +--ro create-time?        yang:timeticks
    |  |  +--ro create-mask?        bits
    |  +--ro queue-key?             uint16
    |  +--ro dest-mac-address?      ieee:mac-address
    |  +--ro source-mac-address?    ieee:mac-address
    |  +--ro vid?                   dot1q-types:vlan-index-type
    |  +--ro msdu?                  yang:hex-string
    +--ro max-ci-stream-entries?   uint32 {congestion-isolation-bridge}?
    +--rw stream-gates {congestion-isolation-bridge}?
    |  +--rw stream-gate-instance-table* [stream-gate-instance-id]
    |  |  +--rw stream-gate-instance-id    uint32
    |  |  +--rw gate-enable?               boolean
    |  |  +--rw admin-gate-states?         gate-state-value-type
    |  |  +--rw admin-ipv?                 ipv-spec-type
    |  +--ro max-stream-gate-instances?    uint32
    +--rw stream-filters {congestion-isolation-bridge}?
       +--rw stream-filter-instance-table* [stream-filter-instance-id]
       |  +--rw stream-filter-instance-id                       uint32
       |  +--rw (stream-handle-spec)?
       |  |  +--:(wildcard)
       |  |  |  +--rw wildcard?                                 empty
       |  |  +--:(stream-handle)
       |  |  |  +--rw stream-handle                             uint32
       |  |  +--:(null-handle) {congestion-isolation-bridge}?
       |  |     +--rw null-handle?                              empty
       |  +--rw priority-spec
       |  |       priority-spec-type
       |  +--rw max-sdu-size                                    uint32
       |  +--rw stream-blocked-due-to-oversize-frame-enabled?   boolean
       |  +--rw stream-blocked-due-to-oversize-frame?           boolean
       |  +--rw stream-gate-ref                                 leafref
       +--ro max-stream-filter-instances?    uint32
  augment /if:interfaces/if:interface/dot1q:bridge-port:
    +--ro cip-mac-address?     ieee:mac-address
    |       {congestion-isolation-bridge}?
    +--ro cip-ipv4-address?    inet:ipv4-address
    |       {congestion-isolation-bridge}?
    +--ro cip-ipv6-address?    inet:ipv6-address
    |       {congestion-isolation-bridge}?
    +--ro cip-cim-port?        inet:port-number
    |       {congestion-isolation-bridge}?
    +--rw queue-map* [priority] {congestion-isolation-bridge}?
    |  +--rw priority                      dot1q-types:priority-type
    |  +--rw abs-traffic-class-plus-one?
    |          abs-traffic-class-plus-one-type
    +--rw min-header-octets?   uint16 {congestion-isolation-bridge}?
    +--rw max-cim-tx?          uint16 {congestion-isolation-bridge}?
```

48.6 YANG modules[10] [11] [12]

48.6.2 The ieee802-dot1q-types YANG module

Delete the YANG module in 48.6.2.

Insert the following YANG module in 48.6.2:

```
module ieee802-dot1q-types {
  namespace urn:ieee:std:802.1Q:yang:ieee802-dot1q-types;
  prefix dot1q-types;
  import ietf-yang-types {
    prefix yang;
  }
  organization
    "IEEE 802.1 Working Group";
  contact
    "WG-URL: http://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
    "Common types used within dot1Q-bridge modules.

    References in this YANG module to IEEE Std 802.1Q are to IEEE Std
    802.1Q-2022 as amended by IEEE Std 802.1Qcz-2023.

    Copyright (C) IEEE (2023).

    This version of this YANG module is part of IEEE Std 802.1Q; see the
    standard itself for full legal notices.";
  revision 2023-07-03 {
    description
      "Published as part of IEEE Std 802.1Qcz-2023.";
    reference
      "IEEE Std 802.1Qcz-2023, Bridges and Bridged Networks - Congestion
      Isolation.";
  }
  revision 2022-10-29 {
    description
      "Published as part of IEEE Std 802.1Q-2022.";
    reference
      "IEEE Std 802.1Q-2022, Bridges and Bridged Networks.";
  }
  revision 2020-06-04 {
    description
      "Published as part of IEEE Std 802.1Qcx-2020.";
    reference
      "IEEE Std 802.1Qcx-2020, Bridges and Bridged Networks - YANG Data
      Model for Connectivity Fault Management.";
  }
  revision 2018-03-07 {
    description
      "Published as part of IEEE Std 802.1Q-2018.";
```

[10] 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.

[11] 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/.

[12] 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.

```
  reference
    "IEEE Std 802.1Q-2018, Bridges and Bridged Networks.";
}
identity dot1q-vlan-type {
  description
    "Base identity from which all 802.1Q VLAN tag types are derived
    from.";
}
identity c-vlan {
  base dot1q-vlan-type;
  description
    "An 802.1Q Customer VLAN, using the 81-00 EtherType.";
  reference
    "5.5 of IEEE Std 802.1Q";
}
identity s-vlan {
  base dot1q-vlan-type;
  description
    "An 802.1Q Service VLAN, using the 88-A8 EtherType originally
    introduced in 802.1ad, and incorporated into 802.1Q (2011)";
  reference
    "5.6 of IEEE Std 802.1Q";
}
identity transmission-selection-algorithm {
  description
    "Specify the transmission selection algorithms of IEEE Std
    802.1Q Table 8-6";
}
identity strict-priority {
  base transmission-selection-algorithm;
  description
    "Indicates the strict priority transmission selection algorithm.";
  reference
    "Table 8-6 of IEEE Std 802.1Q";
}
identity credit-based-shaper {
  base transmission-selection-algorithm;
  description
    "Indicates the credit based shaper transmission selection
    algorithm.";
  reference
    "Table 8-6 of IEEE Std 802.1Q";
}
identity enhanced-transmission-selection {
  base transmission-selection-algorithm;
  description
    "Indicates the enhanced transmission selection algorithm.";
  reference
    "Table 8-6 of IEEE Std 802.1Q";
}
identity asynchronous-traffic-shaping {
  base transmission-selection-algorithm;
  description
    "Indicates the asynchronous transmission selection algorithm.";
  reference
    "Table 8-6 of IEEE Std 802.1Q";
}
identity vendor-specific {
  base transmission-selection-algorithm;
  description
    "Indicates a vendor specific transmission selection algorithm.";
  reference
    "Table 8-6 of IEEE Std 802.1Q";
}
typedef name-type {
  type string {
    length "0..32";
  }
  description
    "A text string of up to 32 characters, of locally determined
    significance.";
}
```

```
typedef port-number-type {
  type uint32 {
    range "1..4095";
  }
  description
    "The port number of the Bridge port for which this entry contains
    Bridge management information.";
}
typedef priority-type {
  type uint8 {
    range "0..7";
  }
  description
    "A range of priorities from 0 to 7 (inclusive). The Priority Code
    Point (PCP) is a 3-bit field that refers to the class of service
    associated with an 802.1Q VLAN tagged frame. The field specifies a
    priority value between 0 and 7, these values can be used by quality
    of service (QoS) to prioritize different classes of traffic.";
}
typedef num-traffic-class-type {
  type uint8 {
    range "1..8";
  }
  description
    "The number of traffic classes supported or participating in a
    particular feature. There are between 1 and 8 supported traffic
    classes defined by IEEE Std 802.1Q.";
}
typedef vid-range-type {
  type string {
    pattern
      "([1-9]"+
      "[0-9]{0,3}"+
      "(-[1-9][0-9]{0,3})?"+
      "(,[1-9][0-9]{0,3}(-[1-9][0-9]{0,3})?)*)";
  }
  description
    "A list of VLAN Ids, or non overlapping VLAN ranges, in ascending
    order, between 1 and 4094.

    This type is used to match an ordered list of VLAN Ids, or
    contiguous ranges of VLAN Ids. Valid VLAN Ids must be in the range
    1 to 4094, and included in the list in non overlapping ascending
    order.

    For example: 1,10-100,250,500-1000";
}
typedef vlanid {
  type uint16 {
    range "1..4094";
  }
  description
    "The vlanid type uniquely identifies a VLAN. This is the 12-bit
    VLAN-ID used in the VLAN Tag header. The range is defined by the
    referenced specification. This type is in the value set and its
    semantics equivalent to the VlanId textual convention of the SMIv2.";
}
typedef vlan-index-type {
  type uint32 {
    range "1..4094 | 4096..4294967295";
  }
  description
    "A value used to index per-VLAN tables. Values of 0 and 4095 are
    not permitted. The range of valid VLAN indices. If the value is
    greater than 4095, then it represents a VLAN with scope local to
    the particular agent, i.e., one without a global VLAN-ID assigned
    to it. Such VLANs are outside the scope of IEEE 802.1Q, but it is
    convenient to be able to manage them in the same way using this
    YANG module.";
  reference
    "9.6 of IEEE Std 802.1Q";
}
```

```
typedef mstid-type {
  type uint32 {
    range "1..4094";
  }
  description
    "In an MSTP Bridge, an MSTID, i.e., a value used to identify a
    spanning tree (or MST) instance";
  reference
    "13.8 of IEEE Std 802.1Q";
}
typedef pcp-selection-type {
  type enumeration {
    enum 8P0D {
      description
        "8 priorities, 0 drop eligible";
    }
    enum 7P1D {
      description
        "7 priorities, 1 drop eligible";
    }
    enum 6P2D {
      description
        "6 priorities, 2 drop eligible";
    }
    enum 5P3D {
      description
        "5 priorities, 3 drop eligible";
    }
  }
  description
    "Priority Code Point selection types.";
  reference
    "12.6.2.5.3, 6.9.3 of IEEE Std 802.1Q";
}
typedef protocol-frame-format-type {
  type enumeration {
    enum Ethernet {
      description
        "Ethernet frame format";
    }
    enum rfc1042 {
      description
        "RFC 1042 frame format";
    }
    enum snap8021H {
      description
        "SNAP 802.1H frame format";
    }
    enum snapOther {
      description
        "Other SNAP frame format";
    }
    enum llcOther {
      description
        "Other LLC frame format";
    }
  }
  description
    "A value representing the frame format to be matched.";
  reference
    "12.10.1.7.1 of IEEE Std 802.1Q";
}
typedef ethertype-type {
  type string {
    pattern "[0-9a-fA-F]{2}-[0-9a-fA-F]{2}";
  }
  description
    "The EtherType value represented in the canonical order defined by
    IEEE 802. The canonical representation uses uppercase characters.";
  reference
    "9.2 of IEEE Std 802-2014";
}
```

```
typedef dot1q-tag-type {
  type identityref {
    base dot1q-vlan-type;
  }
  description
    "Identifies a specific 802.1Q tag type";
  reference
    "9.5 IEEE Std 802.1Q";
}
typedef traffic-class-type {
  type uint8 {
    range "0..7";
  }
  description
    "This is the numerical value associated with a traffic class in a
    Bridge. Larger values are associated with higher priority traffic
    classes.";
  reference
    "3.273 of IEEE Std 802.1Q";
}
grouping dot1q-tag-classifier-grouping {
  description
    "A grouping which represents an 802.1Q VLAN, matching both the
    EtherType and a single VLAN Id.";
  leaf tag-type {
    type dot1q-tag-type;
    mandatory true;
    description
      "VLAN type";
  }
  leaf vlan-id {
    type vlanid;
    mandatory true;
    description
      "VLAN Id";
  }
}
grouping dot1q-tag-or-any-classifier-grouping {
  description
    "A grouping which represents an 802.1Q VLAN, matching both the
    EtherType and a single VLAN Id or 'any' to match on any VLAN Id.";
  leaf tag-type {
    type dot1q-tag-type;
    mandatory true;
    description
      "VLAN type";
  }
  leaf vlan-id {
    type union {
      type vlanid;
      type enumeration {
        enum any {
          value 4095;
          description
            "Matches 'any' VLAN in the range 1 to 4094 that is not
            matched by a more specific VLAN Id match";
        }
      }
    }
    mandatory true;
    description
      "VLAN Id or any";
  }
}
grouping dot1q-tag-ranges-classifier-grouping {
  description
    "A grouping which represents an 802.1Q VLAN that matches a range of
    VLAN Ids.";
  leaf tag-type {
    type dot1q-tag-type;
    mandatory true;
    description
```

```
      "VLAN type";
  }
  leaf vlan-ids {
    type vid-range-type;
    mandatory true;
    description
      "VLAN Ids";
  }
}
grouping dot1q-tag-ranges-or-any-classifier-grouping {
  description
    "A grouping which represents an 802.1Q VLAN, matching both the
    EtherType and a single VLAN Id, ordered list of ranges, or 'any' to
    match on any VLAN Id.";
  leaf tag-type {
    type dot1q-tag-type;
    mandatory true;
    description
      "VLAN type";
  }
  leaf vlan-id {
    type union {
      type vid-range-type;
      type enumeration {
        enum any {
          value 4095;
          description
            "Matches 'any' VLAN in the range 1 to 4094.";
        }
      }
    }
    mandatory true;
    description
      "VLAN Ids or any";
  }
}
grouping priority-regeneration-table-grouping {
  description
    "The priority regeneration table provides the ability to map
    incoming priority values on a per-Port basis, under management
    control.";
  reference
    "6.9.4 of IEEE Std 802.1Q";
  leaf priority0 {
    type priority-type;
    default "0";
    description
      "Priority 0";
    reference
      "12.6.2.3, 6.9.4 of IEEE Std 802.1Q";
  }
  leaf priority1 {
    type priority-type;
    default "1";
    description
      "Priority 1";
    reference
      "12.6.2.3, 6.9.4 of IEEE Std 802.1Q";
  }
  leaf priority2 {
    type priority-type;
    default "2";
    description
      "Priority 2";
    reference
      "12.6.2.3, 6.9.4 of IEEE Std 802.1Q";
  }
  leaf priority3 {
    type priority-type;
    default "3";
    description
      "Priority 3";
```

```
      reference
        "12.6.2.3, 6.9.4 of IEEE Std 802.1Q";
    }
    leaf priority4 {
      type priority-type;
      default "4";
      description
        "Priority 4";
      reference
        "12.6.2.3, 6.9.4 of IEEE Std 802.1Q";
    }
    leaf priority5 {
      type priority-type;
      default "5";
      description
        "Priority 5";
      reference
        "12.6.2.3, 6.9.4 of IEEE Std 802.1Q";
    }
    leaf priority6 {
      type priority-type;
      default "6";
      description
        "Priority 6";
      reference
        "12.6.2.3, 6.9.4 of IEEE Std 802.1Q";
    }
    leaf priority7 {
      type priority-type;
      default "7";
      description
        "Priority 7";
      reference
        "12.6.2.3, 6.9.4 of IEEE Std 802.1Q";
    }
  }
  grouping pcp-decoding-table-grouping {
    description
      "The Priority Code Point decoding table enables the decoding of the
      priority and drop-eligible parameters from the PCP.";
    reference
      "6.9.3 of IEEE Std 802.1Q";
    list pcp-decoding-map {
      key "pcp";
      description
        "This map associates the priority code point field found in the
        VLAN with a priority and drop eligible value based upon the
        priority code point selection type.";
      leaf pcp {
        type pcp-selection-type;
        description
          "The priority code point selection type.";
        reference
          "12.6.2.7, 6.9.3 of IEEE Std 802.1Q";
      }
      list priority-map {
        key "priority-code-point";
        description
          "This map associates a priority code point value with priority
          and drop eligible parameters.";
        leaf priority-code-point {
          type priority-type;
          description
            "Priority associated with the pcp.";
          reference
            "12.6.2.7, 6.9.3 of IEEE Std 802.1Q";
        }
        leaf priority {
          type priority-type;
          description
            "Priority associated with the pcp.";
          reference
```

```
          "12.6.2.7, 6.9.3 of IEEE Std 802.1Q";
      }
      leaf drop-eligible {
        type boolean;
        description
          "Drop eligible value for pcp";
        reference
          "12.6.2.7, 6.9.3 of IEEE Std 802.1Q";
      }
    }
  }
}
grouping pcp-encoding-table-grouping {
  description
    "The Priority Code Point encoding table encodes the priority and
    drop-eligible parameters in the PCP field of the VLAN tag.";
  reference
    "12.6.2.9, 6.9.3 of IEEE Std 802.1Q";
  list pcp-encoding-map {
    key "pcp";
    description
      "This map associates the priority and drop-eligible parameters
      with the priority used to encode the PCP of the VLAN based upon
      the priority code point selection type.";
    leaf pcp {
      type pcp-selection-type;
      description
        "The priority code point selection type.";
      reference
        "12.6.2.7, 6.9.3 of IEEE Std 802.1Q";
    }
    list priority-map {
      key "priority dei";
      description
        "This map associates the priority and drop-eligible parameters
        with the priority code point field of the VLAN tag.";
      leaf priority {
        type priority-type;
        description
          "Priority associated with the pcp.";
        reference
          "12.6.2.7, 6.9.3 of IEEE Std 802.1Q";
      }
      leaf dei {
        type boolean;
        description
          "The drop eligible value.";
        reference
          "12.6.2, 8.6.6 of IEEE Std 802.1Q";
      }
      leaf priority-code-point {
        type priority-type;
        description
          "PCP value for priority when DEI value";
        reference
          "12.6.2.9, 6.9.3 of IEEE Std 802.1Q";
      }
    }
  }
}
grouping service-access-priority-table-grouping {
  description
    "The Service Access Priority Table associates a received priority
    with a service access priority.";
  reference
    "12.6.2.17, 6.13.1 of IEEE Std 802.1Q";
  leaf priority0 {
    type priority-type;
    default "0";
    description
      "Service access priority value for priority 0";
    reference
```

```
        "12.6.2.17, 6.13.1 of IEEE Std 802.1Q";
    }
    leaf priority1 {
      type priority-type;
      default "1";
      description
        "Service access priority value for priority 1";
      reference
        "12.6.2.17, 6.13.1 of IEEE Std 802.1Q";
    }
    leaf priority2 {
      type priority-type;
      default "2";
      description
        "Service access priority value for priority 2";
      reference
        "12.6.2.17, 6.13.1 of IEEE Std 802.1Q";
    }
    leaf priority3 {
      type priority-type;
      default "3";
      description
        "Service access priority value for priority 3";
      reference
        "12.6.2.17, 6.13.1 of IEEE Std 802.1Q";
    }
    leaf priority4 {
      type priority-type;
      default "4";
      description
        "Service access priority value for priority 4";
      reference
        "12.6.2.17, 6.13.1 of IEEE Std 802.1Q";
    }
    leaf priority5 {
      type priority-type;
      default "5";
      description
        "Service access priority value for priority 5";
      reference
        "12.6.2.17, 6.13.1 of IEEE Std 802.1Q";
    }
    leaf priority6 {
      type priority-type;
      default "6";
      description
        "Service access priority value for priority 6";
      reference
        "12.6.2.17, 6.13.1 of IEEE Std 802.1Q";
    }
    leaf priority7 {
      type priority-type;
      default "7";
      description
        "Service access priority value for priority 7";
      reference
        "12.6.2.17, 6.13.1 of IEEE Std 802.1Q";
    }
  }
  grouping traffic-class-table-grouping {
    description
      "The Traffic Class Table models the operations that can be
      performed on, or can inquire about, the current contents of the
      Traffic Class Table (8.6.6) for a given Port.";
    reference
      "12.6.3, 8.6.6 of IEEE Std 802.1Q";
    list traffic-class-map {
      key "priority";
      description
        "The priority index into the traffic class table.";
      leaf priority {
        type priority-type;
```

```
      description
        "The priority of the traffic class entry.";
      reference
        "8.6.6 of IEEE Std 802.1Q";
    }
    list available-traffic-class {
      key "num-traffic-class";
      description
        "The traffic class index associated with a given priority
        within the traffic class table.";
      reference
        "8.6.6 of IEEE Std 802.1Q";
      leaf num-traffic-class {
        type uint8 {
          range "1..8";
        }
        description
          "The available number of traffic classes.";
        reference
          "8.6.6 of IEEE Std 802.1Q";
      }
      leaf traffic-class {
        type traffic-class-type;
        description
          "The traffic class index associated with a given traffic
          class entry.";
        reference
          "8.6.6 of IEEE Std 802.1Q";
      }
    }
  }
}
grouping transmission-selection-table-grouping {
  description
    "The Transmission Selection Algorithm Table models the operations
    that can be performed on, or can inquire about, the current contents
    of the Transmission Selection Algorithm Table (12.20.2) for a given
    Port.";
  reference
    "12.20.2, 8.6.8 of IEEE Std 802.1Q";
  list transmission-selection-algorithm-map {
    key "traffic-class";
    description
      "The traffic class to index into the transmission selection
      table.";
    leaf traffic-class {
      type traffic-class-type;
      description
        "The traffic class of the entry.";
      reference
        "8.6.6 of IEEE Std 802.1Q";
    }
    leaf transmission-selection-algorithm {
      type identityref {
        base dot1q-types:transmission-selection-algorithm;
      }
      description
        "Transmission selection algorithm";
      reference
        "8.6.8, Table 8-6 of IEEE Std 802.1Q";
    }
  }
}
grouping port-map-grouping {
  description
    "A set of control indicators, one for each Port. A Port Map,
    containing a control element for each outbound Port";
  reference
    "8.8.1, 8.8.2 of IEEE Std 802.1Q";
  list port-map {
    key "port-ref";
    description
```

```
  "The list of entries composing the port map.";
leaf port-ref {
  type port-number-type;
  description
    "The interface port reference associated with this map.";
  reference
    "8.8.1 of IEEE Std 802.1Q";
}
choice map-type {
  description
    "Type of port map";
  container static-filtering-entries {
    description
      "Static filtering entries attributes.";
    leaf control-element {
      type enumeration {
        enum forward {
          description
            "Forwarded, independently of any dynamic filtering
            information held by the FDB.";
        }
        enum filter {
          description
            "Filtered, independently of any dynamic filtering
            information.";
        }
        enum forward-filter {
          description
            "Forwarded or filtered on the basis of dynamic
            filtering information, or on the basis of the default
            Group filtering behavior for the outbound Port (8.8.6)
            if no dynamic filtering information is present
            specifically for the MAC address.";
        }
      }
      description
        "A control element for each outbound Port, specifying that
        a frame with a destination MAC address, and in the case of
        VLAN Bridge components, VID that meets this specification.";
      reference
        "8.8.1 of IEEE Std 802.1Q";
    }
    leaf connection-identifier {
      type port-number-type;
      description
        "A Port MAP may contain a connection identifier (8.8.12)
        for each outbound port. The connection identifier may be
        associated with the Bridge Port value maintained in a
        Dynamic Filtering Entry of the FDB for Bridge Ports.";
      reference
        "8.8.1, 8.8.12 of IEEE Std 802.1Q";
    }
  }
  container static-vlan-registration-entries {
    description
      "Static VLAN registration entries.";
    leaf registrar-admin-control {
      type enumeration {
        enum fixed-new-ignored {
          description
            "Registration Fixed (New ignored).";
        }
        enum fixed-new-propagated {
          description
            "Registration Fixed (New propagated.";
        }
        enum forbidden {
          description
            "Registration Forbidden.";
        }
        enum normal {
          description
```

```
            "Normal Registration.";
        }
      }
      description
        "The Registrar Administrative Control values for MVRP and
        MIRP for the VID.";
      reference
        "8.8.2 of IEEE Std 802.1Q";
    }
    leaf vlan-transmitted {
      type enumeration {
        enum tagged {
          description
            "VLAN-tagged";
        }
        enum untagged {
          description
            "VLAN-untagged";
        }
      }
      description
        "Whether frames are to be VLAN-tagged or untagged when
        transmitted.";
      reference
        "8.8.2 of IEEE Std 802.1Q";
    }
  }
  container mac-address-registration-entries {
    description
      "MAC address registration entries attributes.";
    leaf control-element {
      type enumeration {
        enum registered {
          description
            "Forwarded, independently of any dynamic filtering
            information held by the FDB.";
        }
        enum not-registered {
          description
            "Filtered, independently of any dynamic filtering
            information.";
        }
      }
      description
        "A control element for each outbound Port, specifying that
        a frame with a destination MAC address, and in the case of
        VLAN Bridge components, VID that meets this specification.";
      reference
        "8.8.4 of IEEE Std 802.1Q";
    }
  }
  container dynamic-vlan-registration-entries {
    description
      "Dynamic VLAN registration entries attributes.";
    leaf control-element {
      type enumeration {
        enum registered {
          description
            "Forwarded, independently of any dynamic filtering
            information held by the FDB.";
        }
      }
      description
        "A control element for each outbound Port, specifying that
        a frame with a destination MAC address, and in the case of
        VLAN Bridge components, VID that meets this specification.";
      reference
        "8.8.5 of IEEE Std 802.1Q";
    }
  }
  container dynamic-reservation-entries {
    description
```

```
          "Dynamic reservation entries attributes.";
        leaf control-element {
          type enumeration {
            enum forward {
              description
                "Forwarded, independently of any dynamic filtering
                information held by the FDB.";
            }
            enum filter {
              description
                "Filtered, independently of any dynamic filtering
                information.";
            }
          }
          description
            "A control element for each outbound Port, specifying that
            a frame with a destination MAC address, and in the case of
            VLAN Bridge components, VID that meets this specification.";
          reference
            "8.8.7 of IEEE Std 802.1Q";
        }
      }
      container dynamic-filtering-entries {
        description
          "Dynamic filtering entries attributes.";
        leaf control-element {
          type enumeration {
            enum forward {
              description
                "Forwarded, independently of any dynamic filtering
                information held by the FDB.";
            }
          }
          description
            "A control element for each outbound Port, specifying that
            a frame with a destination MAC address, and in the case of
            VLAN Bridge components, VID that meets this specification.";
          reference
            "8.8.3 of IEEE Std 802.1Q";
        }
      }
    }
  }
}
grouping bridge-port-statistics-grouping {
  description
    "Grouping of bridge port statistics.";
  reference
    "12.6.1.1.3 of IEEE Std 802.1Q";
  leaf delay-exceeded-discards {
    type yang:counter64;
    description
      "The number of frames discarded by this port due to excessive
      transit delay through the Bridge. It is incremented by both
      transparent and source route Bridges.";
    reference
      "12.6.1.1.3, 8.6.6 of IEEE Std 802.1Q";
  }
  leaf mtu-exceeded-discards {
    type yang:counter64;
    description
      "The number of frames discarded by this port due to an excessive
      size. It is incremented by both transparent and source route
      Bridges.";
    reference
      "Item g) in 12.6.1.1.3 of IEEE Std 802.1Q";
  }
  leaf frame-rx {
    type yang:counter64;
    description
      "The number of frames that have been received by this port from
      its segment. Note that a frame received on the interface
```

```
    corresponding to this port is only counted by this object if and
    only if it is for a protocol being processed by the local
    bridging function, including Bridge management frames.";
  reference
    "12.6.1.1.3 of IEEE Std 802.1Q";
}
leaf octets-rx {
  type yang:counter64;
  description
    "The total number of octets in all valid frames received
    (including BPDUs, frames addressed to the Bridge as an end
    station, and frames that were submitted to the Forwarding
    Process).";
  reference
    "12.6.1.1.3 of IEEE Std 802.1Q";
}
leaf frame-tx {
  type yang:counter64;
  description
    "The number of frames that have been transmitted by this port to
    its segment. Note that a frame transmitted on the interface
    corresponding to this port is only counted by this object if and
    only if it is for a protocol being processed by the local
    bridging function, including Bridge management frames.";
}
leaf octets-tx {
  type yang:counter64;
  description
    "The total number of octets that have been transmitted by this
    port to its segment.";
}
leaf discard-inbound {
  type yang:counter64;
  description
    "Count of received valid frames that were discarded (i.e.,
    filtered) by the Forwarding Process.";
  reference
    "12.6.1.1.3 of IEEE Std 802.1Q";
}
leaf forward-outbound {
  type yang:counter64;
  description
    "The number of frames forwarded to the associated MAC Entity
    (8.5).";
  reference
    "12.6.1.1.3 of IEEE Std 802.1Q";
}
leaf discard-lack-of-buffers {
  type yang:counter64;
  description
    "The count of frames that were to be transmitted through the
    associated Port but were discarded due to lack of buffers.";
  reference
    "12.6.1.1.3 of IEEE Std 802.1Q";
}
leaf discard-transit-delay-exceeded {
  type yang:counter64;
  description
    "The number of frames discarded by this port due to excessive
    transit delay through the Bridge. It is incremented by both
    transparent and source route Bridges.";
  reference
    "12.6.1.1.3 of IEEE Std 802.1Q";
}
leaf discard-on-error {
  type yang:counter64;
  description
    "The number of frames that were to be forwarded on the associated
    MAC but could not be transmitted (e.g., frame would be too large,
    6.5.8).";
  reference
    "12.6.1.1.3 of IEEE Std 802.1Q";
```

```
        }
    }
}
```

48.6.11 The ieee802-dot1q-stream-filters-gates YANG module

Delete the YANG module in 48.6.11.

Insert the following YANG module in 48.6.11:

```
module ieee802-dot1q-stream-filters-gates {
  yang-version "1.1";
  namespace urn:ieee:std:802.1Q:yang:ieee802-dot1q-stream-filters-gates;
  prefix sfsg;
  organization
    "IEEE 802.1 Working Group";
  contact
    "WG-URL: http://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 IEEE 802.1Q Bridge components
    that support Stream Filters and Stream Gates.

    References in this YANG module to IEEE Std 802.1Q are to IEEE Std
    802.1Q-2022 as amended by IEEE Std 802.1Qcz-2023.

    Copyright (C) IEEE (2023).

    This version of this YANG module is part of IEEE Std 802.1Q; see the
    standard itself for full legal notices.";
  revision 2023-07-03 {
    description
      "Published as part of IEEE Std 802.1Qcz-2023.";
    reference
      "IEEE Std 802.1Qcz-2023 - Bridges and Bridged Networks - Amendment:
      Congestion Isolation.";
  }
  revision 2022-10-29 {
    description
      "Published as part of IEEE Std 802.1Q-2022.";
    reference
      "IEEE Std 802.1Q-2022, Bridges and Bridged Networks.";
  }
  revision 2020-11-06 {
    description
      "Published as part of IEEE Std 802.1Qcr-2020.";
    reference
      "IEEE Std 802.1Qcr-2020, Bridges and Bridged Networks -
      Asynchronous Traffic Shaping.";
  }
  feature closed-gate-state {
    description
      "The bridge component supports gate state closed.";
    reference
      "IEEE Std 802.1Q";
  }

  /* Types and groupings */
  typedef priority-spec-type {
    type enumeration {
      enum zero {
        value 0;
        description
          "Priority 0";
      }
```

```
    enum one {
      value 1;
      description
        "Priority 1";
    }
    enum two {
      value 2;
      description
        "Priority 2";
    }
    enum three {
      value 3;
      description
        "Priority 3";
    }
    enum four {
      value 4;
      description
        "Priority 4";
    }
    enum five {
      value 5;
      description
        "Priority 5";
    }
    enum six {
      value 6;
      description
        "Priority 6";
    }
    enum seven {
      value 7;
      description
        "Priority 7";
    }
    enum wildcard {
      description
        "wildcard value";
    }
  }
  description
    "The frame's priority value";
  reference
    "8.6.5.2 of IEEE Std 802.1Q";
}
typedef ipv-spec-type {
  type enumeration {
    enum zero {
      value 0;
      description
        "Priority 0";
    }
    enum one {
      value 1;
      description
        "Priority 1";
    }
    enum two {
      value 2;
      description
        "Priority 2";
    }
    enum three {
      value 3;
      description
        "Priority 3";
    }
    enum four {
      value 4;
      description
        "Priority 4";
    }
```

```
    enum five {
      value 5;
      description
        "Priority 5";
    }
    enum six {
      value 6;
      description
        "Priority 6";
    }
    enum seven {
      value 7;
      description
        "Priority 7";
    }
    enum null {
      description
        "null value";
    }
  }
  description
    "An IPV can be either of the following:
       1) The null value. For a frame that passes through the gate, the
          priority value associated with the frame is used to determine
          the frame's traffic class, using the Traffic Class Table as
          specified in 8.6.6.
       2) An internal priority value. For a frame that passes through
          the gate, the IPV is used, in place of the priority value
          associated with the frame, to determine the frame's traffic
          class, using the Traffic Class Table as specified in 8.6.6.";
  reference
    "8.6.5.2 of IEEE Std 802.1Q";
}
typedef gate-state-value-type {
  type enumeration {
    enum closed {
      description
        "Gate closed";
    }
    enum open {
      description
        "Gate open";
    }
  }
  description
    "The gate-state-value-type indicates a gate state, open or closed,
    for the stream gate.";
  reference
    "12.31.3.2.1 of IEEE Std 802.1Q";
}
grouping sfsg-parameters {
  description
    "The grouping of all stream filter and stream gate parameters.";
  container stream-gates {
    description
      "This container encapsulates all nodes related to Stream Gates.";
    list stream-gate-instance-table {
      key "stream-gate-instance-id";
      description
        "Each list entry contains a set of parameters that defines a
        single stream gate (8.6.5.4), as detailed in Table 12-36.
        Entries in the table can be created or removed dynamically in
        implementations that support dynamic configuration of stream
        gates.";
      reference
        "12.31.3 of IEEE Std 802.1Q";
      leaf stream-gate-instance-id {
        type uint32;
        description
          "An integer table index that allows the stream gate to be
          referenced from Stream Filter Instance Table entries.";
        reference
```

```
        "12.31.2.5 of IEEE Std 802.1Q
        8.6.5.3 of IEEE Std 802.1Q
        8.6.5.4 of IEEE Std 802.1Q";
    }
    leaf gate-enable {
      type boolean;
      default "false";
      description
        "A Boolean variable that indicates whether the operation of
        the state machines is enabled (TRUE) or disabled (FALSE).
        This variable is set by management. The default value of this
        variable is FALSE.";
      reference
        "8.6.9.4.14 of IEEE Std 802.1Q";
    }
    leaf admin-gate-states {
      type gate-state-value-type;
      default "open";
      description
        "The administratively set gate state of this gate.";
      reference
        "12.31.3.2.1 of IEEE Std 802.1Q
        8.6.10.4 of IEEE Std 802.1Q";
    }
    leaf admin-ipv {
      type ipv-spec-type;
      default "null";
      description
        "The administratively set internal priority value
        specification.";
      reference
        "12.31.3.3 of IEEE Std 802.1Q
        8.6.10.6 of IEEE Std 802.1Q
        8.6.5.4 of IEEE Std 802.1Q";
    }
  }
  leaf max-stream-gate-instances {
    type uint32;
    config false;
    description
      "The maximum number of Stream Gate instances supported by this
      Bridge component.";
    reference
      "12.31.1.2 of IEEE Std 802.1Q";
  }
}
container stream-filters {
  description
    "This container encapsulates all nodes related to stream filters.";
  reference
    "12.31 of IEEE Std 802.1Q";
  list stream-filter-instance-table {
    key "stream-filter-instance-id";
    description
      "Each list entry contains a set of parameters that defines a
      single stream filter (8.6.5.1) with associated maximum SDU size
      filtering (8.6.5.3.1), as detailed in Table 12-35. Entries can
      be created or removed dynamically in implementations that
      support dynamic configuration of stream filters. The value of
      the stream-handle-spec and priority-spec parameters associated
      with a received frame determine which stream filter is selected
      by the frame, and therefore what combination of filtering and
      policing actions is applied to the frame. If the
      stream-handle-spec and priority-spec parameters associated with
      a received frame match more than one stream filter, the stream
      filter that is selected is the one that appears earliest in the
      ordered list. If a received frame's stream-handle-spec and
      priority-spec does not match any of the stream filters in the
      list, the frame is processed as if stream filters and stream
      gates would not be supported.";
    reference
      "12.31.2 of IEEE Std 802.1Q";
```

```
leaf stream-filter-instance-id {
  type uint32;
  mandatory true;
  description
    "An integer index value that determines the place of the
    stream filter in the ordered list of stream filter instances.
    The values are ordered according to their integer value;
    smaller values appear earlier in the ordered list.";
  reference
    "12.31.2.1 of IEEE Std 802.1Q";
}
choice stream-handle-spec {
  description
    "The stream_handle specification data type allows either of
    the following to be represented:
     a) A stream_handle value, represented as an integer.
     b) The wildcard value, which matches any frame";
  reference
    "12.31.2.2 of IEEE Std 802.1Q";

  /* NOTE: The mapping of the wildcard literal is
   *       other than in the MIB definition, where
   *       the wildcard value is mapped to -1.
   */
  case wildcard {
    leaf wildcard {
      type empty;
      description
        "The stream handle specification represents a wildcard
        value.";
    }
  }
  case stream-handle {
    leaf stream-handle {
      type uint32;
      mandatory true;
      description
        "The stream handle specification refers to a
        stream_handle value.";
    }
  }
}
leaf priority-spec {
  type priority-spec-type;
  mandatory true;
  description
    "The priority specification data type allows either of the
    following to be represented:
     a) A priority value, represented as an integer.
     b) The wildcard value, which matches any priority.";
  reference
    "12.31.2.3 of IEEE Std 802.1Q";
}
leaf max-sdu-size {
  type uint32;
  units "octets";
  mandatory true;
  description
    "The allowed maximum SDU size, in octets. If set to 0, any
    SDU size is accepted.";
  reference
    "8.6.5.3.1 of IEEE Std 802.1Q";
}
leaf stream-blocked-due-to-oversize-frame-enabled {
  type boolean;
  default "false";
  description
    "A value of true indicates that
    stream-blocked-due-to-oversize-frame is set to true as soon
    as a frame exceeds max-sdu-size.";
  reference
    "8.6.5.3.1 of IEEE Std 802.1Q";
```

```
        }
        leaf stream-blocked-due-to-oversize-frame {
          type boolean;
          default "false";
          description
            "Indicates by value true that frames are permanently
            discarded as a result of an initial frame exceeding
            max-sdu-size. The value of
            stream-blocked-due-to-oversize-frame can be administratively
            reset to false.";
          reference
            "8.6.5.3.1 of IEEE Std 802.1Q";
        }
        leaf stream-gate-ref {
          type leafref {
            path
              '..'+
              '/..'+
              '/..'+
              '/stream-gates'+
              '/stream-gate-instance-table'+
              '/stream-gate-instance-id';
          }
          mandatory true;
          description
            "This node refers to the stream gate (12.31.3) that is
            associated with the stream filter. The relationship between
            stream filters and stream gates is many to one; a given
            stream filter can be associated with only one stream gate,
            but there can be multiple stream filters associated with a
            given stream gate.";
          reference
            "12.31.3.1 of IEEE Std 802.1Q";
        }
      }
      leaf max-stream-filter-instances {
        type uint32;
        config false;
        description
          "The maximum number of stream filter instances supported by
          this Bridge component.";
        reference
          "12.31.1.1, 8.6.5.1 of IEEE Std 802.1Q";
      }
    }
  }
}
```

Delete 48.6.12 "The ieee802-dot1q-ats YANG module"

Insert new 48.6.12 "ieee802-dot1q-stream-filters-gates-bridge YANG module" after 48.6.11 as follows:

48.6.12 The ieee802-dot1q-stream-filters-gates-bridge YANG module

```
module ieee802-dot1q-stream-filters-gates-bridge {
  yang-version "1.1";
  namespace
    urn:ieee:std:802.1Q:yang:ieee802-dot1q-stream-filters-gates-bridge;
  prefix sfsg-bridge;
  import ieee802-dot1q-bridge {
    prefix dot1q;
  }
  import ieee802-dot1q-stream-filters-gates {
    prefix sfsg;
  }
  organization
    "IEEE 802.1 Working Group";
  contact
    "WG-URL: https://1.ieee802.org/
    WG-EMail: stds-802-1@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 08855
            USA

    E-mail: STDS-802-1-CHAIRS@LISTSERV.IEEE.ORG";
  description
    "This module provides management of IEEE 802.1Q Bridge components
    that support Stream Filters and Stream Gates.

    Copyright (C) IEEE (2023).

    This version of this YANG module is part of IEEE Std 802.1Q; see the
    standard itself for full legal notices.";
  revision 2023-07-03 {
    description
      "Published as part of IEEE Std 802.1Qcz-2023.";
    reference
      "IEEE Std 802.1Qcz-2023 - Bridges and Bridged Networks - Amendment:
      Congestion Isolation.";
  }
  augment "/dot1q:bridges/dot1q:bridge/dot1q:component" {
    description
      "Augments the Bridge component with stream filters and stream
      gates.";
    uses sfsg:sfsg-parameters;
  }
}
```

Insert 48.6.13 after 48.6.12 as follows:

48.6.13 The ieee802-dot1q-ats YANG module

```
module ieee802-dot1q-ats {
  yang-version "1.1";
  namespace urn:ieee:std:802.1Q:yang:ieee802-dot1q-ats;
  prefix ats;
  import ietf-yang-types {
    prefix yang;
  }
  import ieee802-dot1q-types {
    prefix dot1qtypes;
  }
  import ieee802-dot1q-stream-filters-gates {
    prefix sfsg;
  }
  organization
    "IEEE 802.1 Working Group";
  contact
    "WG-URL: http://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 IEEE 802.1Q Bridge components
    that support Asynchronous Traffic Shaping (ATS).

    References in this YANG module to IEEE Std 802.1Q are to IEEE Std
    802.1Q-2022 as amended by IEEE Std 802.1Qcz-2023.

    Copyright (C) IEEE (2023).

    This version of this YANG module is part of IEEE Std 802.1Q; see the
    standard itself for full legal notices.";
  revision 2023-07-03 {
    description
      "Published as part of IEEE Std 802.1Qcz-2023.";
    reference
      "IEEE Std 802.1Qcz-2023, Bridges and Bridged Networks - Congestion
      Isolation.";
  }
  revision 2022-01-19 {
    description
      "Published as part of IEEE Std 802.1Q-2022.";
    reference
      "IEEE Std 802.1Q-2022, Bridges and Bridged Networks.";
  }
  revision 2020-11-06 {
    description
      "Published as part of IEEE Std 802.1Qcr-2020.";
    reference
      "IEEE Std 802.1Qcr-2020, Bridges and Bridged Networks -
      Asynchronous Traffic Shaping.";
  }
  grouping ats-port-parameters {
    description
      "This container comprises all ATS per-Port parameters.";
    leaf discarded-frames-count {
      type yang:counter64;
      config false;
      description
        "A counter of frames discarded by ATS scheduler instances
        associated with the Bridge Port.";
```

```
    reference
      "12.31.7.2 of IEEE Std 802.1Q";
  }
}
grouping ats-parameters {
  description
    "System specific configuration for ATS includes:
     a) ATS schedulers
     b) ATS scheduler groups";
  container schedulers {
    description
      "This container comprises all nodes related to ATS schedulers.";
    list scheduler-instance-table {
      key "scheduler-instance-id";
      description
        "Each list entry comprises a set of parameters that defines a
        single ATS scheduler instance, as detailed in Table 12-38.";
      reference
        "12.31.5 of IEEE Std 802.1Q";
      leaf scheduler-instance-id {
        type uint32;
        mandatory true;
        description
          "A unique index identifying this ATS scheduler instance.";
        reference
          "12.31.5.1, 8.6.5.6 of IEEE Std 802.1Q";
      }
      leaf committed-information-rate {
        type uint64;
        units "bits/second";
        mandatory true;
        description
          "The committed information rate parameter of this ATS
          scheduler instance.";
        reference
          "12.31.5.3, 8.6.5.6 of IEEE Std 802.1Q";
      }
      leaf committed-burst-size {
        type uint32;
        units "bits";
        mandatory true;
        description
          "The committed burst size parameter of this ATS scheduler
          instance.";
        reference
          "12.31.5.2, 8.6.5.6 of IEEE Std 802.1Q";
      }
      leaf scheduler-group-ref {
        type leafref {
          path
            '../'+
            '/../'+
            '/../'+
            '/scheduler-groups'+
            '/scheduler-group-instance-table'+
            '/scheduler-group-instance-id';
        }
        mandatory true;
        description
          "A reference to the scheduler group (12.31.5.4) associated
          with this ATS scheduler instance. Multiple ATS scheduler
          instances can be associated to one scheduler group, as
          detailed in 8.6.5.6.";
        reference
          "12.31.5.4, 8.6.5.6 of IEEE Std 802.1Q";
      }
    }
    leaf max-scheduler-instances {
      type uint32;
      config false;
      description
        "The maximum number of ATS scheduler instances supported by
```

```
      this Bridge component.";
    reference
      "12.31.1.5 of IEEE Std 802.1Q";
  }
}
container scheduler-groups {
  description
    "This container comprises all ATS scheduler group related nodes.";
  list scheduler-group-instance-table {
    key "scheduler-group-instance-id";
    description
      "Each list entry comprises a set of parameters that defines a
      single ATS scheduler group instance.";
    reference
      "12.31.6, 8.6.5.6 of IEEE Std 802.1Q";
    leaf scheduler-group-instance-id {
      type uint32;
      description
        "A unique index identifying this ATS scheduler group
        instance.";
      reference
        "12.31.6.1, 8.6.5.6 of IEEE Std 802.1Q";
    }
    leaf max-residence-time {
      type uint32;
      units "nanoseconds";
      mandatory true;
      description
        "The maximum residence time parameter of the ATS scheduler
        group.";
      reference
        "12.31.6.2, 8.6.5.6 of IEEE Std 802.1Q";
    }
  }
  leaf max-scheduler-group-instances {
    type uint32;
    config false;
    description
      "The maximum number of ATS scheduler group instances supported
      by this Bridge component.";
    reference
      "12.31.1.6, 8.6.5.6 of IEEE Std 802.1Q";
  }
  container scheduler-timing-characteristics {
    description
      "This container comprises all ATS scheduler timing
      characteristics related nodes.";
    list scheduler-timing-characteristics-table {
      key "reception-port transmission-port";
      config false;
      description
        "Each list entry comprises the timing characteristics of a
        reception Port transmission Port pair, as detailed in Table
        12-41.";
      reference
        "12.31.8, 8.6.11 of IEEE Std 802.1Q";
      leaf reception-port {
        type dot1qtypes:port-number-type;
        config false;
        mandatory true;
        description
          "A reference to the associated reception Port.";
        reference
          "12.31.8.1 of IEEE Std 802.1Q";
      }
      leaf transmission-port {
        type dot1qtypes:port-number-type;
        config false;
        mandatory true;
        description
          "A reference to the associated transmission Port.";
        reference
```

```
            "12.31.8.2 of IEEE Std 802.1Q";
          }
          leaf clock-offset-variation-max {
            type uint32;
            units "nanoseconds";
            config false;
            mandatory true;
            description
              "The maximum clock offset variation associated with the
              reception Port transmission Port pair.";
            reference
              "12.31.8.3 of IEEE Std 802.1Q";
          }
          leaf clock-rate-deviation-max {
            type uint32;
            units "ppm";
            config false;
            mandatory true;
            description
              "The maximum clock rate deviation associated with the
              reception Port transmission Port pair.";
            reference
              "12.31.8.4 of IEEE Std 802.1Q";
          }
          leaf arrival-recognition-delay-max {
            type uint32;
            units "nanoseconds";
            config false;
            mandatory true;
            description
              "The maximum arrival time recognition delay associated with
              the reception Port transmission Port pair.";
            reference
              "12.31.8.5 of IEEE Std 802.1Q";
          }
          leaf processing-delay-min {
            type uint32;
            units "nanoseconds";
            config false;
            mandatory true;
            description
              "The minimum processing delay associated with the reception
              Port transmission Port pair.";
            reference
              "12.31.8.6 of IEEE Std 802.1Q";
          }
          leaf processing-delay-max {
            type uint32;
            units "nanoseconds";
            config false;
            mandatory true;
            description
              "The maximum processing delay associated with the reception
              Port transmission Port pair.";
            reference
              "12.31.8.7 of IEEE Std 802.1Q";
          }
        }
      }
    }
  }
}
uses sfsg:sfsg-parameters {
  augment "stream-filters/stream-filter-instance-table" {
    description
      "Augments the system stream filter for ATS schedulers.";
    uses ats:ats-parameters;
    container scheduler {
      description
        "This container encapsulates ATS scheduler nodes.";
      leaf scheduler-ref {
        type leafref {
          path
```

```
              '../..'+
              '/schedulers'+
              '/scheduler-instance-table'+
              '/scheduler-instance-id';
          }
          description
            "A reference to the ATS scheduler associated with this stream
            filter.";
        }
        leaf scheduler-enable {
          type boolean;
          default "false";
          description
            "If TRUE, this stream filter has an associated ATS scheduler
            referenced by scheduler-ref. If FALSE, no ATS scheduler is
            associated with this stream filter (scheduler-ref is
            ignored).";
        }
      }
    }
  }
}
```

Insert 48.6.14 after 48.6.13 as follows:

48.6.14 The ieee802-dot1q-ats-bridge YANG module

```
module ieee802-dot1q-ats-bridge {
  yang-version "1.1";
  namespace urn:ieee:std:802.1Q:yang:ieee802-dot1q-ats-bridge;
  prefix ats-bridge;
  import ietf-interfaces {
    prefix if;
  }
  import ieee802-dot1q-bridge {
    prefix dot1q;
  }
  import ieee802-dot1q-ats {
    prefix ats;
  }
  import ieee802-dot1q-stream-filters-gates {
    prefix sfsg;
  }
  organization
    "IEEE 802.1 Working Group";
  contact
    "WG-URL: http://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 IEEE 802.1Q Bridge components
    that support Asynchronous Traffic Shaping (ATS).

    Copyright (C) IEEE (2023).

    This version of this YANG module is part of IEEE Std 802.1Q; see the
    standard itself for full legal notices.";
  revision 2023-07-03 {
    description
      "Published as part of IEEE Std 802.1Qcz-2023.";
    reference
      "IEEE Std 802.1Qcz-2023, Bridges and Bridged Networks - Congestion
      Isolation.";
  }
  augment "/if:interfaces/if:interface/dot1q:bridge-port" {
    description
      "Augments Bridge Ports by ATS per-Port parameters.";
    uses ats:ats-port-parameters;
  }
  augment "/dot1q:bridges/dot1q:bridge/dot1q:component" {
    description
      "Augments the Bridge component with ATS parameters.";
    uses sfsg:sfsg-parameters {
      augment "stream-filters/stream-filter-instance-table" {
        description
          "Augments the Bridge component stream filter for ATS
          schedulers.";
        uses ats:ats-parameters;
        container scheduler {
          description
            "This container encapsulates ATS scheduler nodes.";
          leaf scheduler-ref {
            type leafref {
              path
                '..'+
                '/..'+
```

```
                '/schedulers'+
                '/scheduler-instance-table'+
                '/scheduler-instance-id';
            }
            description
              "A reference to the ATS scheduler associated with this
              stream filter.";
          }
          leaf scheduler-enable {
            type boolean;
            default "false";
            description
              "If TRUE, this stream filter has an associated ATS
              scheduler referenced by scheduler-ref. If FALSE, no ATS
              scheduler is associated with this stream filter
              (scheduler-ref is ignored).";
          }
        }
      }
    }
  }
}
```

Insert 48.6.15 after 48.6.14 as follows:

48.6.15 The ieee802-dot1q-congestion-isolation YANG module

```
module ieee802-dot1q-congestion-isolation {
  yang-version "1.1";
  namespace urn:ieee:std:802.1Q:yang:ieee802-dot1q-congestion-isolation;
  prefix dot1q-ci;
  import ietf-yang-types {
    prefix yang;
  }
  import ieee802-types {
    prefix ieee;
  }
  import ieee802-dot1q-stream-filters-gates {
    prefix sfsg;
  }
  import ieee802-dot1q-types {
    prefix dot1q-types;
  }
  import ietf-inet-types {
    prefix inet;
  }
  organization
    "Institute of Electrical and Electronics Engineers";
  contact
    "WG-URL: http://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 YANG module augments the configuration and operational state
    data for interfaces for Congestion Isolation.

    References in this YANG module to IEEE Std 802.1Q are to IEEE Std
    802.1Q-2022 as amended by IEEE Std 802.1Qcz-2023.

    Copyright (C) IEEE (2023).

    This version of this YANG module is part of IEEE Std 802.1Q; see the
    standard itself for full legal notices.";
  revision 2023-07-03 {
    description
      "Published as part of IEEE Std 802.1Qcz-2023.";
    reference
      "IEEE Std 802.1Qcz-2023";
  }

  /*--------------------*/
  /* Feature            */
  /*--------------------*/
  feature congestion-isolation {
    description
      "Feature Congestion Isolation";
  }

  /*--------------------*/
  /* Typedefs           */
  /*--------------------*/
  typedef abs-traffic-class-plus-one-type {
    type enumeration {
      enum monitored-queue-tc-1 {
        value 1;
        description
          "Traffic class 0 of monitored queue.";
```

```
}
enum monitored-queue-tc-2 {
  value 2;
  description
    "Traffic class 1 of monitored queue.";
}
enum monitored-queue-tc-3 {
  value 3;
  description
    "Traffic class 2 of monitored queue.";
}
enum monitored-queue-tc-4 {
  value 4;
  description
    "Traffic class 3 of monitored queue.";
}
enum monitored-queue-tc-5 {
  value 5;
  description
    "Traffic class 4 of monitored queue.";
}
enum monitored-queue-tc-6 {
  value 6;
  description
    "Traffic class 5 of monitored queue.";
}
enum monitored-queue-tc-7 {
  value 7;
  description
    "Traffic class 6 of monitored queue.";
}
enum monitored-queue-tc-8 {
  value 8;
  description
    "Traffic class 7 of monitored queue.";
}
enum congesting-queue-tc-1 {
  value -1;
  description
    "Traffic class 0 of congesting queue.";
}
enum congesting-queue-tc-2 {
  value -2;
  description
    "Traffic class 1 of congesting queue.";
}
enum congesting-queue-tc-3 {
  value -3;
  description
    "Traffic class 2 of congesting queue.";
}
enum congesting-queue-tc-4 {
  value -4;
  description
    "Traffic class 3 of congesting queue.";
}
enum congesting-queue-tc-5 {
  value -5;
  description
    "Traffic class 4 of congesting queue.";
}
enum congesting-queue-tc-6 {
  value -6;
  description
    "Traffic class 5 of congesting queue.";
}
enum congesting-queue-tc-7 {
  value -7;
  description
    "Traffic class 6 of congesting queue.";
}
enum congesting-queue-tc-8 {
```

```
        value -8;
        description
          "Traffic class 7 of congesting queue.";
      }
      enum not-participating-congestion-isolation {
        value 0;
        description
          "Traffic class not participating in congestion isolation.";
      }
    }
    description
      "Specifies a value that can be translated to the numeric value of
      the traffic class to be used as either the congesting or monitored
      queue. The absolute value of the enumerated value is the value of
      the traffic class plus 1. A value of 0 indicates the traffic class
      is not participating in congestion isolation. For example, the
      enumerated value congesting-queue-tc-5 specifies that traffic class
      4 is used as the congesting queue.";
  }
  grouping cip-port-parameters {
    description
      "The bridge port specific configuration for Congestion Isolation.";
    leaf cip-mac-address {
      type ieee:mac-address;
      config false;
      description
        "The source MAC address of a CIM, belonging to the system
        transmitting the CIM.";
      reference
        "49.4.1.2.1 of IEEE Std 802.1Q";
    }
    leaf cip-ipv4-address {
      type inet:ipv4-address;
      config false;
      description
        "The source IPv4 address of a CIM, belonging to the system
        transmitting the IPv4 layer-3 CIM.";
      reference
        "49.4.1.2.2 of IEEE Std 802.1Q";
    }
    leaf cip-ipv6-address {
      type inet:ipv6-address;
      config false;
      description
        "The source IPv6 address of a CIM, belonging to the system
        transmitting the IPv6 layer-3 CIM.";
      reference
        "49.4.1.2.3 of IEEE Std 802.1Q";
    }
    leaf cip-cim-port {
      type inet:port-number;
      config false;
      description
        "The UDP port number to be used by a peer transmitting a layer-3
        CIM. This value will be sent to the peer via LLDP in the CI TLV.";
      reference
        "49.4.1.2.4 of IEEE Std 802.1Q";
    }
    list queue-map {
      key "priority";
      description
        "An array of integers, one entry for each traffic class, 0
        through 7, specifying a value that can be translated to the
        numeric value of the traffic class to be used as either the
        congesting traffic class or the monitored traffic class for the
        traffic class specified by the index. The integers range in value
        from -8 to 8. A value of 0 in the table specifies that the
        traffic class is not participating in congestion isolation. A
        positive number specifies a traffic class for a monitored queue
        that is one less than the value (e.g., a value of 5 represents
        traffic class 4). A negative number specifies a traffic class for
        a congesting queue that is one less than the absolute value (e.g.,
```

```
        a value of -4 represents traffic class 3).";
      reference
        "49.4.1.2.5 of IEEE Std 802.1Q";
      leaf priority {
        type dot1q-types:priority-type;
        description
          "There are eight values of Priority that map to an absolute
          value that is a traffic class plus one, or the value 0 which
          indicates the traffic class is not used by congestion
          isolation.";
        reference
          "49.4.1.2.5 of IEEE Std 802.1Q";
      }
      leaf abs-traffic-class-plus-one {
        type abs-traffic-class-plus-one-type;
        description
          "A value that can be translated to represent a traffic class or
          an indication of non-use. A value of 0 specifies that the
          traffic class is not participating in congestion isolation. A
          positive number specifies a traffic class for a monitored
          queue, and a negative number specifies a traffic class for a
          congesting queue.";
        reference
          "49.4.1.2.5 of IEEE Std 802.1Q";
      }
    }
    leaf min-header-octets {
      type uint16;
      description
        "The minimum number of octets to include in the Encapsulated MSDU
        field of each CIM generated. The default value is 48.";
      reference
        "49.4.1.2.6 of IEEE Std 802.1Q";
    }
    leaf max-cim-tx {
      type uint16;
      description
        "The maximum number of times a CIM PDU will be sent for a
        congesting flow. The default value is 3.";
      reference
        "49.4.1.2.7 of IEEE Std 802.1Q";
    }
  }
  grouping cip-parameters {
    description
      "The system specific configuration for Congestion Isolation.";
    leaf ci-master-enable {
      type boolean;
      description
        "Specifies whether CI is enabled in this system.";
      reference
        "49.4.1.1.1 of IEEE Std 802.1Q";
    }
    leaf ci-cim-tx-priority {
      type dot1q-types:priority-type;
      config false;
      description
        "Specifies the priority value to be used when transmitting CIMs
        from the system. The default is 6.";
      reference
        "49.4.1.1.2 of IEEE Std 802.1Q";
    }
    leaf ci-max-flow-life {
      type uint32;
      config false;
      description
        "Specifies the maximum number of centiseconds that a congesting
        flow entry, created by the receipt of a CIM, can remain in the CI
        Stream Table after the congesting queue has transitioned from
        congested back to non-congested. The default value is 100.";
      reference
        "49.4.1.1.3 of IEEE Std 802.1Q";
```

```
}
container ci-peers {
  description
    "Contains information about an immediate peer obtained from a
    received LLDP Congestion Isolation TLV.";
  list ci-peer-table {
    key "reception-port";
    description
      "Contains entries for each participating immediate peer and
      provides the information needed to generate a CIM for
      transmission to the peer.";
    reference
      "49.3.6 of IEEE Std 802.1Q";
    leaf reception-port {
      type dot1q-types:port-number-type;
      description
        "The port number where the immediate congestion isolation
        participating peer is attached.";
      reference
        "49.3.6 of IEEE Std 802.1Q";
    }
    leaf cim-type {
      type enumeration {
        enum l2 {
          description
            "Layer 2 CIM encapsulation.";
        }
        enum ipv4 {
          description
            "IPv4 CIM encapsulation.";
        }
        enum ipv6 {
          description
            "IPv6 CIM encapsulation.";
        }
      }
      description
        "The format of the CIM expected by the peer.";
      reference
        "49.3.6 of IEEE Std 802.1Q";
    }
    leaf peer-mac-address {
      type ieee:mac-address;
      description
        "The destination MAC address to use when generating a CIM for
        the peer.";
      reference
        "49.3.6 of IEEE Std 802.1Q";
    }
    leaf peer-ipv4-address {
      type inet:ipv4-address;
      description
        "The destination IPv4 address to use when generating an IPv4
        layer-3 CIM for the peer.";
      reference
        "49.3.6 of IEEE Std 802.1Q";
    }
    leaf peer-ipv6-address {
      type inet:ipv6-address;
      description
        "The destination IPv6 address to use when generating an IPv6
        layer-3 CIM for the peer.";
      reference
        "49.3.6 of IEEE Std 802.1Q";
    }
    leaf peer-udp-port {
      type inet:port-number;
      description
        "The UDP port number to use when generating a layer-3 CIM for
        the peer.";
      reference
        "49.3.6 of IEEE Std 802.1Q";
```

```
    }
    leaf peer-cim-encap-len {
      type uint16 {
        range "0..512";
      }
      description
        "The number of octets from the MSDU to include in the
        Encapsulated MSDU field of the CIM PDU";
      reference
        "49.3.6 of IEEE Std 802.1Q";
    }
  }
  leaf max-ci-peer-entries {
    type uint32;
    config false;
    description
      "Specifies the maximum number of CI peer entries that can be
      stored.";
    reference
      "49.3.6 of IEEE Std 802.1Q";
  }
}
container ci-streams {
  description
    "Contains control information to manage congestion flows.";
  list ci-stream-table {
    key "stream-handle-id";
    config false;
    description
      "Contains entries for each congesting flow and has a 1:1
      mapping to entries in the IEEE Std 802.1CB Stream Identity
      Table.";
    reference
      "49.3.7 of IEEE Std 802.1Q";
    leaf stream-handle-id {
      type uint32;
      config false;
      description
        "There is a unique stream handle ID for each congesting flow
        stored in the CI Stream Table.";
      reference
        "49.4.1.5.1 of IEEE Std 802.1Q";
    }
    leaf cim-count {
      type uint16;
      config false;
      description
        "Contains a count of the number of CIMs sent for a congesting
        flow.";
      reference
        "49.4.1.5.2 of IEEE Std 802.1Q";
    }
    leaf create-time {
      type yang:timeticks;
      config false;
      description
        "The time (SysUpTime, IETF RFC 3418) at which the CI Stream
        Table entry was created.";
      reference
        "49.4.1.5.3 of IEEE Std 802.1Q";
    }
    leaf create-mask {
      type bits {
        bit local-create {
          position 0;
          description
            "CI Stream entry was created because congestion was
            detected locally by the AQM.";
        }
        bit cim-create {
          position 1;
          description
```

```
            "CI Stream entry was created because of the receipt of a
            CIM.";
          }
        }
        config false;
        description
          "Indicates the reason for creating or updating the CI Stream
          Table entry. The LSB indicates that the entry was created or
          updated because the AQM determined that a forwarded frame is
          part of a congesting flow. The MSB indicates that the entry
          was created or updated because of the receipt of a CIM.";
        reference
          "49.4.1.5.4 of IEEE Std 802.1Q";
      }
    }
    leaf queue-key {
      type uint16;
      config false;
      description
        "Represents the unique queue identity of a congesting queue at
        an egress port that a congesting flow is traversing. The key is
        calculated by the product of the congesting traffic class
        number plus one and the port number.";
      reference
        "49.4.1.5.5 of IEEE Std 802.1Q";
    }
    leaf dest-mac-address {
      type ieee:mac-address;
      config false;
      description
        "The destination MAC address of a congesting flow.";
      reference
        "49.4.1.5.6 of IEEE Std 802.1Q";
    }
    leaf source-mac-address {
      type ieee:mac-address;
      config false;
      description
        "The source MAC address of a congesting flow.";
      reference
        "49.4.1.5.7 of IEEE Std 802.1Q";
    }
    leaf vid {
      type dot1q-types:vlan-index-type;
      config false;
      description
        "The VID of a congesting flow.";
      reference
        "49.4.1.5.8 of IEEE Std 802.1Q";
    }
    leaf msdu {
      type yang:hex-string;
      config false;
      description
        "The initial octets of the MSDU of a congesting flow. The number
        of octets to keep in the CI Stream Table entry is specified by
        the peer CIM encapsulation length of the CI Peer Table.";
      reference
        "49.4.1.5.9 of IEEE Std 802.1Q";
    }
  }
  leaf max-ci-stream-entries {
    type uint32;
    config false;
    description
      "Specifies the maximum number of CI stream entries that can be
      stored.";
    reference
      "49.4.1.5 of IEEE Std 802.1Q";
  }
}
```

```
  /*--------------------*/
  /* Configuration Data */
  /*--------------------*/
  uses sfsg:sfsg-parameters {
    augment
      "stream-filters/stream-filter-instance-table/stream-handle-spec" {
      if-feature "congestion-isolation";
      description
        "Dot1q Congestion Isolation";
      case null-handle {
        description
          "Congestion isolation specific stream_handle specifications.";
        leaf null-handle {
          type empty;
          description
            "The stream_handle specification represents the value when no
            stream_handle is provided.";
        }
      }
    }
  }
}
```

Insert 48.6.16 as follows:

48.6.16 The ieee802-dot1q-congestion-isolation-bridge YANG module

```
module ieee802-dot1q-congestion-isolation-bridge {
  yang-version "1.1";
  namespace
    urn:ieee:std:802.1Q:yang:ieee802-dot1q-congestion-isolation-bridge;
  prefix ci-bridge;
  import ietf-interfaces {
    prefix if;
  }
  import ieee802-dot1q-bridge {
    prefix dot1q;
  }
  import ieee802-dot1q-congestion-isolation {
    prefix ci;
  }
  import ieee802-dot1q-stream-filters-gates {
    prefix sfsg;
  }
  organization
    "IEEE 802.1 Working Group";
  contact
    "WG-URL: https://1.ieee802.org/
    WG-EMail: stds-802-1@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 08855
            USA

    E-mail: stds-802-1-chairs@listserv.ieee.org";
  description
    "This module provides management of IEEE 802.1Q Bridge components
    that support Congestion Isolation.

    Copyright (C) IEEE (2023).

    This version of this YANG module is part of IEEE Std 802.1Q; see the
    standard itself for full legal notices.";
  revision 2023-07-03 {
    description
      "Published as part of IEEE Std 802.1Qcz-2023.";
    reference
      "IEEE Std 802.1Qcz-2023 - Bridges and Bridged Networks - Amendment:
      Congestion Isolation.";
  }
  feature congestion-isolation-bridge {
    description
      "Feature Congestion Isolation in Bridges";
  }
  augment "/dot1q:bridges/dot1q:bridge/dot1q:component" {
    if-feature "congestion-isolation-bridge";
    description
      "Augments the Bridge component with stream filters and stream
      gates.";
    uses ci:cip-parameters;
    uses sfsg:sfsg-parameters {
      augment
        "stream-filters/stream-filter-instance-table/stream-handle-spec" {
        if-feature "congestion-isolation-bridge";
        description
          "Dot1q Congestion Isolation";
        case null-handle {
          description
            "Congestion isolation specific stream_handle specifications.";
          leaf null-handle {
            type empty;
            description
```

```
              "The stream_handle specification represents the value when
              no stream_handle is provided.";
          }
        }
      }
    }
  }
  augment "/if:interfaces/if:interface/dot1q:bridge-port" {
    if-feature "congestion-isolation-bridge";
    description
      "Augment a bridge port with Congestion Isolation specific
      configuration.";
    uses ci:cip-port-parameters;
  }
}
```

Insert new Clause 49 "Congestion Isolation" after Clause 48 as follows:

49. Congestion Isolation

Congestion Isolation (CI) mitigates head-of-line blocking caused by the frequent use of PFC in lossless networks and reduces frame loss in lossy networks that are not using PFC. CI identifies the flows that are most likely causing congestion, isolates them to a separate lower priority traffic class and signals to the upstream peer to do the same. CI effectively moves the congesting flows out of the way, temporarily delaying the delivery of congesting frames, while the higher layer congestion control feedback loop has time to take effect.

This clause introduces the concepts and protocols essential to congestion isolation as follows:

a) The objectives for congestion isolation (49.1).
b) Principles of congestion isolation (49.2).
c) Congestion Isolation Aware Forwarding Process (49.3).
d) Congestion Isolation Protocol (49.4).
e) Topology Recognition (49.5).

In current data center networks, traffic can be a mix of various multi-tenant TCP and UDP flows across both the physical underlay and virtual overlay network. Intermittent congestion within the network can occur from an unfortunate mix of flows across the network. For example, a small number of long duration 'elephant' flows can align in such a way to create queuing delays for the larger number of short, but critical, 'mice' flows. In this case, the 'elephant' flows would be considered congesting flows to the 'mice' flows. Any flow can become a congesting flow when it contributes to congestion in the network.

Queuing delays deter the end-to-end congestion control loop, and in a lossless environment, cannot prevent Priority-based Flow Control (PFC) from being invoked (see Clause 36). When buffers fill and eventual flow-control kicks in (for lossless networks), non-congesting flows can be blocked by the backlog of frames from congesting flows. If PFC is not being used, frame loss for non-congesting flows can result in long retransmission timeouts, significantly penalizing such flows, which are often used for application control and synchronization.

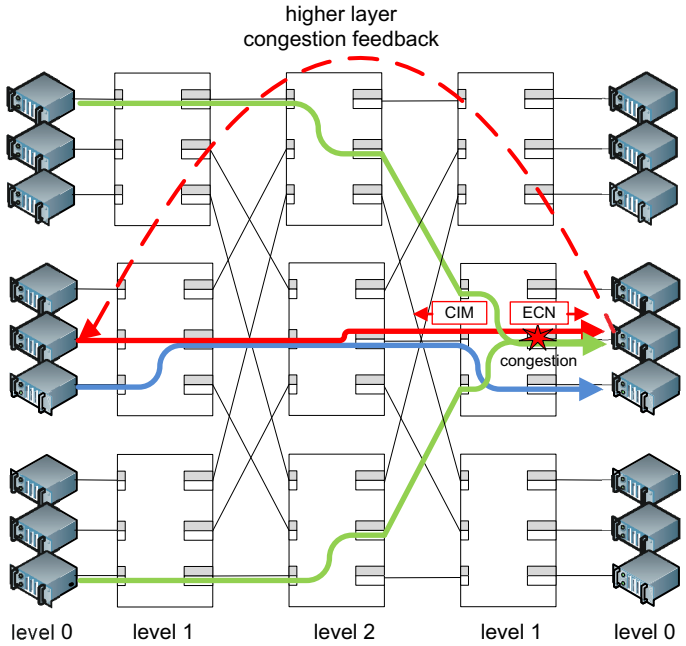


Figure 49-1—Congestion Isolation example operation

Figure 49-1 shows an example operation of CI. In the figure, all of the relay systems are layer-3 routers and are congestion isolation aware systems.The example shows a network of layer-3 routers, but congestion isolation also applies to Bridged Networks. Each system is showing two queues on each port; a monitored queue and a congesting queue. Server-to-server traffic is flowing from left to right across a data center network. When congestion is detected CI attempts to identify the congesting flows (49.2.1). For each identified congesting flow (e.g. the red flow in Figure 49-1), the congestion isolation aware system takes local actions to isolate the congesting flow, sends a Congestion Isolation Message (CIM) upstream if the congesting queue is congested, and sends Explicit Congestion Notification (ECN) downstream.

The local actions taken by a congestion isolation aware system deprioritize frames from the congesting flow and place them in a dedicated congesting flow queue (49.2.3). An entry is made in the IEEE Std 802.1CB Stream identity table of the local system so that subsequent frames from the congesting flow can be identified and deprioritized (49.2.2).

When a flow is isolated the deprioritized frames are queued in the congesting flow queue. When that queue becomes congested (49.2.1) and the upstream peer is congestion isolation aware, the CI functionality signals to the immediate upstream peer using a CIM (49.2.5).

The CIM contains flow description information necessary for the upstream peer to identify the same congesting flow. The upstream peer creates a Stream identity table entry using the contents of the CIM (49.2.2). The table entry is used to isolate the same flow by identifying subsequent frames and deprioritizing those frames to the congested flow queue.

The IP packets in frames of the congesting flows are marked with higher layer congestion signals such as those defined by the IETF RFC 3168 for Explicit Congestion Notification (ECN). Since CI is performed within the network it is essential that end-to-end higher layer congestion control is combined with CI so the sending sources will reduce their rate of transmission in response to the congestion signals. ECN operates by marking packets where they encounter queuing delay as they travel towards the destination. At the IP destination, feedback is signaled to the source system, so it takes time for the signals to propagate and ultimately impact the transmission rate of the source system.

The frames in the congesting flow queue are serviced at a lower priority than other non-congesting queues, so if congestion persists, the congesting flow queue may fill. When the congesting flow queue fills, the ingress port feeding that queue can issue PFC for the lower priority queue to avoid frame loss (49.2.4). In this case, PFC only acts on the lower priority congesting flow queues and other well-behaved flows continue through the network via non-congesting priority queues.

49.1 Congestion isolation objectives

The operation, procedures, and protocols of congestion isolation are designed to meet the following objectives by category:

Functionality

a) With high probability, identify the flows that are causing congestion.
b) Avoid head-of-line blocking of non-congesting flows locally by quickly adjusting the traffic class of congesting flows.
c) Avoid head-of-line blocking of non-congesting flows upstream by signaling to upstream peers the information needed to isolate the same congesting flows.
d) Reduce the frequency of invoking PFC in a lossless environment.

Compatibility

e) Work in legacy environments by automatically detecting legacy peers and disabling CIM signaling.
f) Work in existing lossless environments using PFC without requiring additional traffic classes.

g) Work in conjunction with higher layer end-to-end congestion control protocols (e.g Explicit Congestion Notification (ECN), Remote Direct Memory Access (RDMA) over Converged Ethernet (RoCE), Data Center Quantized Congestion Notification (DCQCN [B68])).
h) Work in both layer-2 and layer-3 networks.
i) Coexist with existing traffic scheduling paradigms on other traffic classes.

Performance

j) Reduce average flow completion time across the data center network.
k) Reduce the amount of time frames are paused when PFC is enabled.
l) Reduce overall frame loss when PFC is not enabled.
m) Reduce head-of-line blocking of victim flows at upstream peers from PFC.
n) Reduce overall congestion control signaling.
o) Increase link utilization.

Scale

p) Work in arbitrary data center network topologies with a mix of link speeds.
q) Limit messaging overhead by restricting message propagation to hop-by-hop.
r) Reduce Stream identity table requirements by only requiring the registration of congesting flows and providing facilities to rapidly remove flows that are no longer congesting.

Implementation complexity

s) Limit the impact of existing traffic selection algorithms.
t) Achieve the benefits of congestion isolation without additional buffer requirements.
u) Support implementations of existing traffic classes.
v) Leverage existing standard functionality for congesting flow identification and stream identification.

Manageability

w) Only require a small set of configuration parameters that are consistent across multiple Bridge deployments.
x) Limit the ability to configure an inoperable environment.
y) Provide auto discovery of peer capabilities using existing LLDP messages and without creating additional hello and auto-configuration protocols.

49.2 Principles of congestion isolation

This subclause introduces the principles of congestion isolation. Items a) through f) describe the life of a congesting flow from identification through isolation to returning the flow to non-congesting status. Item g) describes a mechanism for determining a device's level in the data center topology that can be used to ensure compatibility and proper operation of existing protocols. Item h) compares and contrasts congestion isolation with Congestion Notification (see Clause 30).

The following items describe the principles of congestion isolation:

a) Congesting flow identification (49.2.1).
b) IEEE Std 802.1CB stream identification (49.2.2).
c) Flow priority modification (49.2.3).
d) Priority-based Flow Control interaction (49.2.4)
e) Congestion isolation signaling (49.2.5).
f) Congesting to non-congesting status change (49.2.6).
g) System topology and port orientation (49.2.7).
h) Comparison to Congestion Notification (49.2.8).

49.2.1 Congesting flow identification

An essential step in the process of CI is identifying congesting flows by an Active Queue Management (AQM) scheme that supports Explicit Congestion Notification (ECN) specified in IETF RFC 3168. There are many potential methods of identifying congesting flows and interoperable implementations can exist using different approaches. The CIP Congestion Detection function (49.3.1) of the Congestion Isolation Aware Forwarding Process (49.3) is responsible for implementing the AQM. This standard defines the CP algorithm (30.2.1) for detecting Congestion Controlled Flows (CCFs) in congestion aware Bridges. This approach may be used to detect congesting flows in a CI aware system. A number of other possible approaches, including those that support the end-to-end ECN congestion control, are discussed in IETF RFC 7567 [B45].

Many modern data centers utilize encapsulated overlay networks, such as those described in IETF RFC 8014 [B46]. An overlay network can carry multiple encapsulated flows within a single encapsulation flow. The congesting and non-congesting flows identified by CI are the outer encapsulation flow as seen by the underlay network. The inner encapsulated flows might not be visible to the Bridges and routers within the data center network, and are therefore not separated into congesting and non-congesting flows.

49.2.2 IEEE Std 802.1CB stream identification

Subsequent frames of congesting flows are identified by matching in the IEEE Std 802.1CB Stream identity table. Congesting flow entries are added to and removed from the Stream identity table as tsnStreamIdEntry objects using the managed object interface specified in Clause 9 of IEEE Std 802.1CB-2017. The tsnStreamIdIdentificationType for these objects is IP stream identification. The contents for an IP stream tsnStreamIdEntry come from the received frame that has been identified as causing congestion or from the parameters in the CIM PDU (49.4.3.4) from a peer. Flows matching in the Stream identity table will provide a stream_handle for congesting flows to the EISS. The stream_handle for congesting flows is used as the tsnStreamIdHandle entity of the tsnStreamIdEntry object.

Congestion isolation uses stream_handles to identify frames of congesting and non-congesting flows. This use prohibits stream_handles from being used by other functionality requiring stream_handles on a port where congestion isolation operates.

49.2.3 Flow priority modification

CI uses the facilities of per-stream classification and metering (8.6.5.2) to modify the priority of congesting flow frames. The stream_handle, available as part of the connection_identifier, is provided by the Stream identification function and accompanies frames of congesting flows as they pass through a relay. This stream_handle is used to select a stream filter instance and stream gate instance that will modify the priority of the frame for congesting flows. A single stream filter instance from the stream filter instance table (8.6.5.2.3), with a wildcard match on the stream_handle, is used to select a stream gate instance that contains the new internal priority value (IPV). Configuration of the stream filter instance table and stream gate instance table is described in 8.6.5.

The process of modifying the priority of subsequent frames of a congesting flow brings with it the risk of misordering. There may be a period of time where frames for the same flow exist in multiple queues at the same time. Strict priority transmission selection can ensure ordering is maintained for congesting flows because the monitored queue is higher priority than the congesting queue. However, other transmission selection algorithms may be desired. Congestion isolation implementations need to ensure that misordering (6.5.3) remains negligible. Annex W discusses possible approaches for ensuring ordering.

49.2.4 Priority-based Flow Control interaction

Priority-based Flow Control (PFC) (Clause 36) is used in data centers to create lossless traffic classes in the data center network. PFC allows link flow control to be performed on a per-priority basis. For PFC to operate properly, it is imperative that the downstream system can determine the priority of the frame when it egresses the upstream peer. The Priority Code Point (PCP—see 6.9.3) field of a VLAN tag encodes a

frame's priority. Since an upstream congestion isolation aware system modifies the priority of congesting frames, it must also modify the PCP so the downstream system can assert PFC, if needed, on the correct priority. Therefore all frames must be VLAN tagged when operating CI with PFC in a lossless environment. Additional design considerations for the interaction of PFC and CI are discussed in W.2.

49.2.5 Congestion isolation signaling

Once a flow has been isolated and subsequent frames are forwarded through the congesting queue and the congesting queue becomes congested, it is useful to inform the upstream peer of this event by signaling a Congestion Isolation Message (CIM). Upon receiving a CIM, the upstream peer can isolate the same flow by creating an entry in the IEEE Std 802.1CB Stream identity table. The benefit of isolating a flow upon the directive of a peer is that the congesting flow can be moved out of the way of other non-congesting flows and the potential for head-of-line blocking can be reduced.

The CIM contains parameters and a portion of the received frame so the upstream peer can identify the congesting flow and create an entry in its Stream identity table. The parameters and portion of the received frame included in the CIM must be the same as those of the frame sent by the upstream peer in order for that peer to identify the same flow. Features such as the VID translation table (6.9) can change the frame's parameters from what was sent by the upstream peer and should not be used with CI.

The CIM is addressed to the upstream peer. The system generating the CIM must locate CIM format information and the address parameters of the upstream peer by indexing into the CI Peer Table (49.3.6) using the reception port as the index. The CI Peer Table is built using information provided by LLDP and the Congestion Isolation TLV (D.2.15).

By default, a CIM contains the first 64 bytes of the congesting frame's mac_service_data_unit. Systems encapsulating and decapsulating flows for overlay networks may request the peer to include up to 512 octets of the received frame in the CIM. This allows the systems to access and identify encapsulated flows within the congesting flow encapsulation.

49.2.6 Congesting to non-congesting status change

Flows that are no longer causing congestion may be removed from the Stream identity table. Many methods of determining that a flow is no longer causing congestion are possible, but at a minimum, all flows in the Stream identity table for the port can be removed when the congesting queue for that port becomes empty. Waiting until the congesting queue is empty can cause congesting flows to remain in the congesting state longer than necessary, but it allows an implementation to easily abide by the frame misordering requirements of (6.5.3). Other approaches can react quickly and independently of other congesting flows, but may bring the risk of misordering. Implementations need to ensure that misordering is negligible. An example approach for avoiding misordering when returning a flow to non-congesting status can be seen in Annex W.

Frames from congesting flows received downstream from the root of congestion may be safely returned to the non-congesting traffic class. These frames are easily identified downstream because they are received on the congesting traffic class, but do not have a matching entry in the Stream identity table and will therefore not have a stream_handle parameter when passed through relay. These frames are isolated to the congesting queue by an upstream peer and the traffic class, as well as the associated Priority Code Point (PCP—see 6.9.3) or other indicators used to select a traffic class, such as the Differentiated Services Code Point (DSCP—see IETF RFC 2474) are modified upstream to indicate they are part of a congesting flow. Downstream from the congestion, however, these frames can be safely forwarded through the monitored queue. A second stream filter instance is used to return these frames to the monitored queue and update the PCP or other indicators used to select a traffic class. This stream filter is defined to match on the absence of

a stream_handle and the priority for the congesting queue. The end-to-end ECN congestion markings remain unchanged and the congestion indications in the higher layer protocols will be noted at the source of the flow once the feedback is propagated.

NOTE—As noted in 6.8.1, modification to a frame's PCP or other indicators used to select a traffic class, will require the FCS to be regenerated. Options for regenerating the FCS are discussed in Annex O.

49.2.7 System topology and port orientation

Figure 49-1 shows an example of a popular data center topology. Other topologies are possible, but they all can be described as having devices positioned at levels within the topology. The topology levels are distinguished by considering the number of link hops from any interior system to non-relay end stations or servers at the edge of the network. By this definition, end stations and servers are at level 0. The immediate attached device would be at level 1 and further interior only systems could be at level 2 or higher depending on the connectivity of the topology.

A port's orientation is distinguished by considering the level in the topology a port is facing. A port facing a lower level has an orientation of a downlink, while a port facing a higher level has an orientation of an uplink. A port facing a system at the same level has an orientation of a crosslink.

Congestion isolation benefits from knowing a system's level in the topology. Recognizing the level is automated by the use of the LLDP Topology Recognition TLV (D.2.16) and the procedures defined in 49.5.3. During the process of isolating a congesting flow, the frame's priority may be changed from its original value. The corresponding Priority Code Point (PCP—see 6.9.3) or Differentiated Services Code Point (DSCP—see IETF RFC 2474) received at the destination may be different than the value provided by the original sender. To avoid complications with unexpected PCP or DSCP values, the Bridge or router at level 1 in the topology may change the PCP or DSCP back to the original value for the monitored queue.

In addition to avoiding complications with changed PCP or DSCP values, knowing a system's level in the topology can assist in identifying the type of congestion experienced and consequentially a strategy for mitigating it. Ports of Bridges or routers at level 1 in the topology are connected to non-relay end stations or servers. Congestion on these ports can often be attributed to incast traffic patterns. Congestion on links of systems that are at level 2 or higher in the topology may be experiencing in-network congestion. It has been shown that load balancing techniques, which may alleviate in-network congestion, are counter productive at addressing incast congestion [B60].

Lossless networks enabled by PFC have been shown, in certain circumstances, to have circular buffer dependencies that can cause deadlocks when traffic is re-routed due to link failures [B5]. Again, knowing the position in the topology assists in knowing when traffic has been re-routed and can be used to break circular buffer dependent deadlocks [B4].

49.2.8 Comparison to Congestion Notification

Congestion Isolation and Congestion Notification (Clause 30) share common aspects but are distinctly different. Both generate congestion messages and send them upstream, but CN directs the message across the Bridged Network to the source station, while CI directs the message to the immediate peer. CI is intended to operate in layer 3 and layer 2 networks with higher layer end-to-end congestion control supported by the end stations to regulate the rate of traffic injection into the network. CN is designed to operate across a large layer 2 domain where reaction points in end-station network adapters regulate traffic injection. CI isolates congesting flows by reclassifying their traffic class. CN does not modify the traffic class of frames.

49.3 The Congestion Isolation Aware Forwarding Process

This subclause specifies the architecture of the Congestion Isolation Point (CIP) in the Forwarding Process of a congestion isolation aware Bridge. In this architecture, a router is as a higher layer entity that relays frames using layer-3 information but uses the forwarding process of the underlying congestion isolation aware Bridge to deliver frames to peers and end stations.

The models of operation in this clause provide a basis for specifying the externally observable behavior of CI, and are not intended to place additional constraints on implementations; these can adopt any internal model of operation compatible with the externally observable behavior specified. Conformance of equipment to this standard is purely in respect of observable protocol.

Figure 8-12 illustrates the Bridge Forwarding Process at its highest conceptual level. Figure 8-16 shows the specific filtering and assignment functions of the flow classification and metering elements in the Forwarding Process of a congestion isolation aware Bridge. Figure 49-2 focuses on the operation of a single Bridge Port and the relationship of new elements to the queuing and classification functions. Five new elements and two new managed tables are specified for a CI aware Bridge as follows:

a) CIP Congestion Detection (49.3.1).
b) CIP transmission gates (49.3.2).
c) CIM Demultiplexer (49.3.3).
d) Congesting flow identification (49.3.4).
e) CIM Multiplexer (49.3.5).
f) CI Peer Table (49.3.6).
g) CI Stream Table (49.3.7).

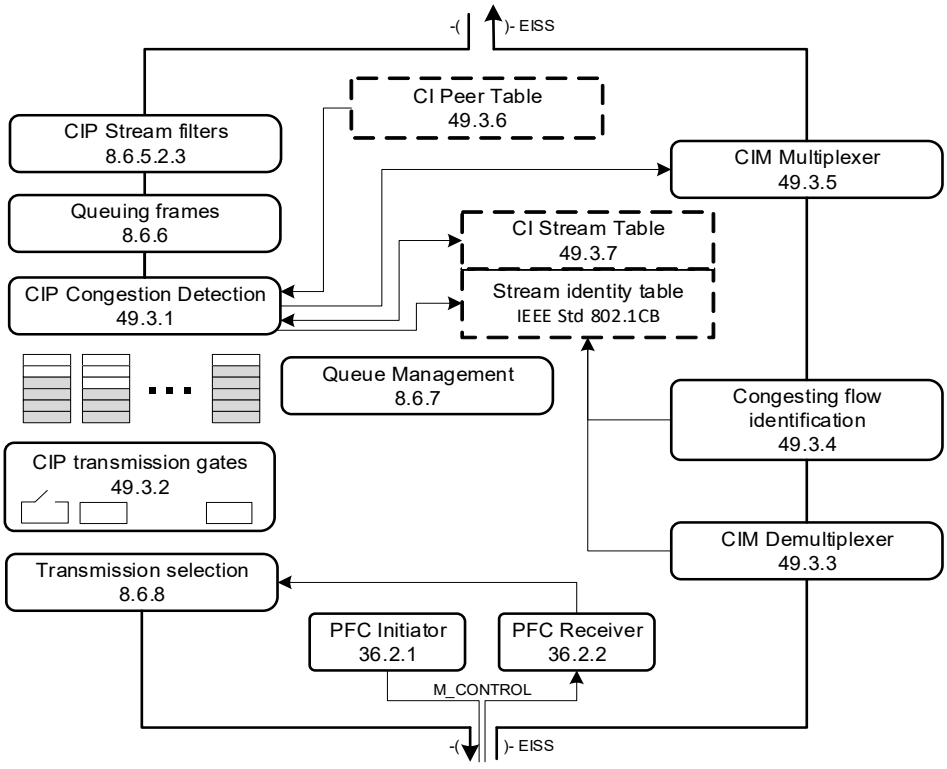


Figure 49-2—Congestion Isolation reference diagram

49.3.1 CIP Congestion Detection

CIP Congestion Detection identifies frames of a congesting flow, inserts frames passed by the Queuing Frames entity (8.6.6) into the appropriate queue or discards them and can generate a CIM based on the contents of the frame. CIP Congestion Detection is also responsible for creating entries in the Stream identity table and the CI Stream Table (49.3.7) for newly identified congesting flows. As described in 49.2.1, frames of a congesting flow are identified by a suitable AQM implemented by CIP Congestion Detection, such as the algorithm specified by a CP in 30.2.1.

Frames given to CIP Congestion Detection by the Queuing Frames entity (8.6.6) in an EM_UNITDATA.request (49.4.2.2) may be identified by the AQM as being part of a congesting flow. CIP Congestion Detection creates a new entry in the Stream identity table and the CI Stream Table for congesting flows received on a monitored queue. A CIM may be generated from the parameters obtained with the received frame and values from the CI Peer Table entry for the source port of the received frame. The CIM is delivered to the upstream peer via the CIM Multiplexer.

On each EM_UNITDATA.request, CIP Congestion Detection and its associated AQM indicate to the CIP procedures (49.4) whether a monitored or congesting queue is empty, congested, or not congested. The AQM or other means can be used to provide the queue status.

49.3.2 CIP transmission gates

CIP transmission gates control whether or not a queued frame can be selected for transmission by the transmission selection algorithm. The purpose of controlling a queue's availability to traffic selection is to allow the CI implementation a means to preserve order of congesting flow frames. The need to preserve order is dependent upon the transmission selection algorithm configured for the congesting and monitored queues. When the transmission selection algorithm is strict priority, the state of the transmission gate is permanently *open*. When the transmission selection algorithm is anything other than strict priority the implementation is responsible for ensuring order. An example approach is discussed in Annex W.

49.3.3 CIM Demultiplexer

The CIM Demultiplexer identifies CIMs received from the LAN and uses the content of the CIM PDU (49.4.3.4) to create an entry in the IEEE Std 802.1CB Stream identity table. A CIM PDU may be encapsulated by three different CIM encapsulations; layer-2, IPv4, or IPv6. Implementations supporting IPv4 and IPv6 encapsulations must be able to identify and validate IPv4 and/or IPv6 packets in the CIM Demultiplexer. The rules for validating received CIMs are specified in 49.4.3.5.

49.3.4 Congesting flow identification

Frames received from the LAN belonging to congesting flows are identified by the Stream identification function of IEEE Std 802.1CB. The Stream identification function provides a stream_handle subparameter in the connection_identifier parameter of an EM_UNITDATA.indication for frames of congesting flows and does not provide a stream_handle for frames of non-congesting flows. The presence or non-presence of the stream_handle is used to match a stream filter instance in the per-stream classification and metering function to modify the frame's priority (8.6.5.2.3).

49.3.5 CIM Multiplexer

The CIM Multiplexer inserts CIMs generated by the CIP Congestion Detection element among frames received from the LAN. Layer-2 encapsulated CIMs (49.4.3.1) are delivered to the upstream peer through the Bridge relay. Layer-3 encapsulated CIMs (49.4.3.2 and 49.4.3.3) are routed to the upstream peer by a higher-layer routing function that is beyond the scope of this standard.

49.3.6 CI Peer Table

The CI Peer Table (12.33.2) contains entries for each participating immediate peer and provides the information needed to generate a CIM for transmission to the peer. The entries are indexed by port number. An entry contains the format type of the CIM needed to reach the peer as well as the addressing information needed to generate the message. This includes the MAC address to use as the destination address and optionally an IPv4 or IPv6 address. The entry provides the UDP port number to use when the CIM encapsulation is a layer-3. An entry also contains the number of bytes of the received congesting flow frame to encapsulate in the CIM PDU itself. The contents of the entry are obtained from the LLDP Congestion Isolation TLV (D.2.15) received from participating peers.

49.3.7 CI Stream Table

The CI Stream Table (12.33.3) contains entries for each congesting flow and has a 1:1 mapping to entries in the IEEE Std 802.1CB Stream identity table. The entries are indexed by the stream_handle provided as a subparameter of the connection_identifier in EM_UNITDATA.request (49.4.2.2) invocations at the EISS. Each entry contains controlling variables (49.4.1.5) that allow an implementation to manage a congesting flow. This includes a means of identifying the congesting queue used to isolate the congesting flow. It also maintains a count of the CIMs sent on behalf of the congesting flow as well as an indication of why the entry was created or updated.

49.4 Congestion Isolation Protocol

Congestion isolation aware systems control forwarding elements, participate in congestion isolation protocols, and act upon the LLDP Congestion Isolation TLV as specified in this subclause. This includes:

a) Variables controlling operation (49.4.1).
b) CIP procedures (49.4.2).
c) Encoding of the CIM PDU and CIM encapsulations (49.4.3).
d) LLDP Congestion Isolation TLV (49.4.4).

49.4.1 Variables controlling operation

The congestion isolation variables control the operation of the CI entity and the CIP entity.

49.4.1.1 CI entity variables

Every congestion isolation aware system has a set of CI entity variables to control the overall operation of CI. These variables are included in the CI entity managed object (12.33.1). These include the following:

a) ciMasterEnable (49.4.1.1.1).
b) ciCIMTransmitPriority (49.4.1.1.2).
c) ciMaxFlowLife (49.4.1.1.3).

49.4.1.1.1 ciMasterEnable

A boolean value specifying whether CI is enabled in this system. If ciMasterEnable is FALSE all congestion isolation activity is disabled; CIMs and LLDP Congestion Isolation TLVs are not generated and are ignored on receipt. If ciMasterEnable is TRUE the other managed objects and variables specified in the clause control the operation of CI.

49.4.1.1.2 ciCIMTransmitPriority

An integer specifying the priority value to be used when transmitting CIMs from the system. The default is 6.

49.4.1.1.3 ciMaxFlowLife

An unsigned integer specifying the maximum number of centiseconds that a congesting flow entry, created by the receipt of a CIM, can remain in the CI Stream Table beyond the time indicated by the per-port per-queue variable cipNonCongestedTime (49.4.1.4.2). The default value is 100.

49.4.1.2 CIP entity variables

The following variables control the operation of a CIP:

a) cipMacAddress (49.4.1.2.1)
b) cipIPv4Address (49.4.1.2.2)
c) cipIPv6Address (49.4.1.2.3)
d) cipCIMUDPPort (49.4.1.2.4)
e) cipQueueMap[] (49.4.1.2.5)
f) cipMinHeaderOctets (49.4.1.2.6)

49.4.1.2.1 cipMacAddress

The MAC address, belonging to the system transmitting the CIM (49.4.3), used as the source_address of CIMs sent from the CIP.

49.4.1.2.2 cipIPv4Address

The IPv4 address, belonging to the system transmitting the IPv4 layer-3 CIM (49.4.3.2), used as the IPv4 source address in the IPv4 header (IETF RFC 791) of IPv4 layer-3 CIMs sent from the CIP. The cipIPv4Address is included in the LLDP Congestion Isolation TLV (D.2.15) to allow peers to properly generate IPv4 layer-3 CIMs that can be received by the system.

49.4.1.2.3 cipIPv6Address

The IPv6 address, belonging to the system transmitting the IPv6 layer-3 CIM (49.4.3.3), used as the IPv6 source address in the IPv6 header (IETF RFC 8200) of IPv6 layer-3 CIMs sent from the CIP. The cipIPv6Address is included in the LLDP Congestion Isolation TLV (D.2.15) to allow peers to properly generate IPv6 layer-3 CIMs that can be received by the system.

49.4.1.2.4 cipCIMUDPPort

The destination UDP port number in the UDP header (IETF RFC 768) of IPv4 and IPv6 layer-3 CIMs sent by peers. The value is also used as the UDP source port number in layer-3 CIMs sent to peers. The UDP port number must be selected from the range of dynamic port numbers, between 49152 and 65535, as specified in IETF RFC 6335. The port number must be currently available for use by the implementation. For example, an implementation may use UDP port 58622, if it is not currently being used by any other application in the system.

49.4.1.2.5 cipQueueMap[]

An array of integers, one entry for each traffic class, 0 through 7, specifying a value that can be translated to the numeric value of the traffic class to be used as either the congesting traffic class or the monitored traffic class for the traffic class specified by the index. The integers range in value from –8 to 8. A value of 0 in the table specifies that the traffic class is not participating in congestion isolation. A positive number specifies a traffic class for a monitored queue that is one less than the value (e.g., a value of 5 represents traffic class 4). A negative number specifies a traffic class for a congesting queue that is one less than the absolute value (e.g., a value of –4 represents traffic class 3).

NOTE—Configuration of the cipQueueMap[] is flexible, allowing the arrangement of multiple monitored and congesting queue sets.

Frames from flows that the AQM determines are causing congestion and are currently transferring through the monitored traffic class specified by the index into this table may have their priority remapped to the translated traffic class specified by the entry in the cipQueueMap[]. Frames from flows that have an entry in the Stream identity table have a stream_handle that specifies a stream filter to remap the priority to the IPV. Frames that are transferring through a congesting traffic class and do not have a stream_handle match on the null-handle stream filter entry to have their priority remapped to the monitored traffic class specified in the IPV.

The cipQueueMap[] is included in the LLDP Congestion Isolation TLV (D.2.15) to inform peers of the system's configuration. Mismatched configurations can be detected by comparing the queue map received in the TLV with configured cipQueueMap[].

49.4.1.2.6 cipMinHeaderOctets

The minimum number of octets that the CIP is to return in the Encapsulated MSDU field of each CIM generated. The default value is 48. The cipMinHeaderOctets is included in the LLDP Congestion Isolation TLV (D.2.15) to inform peers of the required minimum. The cipMinHeaderOctets value from peers is stored in the CI Peer Table (49.3.6) and used to generate CIMs to be transmitted to the peer.

49.4.1.2.7 cipMaxCIM

The maximum number of times a CIM PDU will be sent for a congesting flow. The default value is 3. A larger value provides more resilience to lost CIMs, but generates more traffic on the network.

49.4.1.3 CIP entity per-port variables

For each port in a congestion isolation aware system there is the following set of variables:

a) ciRxPort (49.4.1.3.1)
b) ciAddDel (49.4.1.3.2)

49.4.1.3.1 ciRxPort

A local variable holding the reception port number for a congesting flow. The CI Stream Table (12.33.3) is indexed by this local variable during the construction of a CIM. The value may be loaded during an EM_UNITDATA.request or when entries are being removed from the CI Stream Table and IEEE Std 802.1CB Stream identity table.

49.4.1.3.2 ciAddDel

A local variable holding an enumeration {*add, delete*} that provides an indication of the reason to build and send a CIM. The Add/Del field of the CIM PDU informs the peer that a congesting flow is either being added or deleted. The ciAddDel variable is used by the common buildAndSendCim() procedure (49.4.2.5) to parameterize and properly set the Add/Del field.

49.4.1.4 CIP entity per-port per-traffic class variables

For each port and monitored or congesting queue in a congestion isolation aware system there is the following set of variables:

a) cipGateControl (49.4.1.4.1)
b) cipNonCongestedTime (49.4.1.4.2)
c) cipCongesting (49.4.1.4.3)

49.4.1.4.1 cipGateControl

Determines the state of the transmission gate for a monitored or congesting queue. There is an instance of cipGateControl for each queue that is participating in congestion isolation. The transmission gate allows implementations to maintain frame order when isolating a congesting flow. The value of the cipGateControl variable is either *open* or *closed*. It is directly tied to the state of the transmission gate of the monitored queues and the congesting queue. When the transmission selection algorithm is strict priority, the cipGateControl shall be *open* for all queues. Other transmission selection algorithms may require that order is maintained by controlling the values of cipGateControl. An example implementation approach for a traffic selection algorithm other than strict priority is described in Annex W.

49.4.1.4.2 cipNonCongestedTime

The time (SysUpTime, IETF RFC 3418) at which the queue last transitioned from congested to non-congested. This timestamp is used by the background periodicTableCleanup() procedure (49.4.2.10) to remove stale CI Stream Table entries that were created because of the receipt of a CIM and still remain in the table for a period longer than the ciMaxFlowLife (49.4.1.1.3).

49.4.1.4.3 cipCongesting

A boolean value that is set during the processing of a frame by the EM_UNITDATA.request (49.4.2.2) procedure. The value is set true when the AQM indicates that the monitored queue is no longer congested or the congesting queue is empty. The variable is initialized to false.

49.4.1.5 CIP entity per-stream variables

For each tsnStreamIdEntry object created in the IEEE Std 802.1CB Stream identity table there is a corresponding entry in the CI Stream Table (12.33.3). The entry contains per-stream variables that identify the congesting queue for a congesting flow, count the number of CIMs that have been transmitted for the congesting flow, and register the reasons for creating or updating the tsnStreamIdEntry object. Each entry contains the following variables:

a) ciStreamIdHandle (49.4.1.5.1)
b) ciCIMCount (49.4.1.5.2)
c) ciCreateTime (49.4.1.5.3)
d) ciStreamCreateMask (49.4.1.5.4)
e) ciQueueKey (49.4.1.5.5)
f) ciDestination_address (49.4.1.5.6)
g) ciSource_address (49.4.1.5.7)
h) ciVlan_identifier (49.4.1.5.8)
i) ciMsdu (49.4.1.5.9)

49.4.1.5.1 ciStreamIdHandle

The stream_handle value used to create the tsnStreamIdEntry object in the IEEE Std 802.1CB Stream identity table. This variable provides the 1:1 mapping of the CI Stream Table entry with the tsnStreamIdEntry object.

49.4.1.5.2 ciCIMCount

An integer containing a count of the number of CIMs sent for the congesting flow. The count is reset when a frame from a congesting flow is received on a monitored queue.

49.4.1.5.3 ciCreateTime

The time (SysUpTime, IETF RFC 3418) at which the CI Stream Table entry was created.

49.4.1.5.4 ciStreamCreateMask

A 2-bit mask indicating the reason for creating or updating the CI Stream Table entry. The LSB indicates that the entry was created or updated because the AQM determined that a forwarded frame is part of a congesting flow. The MSB indicates that the entry was created or updated because of the receipt of a CIM. The ciStreamCreateMask allows an implementation to take different actions when de-isolating a congesting flow.

49.4.1.5.5 ciQueueKey

An integer that represents the unique queue identity of a congesting queue at an egress port that a congesting flow is traversing. The key is calculated by the product of the congesting traffic class number plus one and the port number. The key is used to help find all congesting flows using the same queue so the flushCongestingFlows() procedure (49.4.2.9) can efficiently remove them.

49.4.1.5.6 ciDestination_address

A MAC address obtained from the destination_address parameter of an EM_UNITDATA.indication for a congesting flow or from the destination_address field of a received CIM PDU.

49.4.1.5.7 ciSource_address

A MAC address obtained from the source_address parameter of an EM_UNITDATA.indication for a congesting flow or from the source_address field of a received CIM PDU.

49.4.1.5.8 ciVlan_identifier

A VLAN Identifier obtained from the vlan_identifier parameter of an EM_UNITDATA.indication for a congesting flow or from the vlan_identifier field of a received CIM PDU.

49.4.1.5.9 ciMsdu

An octet string containing an MSDU obtained from the mac_service_data_unit parameter of an EM_UNITDATA.indication for a congesting flow or from the Encapsulated MSDU field of a received CIM PDU.

49.4.2 CIP procedures

Congestion isolation is implemented through the procedures of a CIP. These include the following:

a) ciInitialize() (49.4.2.1)
b) EM_UNITDATA.request (parameters) (49.4.2.2)
c) condTransmitCimAddPdu() (49.4.2.3)
d) transmitCimDelPdu() (49.4.2.4)
e) buildAndSendCim() (49.4.2.5)
f) processCimPdu() (49.4.2.6)
g) addCongestingFlow() (49.4.2.7)
h) delCongestingFlow() (49.4.2.8)
i) flushCongestingFlows() (49.4.2.9)
j) periodicTableCleanup() (49.4.2.10)

49.4.2.1 ciInitialize()

Initializes CI support (8.6.5.2.3) for per-stream classification and metering (8.6.5.2) including the creation of stream filter instances and stream gate instances needed for CI operation. At initialization time the procedure performs the following:

a) For each entry in the ciQueueMap[] table do the following:
   1) If the value of the entry in ciQueueMap[] is 0, do nothing and move on to the next entry.
   2) If the value of the entry in ciQueueMap[] is positive, the index specifies a monitored queue and the value can be translated to a congesting queue. Create a stream gate and stream filter as follows:
      i) Allocate a new StreamGateInstance.
      ii) Set the StreamGateEnable attribute to TRUE.
      iii) Set the StreamGateAdminGateStates to open.
      iv) Set the StreamGateAdminIPV to the value of the entry minus one.
      v) Allocate a new StreamFilterInstance.
      vi) Set the StreamHandleSpec to the wildcard.
      vii) Set the PrioritySpec to the index of the entry.
      viii) Set the StreamGateInstanceID to the StreamGateInstance.
   3) If the value of the entry in ciQueueMap[] is negative, the index specifies a congesting queue and the value can be translated to a monitored queue. Create a stream gate and stream filter as follows:
      i) Allocate a new StreamGateInstance.
      ii) Set the StreamGateEnable attribute to TRUE.
      iii) Set the StreamGateAdminGateStates to open.
      iv) Set the StreamGateAdminIPV to the absolute value of the entry minus one.
      v) Allocate a new StreamFilterInstance.
      vi) Set the StreamHandleSpec to none.
      vii) Set the PrioritySpec to the index of the entry.
      viii) Set the StreamGateInstanceID to the StreamGateInstance.
   4) Set cipCongesting for the queue to false.

49.4.2.2 EM_UNITDATA.request (parameters)

A CIP offers an instance of the EISS (6.8) to the Queuing frames function (8.6.6). When called upon to enqueue a frame the priority parameter specifies the target queue that represents the received priority of the frame. The CIP determines if the target queue is a congesting queue or a monitored queue by indexing into the cipQueueMap[] table using the priority parameter.

If the cipQueueMap[priority] value is 0 then the target queue is not participating in congestion isolation and the frame can be enqueued on the target queue with no further processing.

If the cipQueueMap[priority] value is positive then the target queue is a monitored queue. The value from the cipQueueMap[] table determines the congesting queue that will be used for isolating congesting flows from the monitored queue. The congesting queue for this monitored queue is one less than the value of cipQueueMap[priority]

If the cipQueueMap[priority] value is negative then the target queue is a congesting queue. The value from the cipQueueMap[] table determines the monitored queue that will be used for de-isolating congesting flows from the congesting queue. The monitored queue for this congesting queue is one less than the absolute value of cipQueueMap[priority].

The CIP determines if the frame belongs to a flow that has been causing congestion by first checking for the presence of a stream_handle parameter. Frames with the stream_handle parameter are known to be from congesting flows. If the frame does not have a stream_handle and the target queue is a monitored queue, the

CIP interacts with the AQM to determine if the frame is part of a flow that is creating congestion in the monitored queue. Newly identified congesting flows will cause entries to be created in the Stream identity table. If the frame does not have a stream_handle and the target queue is a congesting queue, the CIP remaps the priority to the monitored queue by using the translated value from the cipQueueMap[] table.

Frames that have a stream_handle parameter or have been determined by the AQM (see 49.2.1) to be creating congestion may cause a CIM to be transmitted. The conditions by which a CIM is transmitted are described in condTransmitCimAddPdu().

The CIP uses the same AQM for both the congesting and monitored queues to ensure consistent end-to-end congestion control for frames from a common flow that traverse both queues.

For each frame that is presented for queuing, the CIP performs the following:

a) Determine if the target queue is a monitored queue, a congesting queue or not participating in CI by indexing into the cipQueueMap[] table using the priority parameter and translating the contents as described above.
b) If the target queue is a monitored queue and the stream_handle is not present, then determine if the AQM indicates the frame is from a flow causing congestion in the monitored queue.
    1) If the monitored queue is congested:
        i) Set the LSB and clear the MSB of the ciStreamCreateMask to indicate an entry is being created because congestion has been detected locally by the AQM.
        ii) Call addCongestingFlow() to create an entry in the IEEE Std 802.1CB Stream identification function and the CI Stream Table and initialize the ciCIMCount variable to 0.
        iii) Call condTransmitCimAddPdu() to conditionally generate and transmit a CIM to the peer.
        iv) Modify the frame's PCP to indicate the priority of the congesting queue.
        v) Enqueue the frame on the congesting queue.
        vi) Set cipCongesting true.
    2) If the monitored queue is not congested, enqueue the frame on the monitored queue.
c) If the target queue is a monitored or a congesting queue and the stream_handle is present, the frame is from a congesting flow. Determine from the AQM if the congesting queue is empty, congested, or not congested.
    1) If the congesting queue is empty, call flushCongestingFlows() to remove all flows from the IEEE Std 802.1CB Stream identification function and the CI Stream Table for the target queue.
    2) If the congesting queue is congested:
        i) Load the ciCIMCount variable with the value from the CI Stream Table.
        ii) Call condTransmitCimAddPdu() to conditionally generate and transmit a CIM to the peer.
    3) If the congesting queue is not congested, then optionally:
        i) Call delCongestingFlow() to remove the flow from the IEEE Std 802.1CB Stream identification function and the CI Stream Table.
        ii) Ensure the cipGateControl variable for the monitored and congesting queues are properly set to ensure ordering requirements for the transmission selection algorithm in use.
        iii) Modify the frame's PCP to indicate the priority of the monitored queue.
        iv) Enqueue the frame on the monitored queue.
    4) If the target queue is a monitored queue, reset the ciCIMCount variable in the CI Stream Table.
d) If the target queue is a congesting queue and the stream_handle is not present, the frame is from a flow that may be congesting upstream, but is not congesting locally. The frame priority can be remapped back to the monitored queue.
        i) The PCP is modified to indicate the priority of the monitored queue.
        ii) The frame is enqueued on the monitored queue.

e) Check if the congesting queue is empty and call flushCongestingFlows() to remove all flows from the IEEE Std 802.1CB Stream identification function and the CI Stream Table for the congesting queue.

49.4.2.3 condTransmitCimAddPdu()

This is called by the CIP to conditionally generate and transmit a CIM instructing the peer to add a congesting flow. A CIM will be generated and transmitted if fewer than cipMaxCIM messages have been sent since the ciCIMCount was last reset and the AQM has determined that the congesting queue is congested. The ciCIMCount variable is loaded prior to invoking condTransmitCimAddPdu().

NOTE—Implementations may have additional conditions to restrict or allow the creation of CIMs for adding congesting flows without risking interoperability.

The procedure performs the following:

a) If the ciCIMCount is less than cipMaxCIM and the AQM indicates the congesting queue is congested then do the following:
   1) Set ciAddDel to *add*
   2) Call buildAndSendCim()

49.4.2.4 transmitCimDelPdu()

This is called by the CIP to generate and transmit a CIM instructing the peer that a congesting flow is being removed from the IEEE Std 802.1CB Stream identity table and the CI Stream Table.

The procedure performs the following:

a) Set ciAddDel to *delete*
b) Call buildAndSendCim()

49.4.2.5 buildAndSendCim()

This is a common procedure shared by condTransmitCimAddPdu() and transmitCimDelPdu() to construct and send the CIM. To properly generate the CIM, the CI Peer Table must be searched to retrieve the type of CIM and the address information of the peer that will receive the CIM. There are three formats for a CIM; layer-2, IPv4, and IPv6. All of the formats encapsulate a common CIM PDU. The CIM is constructed in the space provided by the parameters of the EM_UNITDATA.indication. The local variables holding the parameters from an EM_UNITDATA.request are expected to be loaded before the procedure is invoked, whether those parameters came from an actual EM_UNITDATA.request or were loaded from the CI Stream Table. The local ciAddDel variable determines the contents of the Add/Del field of the CIM PDU. The local ciRxPort determines the source port of the congesting flow that is represented in the CIM.

The procedure performs the following:

a) Search the CI Peer Table (12.33.2) using ciRxPort as an index to obtain the ciCIMType, ciPeerMacAddress, and ciPeerCIMEncapLen for the peer. If the ciCIMType is ipv4 then obtain the ciPeerIPv4Address and ciPeerUDPPort from the entry. If the ciCIMType is ipv6 then obtain the ciPeerIPv6Address and ciPeerUDPPort from the entry. If the entry is not found the procedure does nothing; no further processing takes place and no CIM will be generated or transmitted.
b) Fill the Version (49.4.3.4.1) field of the CIM PDU with 0.
c) If ciAddDel is *add* then set the Add/Del bit to 1 otherwise set the Add/Del bit to 0.
d) Set the destination_address (49.4.3.4.4) of the CIM PDU to the value of the destination_address.
e) Set the source_address (49.4.3.4.5) of the CIM PDU to the value of the source_address.
f) Set the vlan_identifier (49.4.3.4.6) of the CIM PDU to the value of the vlan_identifier.

g) Fill the Encapsulated MSDU (49.4.3.4.8) field with the first octets of the mac_service_data_unit. The Encapsulated MSDU field should be filled with the lesser of ciPeerCIMEncapLen or the length of the mac_service_data_unit.

h) Set the Encapsulated MSDU length (49.4.3.4.7) to the number of octets filled into the Encapsulated MSDU field.

i) The format of the CIM constructed in the mac_service_data_unit of the EM_UNITDATA.indication depends upon the ciCIMType variable as follows:

   1) If the ciCIMType is l2:

      i) Insert the CIM PDU EtherType (Table 49-1) encapsulation at the beginning of the mac_service_data_unit of the EM_UNITDATA.indication.

      ii) Fill the Version (49.4.3.1.1) field of the layer 2 CIM encapsulation with 0.

      iii) Fill the Subtype (49.4.3.1.2) field of the layer 2 CIM encapsulation with 0.

   2) If the ciCIMType is ipv4:

      i) Insert the IPv4 EtherType (Figure 49-4) encapsulation at the beginning of the mac_service_data_unit of the EM_UNITDATA.indication.

      ii) Use the ciPeerIPv4Address as the destination IPv4 address, the cipIPv4Address as the source IPv4 address, and the value 17 as the IP protocol field to construct and insert an IETF RFC 791 compliant IPv4 header after the IPv4 EtherType in the mac_service_data_unit of the EM_UNITDATA.indication.

      iii) Use the ciPeerUDPPort as the UDP destination port number and the cipCIMUDPPort as the source port number to construct and insert an IETF RFC 768 compliant UDP header after the IPv4 header in the mac_service_data_unit of the EM_UNITDATA.indication.

   3) If the ciCIMType is ipv6:

      i) Insert the IPv6 EtherType (Figure 49-5) encapsulation at the beginning of the mac_service_data_unit of the EM_UNITDATA.indication.

      ii) Use the ciPeerIPv6Address as the destination IPv6 address, the cipIPv6Address as the source IPv6 address, and the value 17 as the next header field to construct and insert an IETF RFC 8200 compliant IPv6 header after the IPv6 EtherType in the mac_service_data_unit of the EM_UNITDATA.indication.

      iii) Use the ciPeerUDPPort as the UDP destination port number and the cipCIMUDPPort as the source port number to construct and insert an IETF RFC 768 compliant UDP header after the IPv6 header in the mac_service_data_unit of the EM_UNITDATA.indication.

j) Use the ciPeerMacAddress as the destination_address of the EM_UNITDATA.indication for the CIM.

k) Use the cipMacAddress (49.4.1.2.1) as the source_address of the EM_UNITDATA.indication for the CIM.

l) Set the priority parameter of the EM_UNITDATA.indication for the CIM to the value of the ciCIMTransmitPriority (49.4.1.1.2) variable.

m) Pass the CIM as an EM_UNITDATA.indication to the CIM Multiplexer (49.3.5) for transmission to the peer.

49.4.2.6 processCimPdu()

The CIM Demultiplexer (49.3.3) receives CIMs from peers and invokes processCimPdu() to process the CIM and either create entries in the IEEE Std 802.1CB Stream identification function and CI Stream Table or remove entries from the tables. The procedure performs the following actions upon receipt of a CIM:

a) The CIM is validated according to 49.4.3.5 and is discarded if invalid.
b) If the Add/Del bit is set do the following:
    1) Clear the LSB and set the MSB of the ciStreamCreateMask to indicate an entry is being created because of a received CIM.
    2) Extract the parameters and the Encapsulated MSDU from the CIM PDU and call addCongestingFlow().
c) If the Add/Del bit is clear then do the following:
    1) Search the CI Stream Table for an entry that matches the destination_address, source_address, vlan_identifier, and Encapsulated MSDU fields of the CIM.
    2) If no entry is found, then processing is done.
    3) If the MSB of the ciStreamCreateMask is set, then clear it. Otherwise processing is done.
    4) If the LSB of the ciStreamCreateMask is set, then update the CI Stream Table entry with the updated ciStreamCreateMask and processing is done.
    5) If the LSB of the ciStreamCreateMask is clear then call delCongestingFlow().

49.4.2.7 addCongestingFlow()

Registers a flow with the IEEE Std 802.1CB Stream identification function as described in 49.2.2. A tsnStreamIdEntry is created by using initialized variables and the contents of the mac_service_data_unit that is obtained from the received frame or the encapsulated header of a received CIM. The set of managed objects that make up the tsnStreamIdEntry are created as follows:

a) Set the tsnStreamIdHandle object to newly allocated and unique stream_handle.
b) Set the tsnStreamIdOutFacInputPortList include the list of all ports in the system.
c) Set the tsnStreamIdOutFacOutputPortList, tsnStreamIdInFacInputPortList, and tsnStreamIdInFacOutputPortList to null.
d) Set the tsnStreamIdIdentificationType to IP stream identification as specified in IEEE Std 802.1CB.
e) Set the tsnStreamIdParameters for an IP stream identification type as follows:
    1) Set the tsnCpeIpIdDestMac to the destination_address of the received frame or parameter from the CIM.
    2) Set the tsnCpeIpIdTagged to the value **all** as specified in IEEE Std 802.1CB.
    3) Set the tsnCpeIpIdVlan to the vlan_identifier of the received frame or parameter from the CIM.
    4) Set the tsnCpeIpIdIpSource to the IPv4 (IETF RFC 791) or IPv6 (IETF RFC 8200) source address parameter that is contained within the mac_service_data_unit.
    5) Set the tsnCpeIpIdIpDestination to the IPv4 (IETF RFC 791) or IPv6 (IETF RFC 8200) destination address parameter that is contained within the mac_service_data_unit.
    6) Set the tsnCpeIpIdDscp to a value of 64 decimal to ignore the DSCP (IETF RFC 2474) code point when matching received frames.
    7) Set the tsnCpeIpIdNextProtocol to UDP (IETF RFC 768) if the mac_service_data_unit contains a UDP packet, TCP (IETF RFC 793) if it contains a TCP packet, or SCTP (IETF RFC 4960) if it contains an SCTP packet. If the mac_service_data_unit contains another non-supported IP protocol by the implementation then set the tsnCpeIpIdNextProtocol to none and the tsnCpeIpIdSourcePort and tsnCpeIpIdDestinationPort will be ignored.
    8) Set the tsnCpeIpIdSourcePort to the UDP, TCP, or SCTP source port number from the mac_service_data_unit. Set the tsnCpeIpIdSourcePort to 0 if the tsnCpeIpIdNextProtocol field is none.

9) Set the tsnCpeIpIdDestinationPort to the UDP, TCP, or SCTP destination port number from the mac_service_data_unit. Set the tsnCpeIpIdDestinationPort to 0 if the tsnCpeIpIdNextProtocol field is none.

f) Write the tsnStreamIdEntry to the IEEE Std 802.1CB Stream identity table using the specified management operations.

g) Create a new entry in the CI Stream Table:
   1) Set the entry ciStreamHandleId index to the stream_handle.
   2) Set the entry ciCIMCount to 0.
   3) Set the entry ciStreamCreateMask to the variable ciStreamCreateMask.
   4) Set the entry ciQueueKey to the product of the congesting queue plus one and the port number that the queue is supporting.
   5) Set the entry ciDestination_address to the destination_address.
   6) Set the entry ciSource_address to the source_address.
   7) Set the entry ciVlan_identifier to the vlan_identifier.
   8) Fill the entry ciMsdu with the first octets of the mac_service_data_unit. The number of octets to fill the ciMsdu attribute with is determined by the lesser of ciPeerCIMEncapLen or the length of the mac_service_data_unit.
   9) Set the entry ciCreateTime to sysUpTime as specified by IETF RFC 3418.

49.4.2.8 delCongestingFlow()

Removes entries from the IEEE Std 802.1CB Stream identification function and the CI Stream Table as discussed in 49.2.6. The procedure performs the following:

a) Load the destination_address, source_address, vlan_identifier, and mac_service_data_unit parameters from the entry ciDestination_address, ciSource_address, ciVlan_identifier, and ciMsdu, respectively.

b) Call transmitCimDelPdu() to inform the peer that a congesting flow is no longer congesting.

c) Set the tsnStreamIdHandle object to the stream_handle parameter of the frame triggering the deletion.

d) Remove the tsnStreamIdEntry associated with the tsnStreamIdHandle in the IEEE Std 802.1CB Stream identification function.

e) Remove the CI Stream Table entry.

f) if cipCongesting is true, set cipCongesting false and set cipNonCongestedTime to sysUpTime.

49.4.2.9 flushCongestingFlows()

Removes all entries from the IEEE Std 802.1CB Stream identification function that were not created because of the receipt of a CIM and are associated with the current congesting queue at the egress port as discussed in 49.2.6. The procedure performs the following:

a) Calculate the ciQueueKey by taking the product of the congesting traffic class plus one and the egress port number.

b) For each entry in the CI Stream Table with the same ciQueueKey and the MSB of the ciCreateMask in the entry is not set:
   1) Load the destination_address, source_address, vlan_identifier, and mac_service_data_unit parameters from the entry ciDestination_address, ciSource_address, ciVlan_identifier, and ciMsdu, respectively.
   2) Call transmitCimDelPdu() to inform the peer that a congesting flow is no longer congesting.
   3) Set the tsnStreamIdHandle object to the ciStreamIdHandle.
   4) Remove the tsnStreamIdEntry associated with the tsnStreamIdHandle in the IEEE Std 802.1CB Stream identification function.
   5) Remove the CI Stream Table entry.

c) if cipCongesting is true, set cipCongesting false and set cipNonCongestedTime to sysUpTime.

49.4.2.10 periodicTableCleanup()

A background procedure that calculates the number of centiseconds between the creation time of a CI Stream Table entry (49.4.1.5.3) and the cipNonCongestedTime (49.4.1.4.2), and removes any entries with only the MSB of the ciStreamCreateMask (49.4.1.5.4) set that have a calculated value greater than ciMaxFlowLife (49.4.1.1.3). The procedure should be invoked at least once every ciMaxFlowLife time intervals. The procedure performs the following:

a) For each entry in the CI Stream Table with the MSB set and the LSB clear in the ciStreamCreateMask:
    1) Calculate the difference between the cipNonCongestedTime for the queue specified by the ciQueueKey and the entry ciCreateTime.
    2) If the difference is greater than ciMaxFlowLife:
        i) Load the destination_address, source_address, vlan_identifier, and mac_service_data_unit parameters from the entry ciDestination_address, ciSource_address, ciVlan_identifier, and ciMsdu, respectively.
        ii) Call transmitCimDelPdu() to inform the peer that a congesting flow is no longer congesting.
        iii) Set the tsnStreamIdHandle object to the ciStreamIdHandle.
        iv) Remove the tsnStreamIdEntry associated with the tsnStreamIdHandle in the IEEE Std 802.1CB Stream identification function.
        v) Remove the CI Stream Table entry.

49.4.3 Encoding of the CIM PDU

This subclause specifies the method of encoding Congestion Isolation Message (CIM) PDUs. There are three ways of encapsulating CIM PDUs; a layer-2 CIM PDU encapsulation that can be delivered to peers via the Bridge relay and IPv4 and IPv6 layer-3 CIM PDU encapsulations that can be delivered to peers via a higher layer entity above Bridge relay such as a router. All CIMs contain an integral number of octets.

The octets in a Congestion Isolation Message PDU are numbered starting from 1 and increasing in the order they are put into the MSDU that accompanies a request to or indication from the instance of the MAC Internal Sublayer Service (ISS or EISS) used by a congestion isolation entity. The bits in an octet are numbered from 1 to 8 in order of increasing bit significance, where 1 is the LSB in the octet.

Where octets and bits within a Congestion Isolation Message PDU are represented using a diagram, octets shown higher on the page than subsequent octets and octets shown to the left of subsequent octets at the same height on the page are lower numbered; bits shown to the left of other bits within the same octet are higher numbered.

Where two or more consecutive octets are represented as hexadecimal values, lower numbered octet(s) are shown to the left and each octet following the first is preceded by a hyphen, for example, 01-80-C2-00-00-00. When consecutive octets are used to encode a binary number, the lower octet number has the more significant value. When consecutive bits within an octet are used to encode a binary number, the higher bit number has the most significant value. When bits within consecutive octets are used to encode a binary number, the lower octet number composes the more significant bits of the number. A flag is encoded as a single bit, and is set (TRUE) if the bit takes the value 1, and clear (FALSE) otherwise. The remaining bits within the octet can be used to encode other protocol fields.

49.4.3.1 Layer-2 CIM PDU encapsulation

The means for identifying layer-2 encapsulated CIM PDUs consists of two octets containing the EtherType value shown (in hexadecimal notation) in Table 49-1.

Table 49-1—Congestion Isolation Message EtherType

Name	Value
IEEE 802.1Q Congestion Isolation Message (CIM)	89-A2

The layer-2 CIM PDU encapsulation is shown in Figure 49-3.

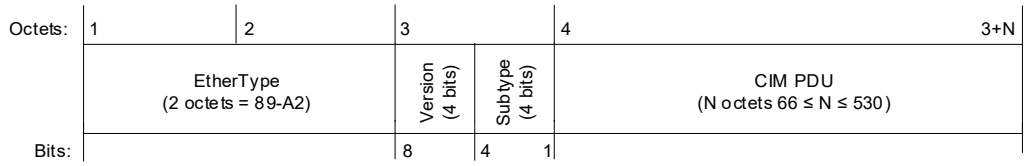


Figure 49-3—Layer-2 CIM encapsulation

49.4.3.1.1 .Version

This field, 4 bits in length, shall be transmitted with the value 0 in this standard. If two Version fields are interpreted as unsigned binary numbers, the greater identifies the more recently defined Version. The Version field occupies the most significant bits of the first octet of the layer-2 CIM encapsulation.

49.4.3.1.2 Subtype

This field, 4 bits in length, shall be transmitted with the value 0 to indicate an encapsulated CIM PDU. The Subtype field occupies the least significant 4 bits of the first octet of the layer-2 CIM encapsulation.

49.4.3.2 IPv4 layer-3 CIM PDU encapsulation

The means of identifying IPv4 layer-3 encapsulated CIM PDUs consist of 2 octets containing the EtherType value for IPv4 packets (08-00) as well as the associated IPv4 header decoding for a UDP datagram carrying the CIM PDU. The encoding of an IPv4 header is defined in IETF RFC 791. IP options are not included in the IPv4 layer-3 encapsulated CIM PDU. The IP protocol field in the IPv4 header consists of 1 octet and identifies the UDP datagram with the value 17. The encoding of a UDP header is defined in IETF RFC 768. The destination port field of the UDP header consists of 2 octets and identifies the encapsulated CIM PDU with the value from the ciPeerUDPPort field of the CI Peer Table (12.33.2) for the row associated with the port of the receiving upstream peer. The source port field of the UDP header is the value of the cipCIMUDPPort variable. The IPv4 encapsulation is shown in Figure 49-4.

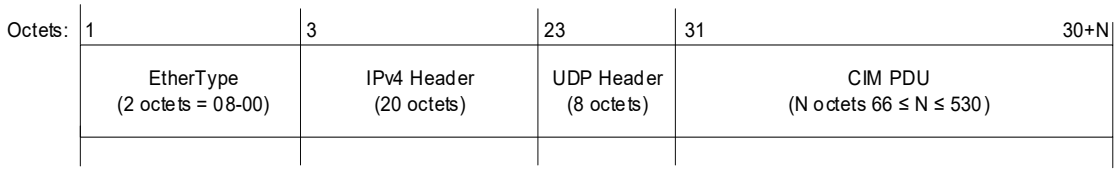


Figure 49-4—IPv4 layer-3 CIM encapsulation

49.4.3.3 IPv6 layer-3 CIM PDU encapsulation

The means of identifying IPv6 layer-3 encapsulated CIM PDUs consist of 2 octets containing the EtherType value for IPv6 packets (86-DD) as well as the associated IPv6 header decoding for a UDP datagram carrying the CIM PDU. The encoding of an IPv6 header is defined in IETF RFC 8200. IPv6 Extension Headers are not used in the IPv6 layer-3 encapsulated CIM PDU. The next header field in the IPv6 headers indicates the upper layer protocol field and consists of 1 octet identifying the UDP datagram with the value 17. The encoding of a UDP header is defined in RFC 768. The destination port field of the UDP header consists of 2 octets and identifies the encapsulated CIM PDU with the value from the ciPeerUDPPort field of the CI Peer Table (12.33.2) for the row associated with the port of the receiving upstream peer. The source port field of the UDP header is the value of the cipCIMUDPPort variable. The IPv6 encapsulation is shown in Figure 49-5.

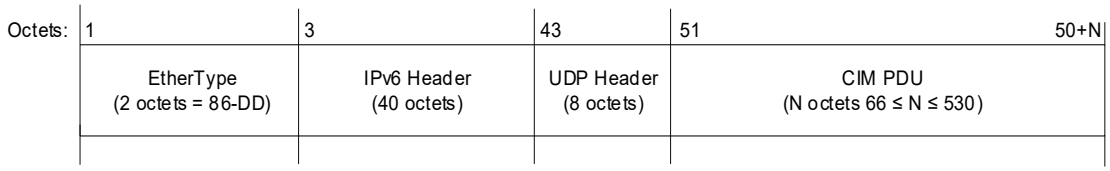


Figure 49-5—IPv6 layer-3 CIM encapsulation

49.4.3.4 Congestion Isolation Message PDU format

The format of a Congestion Isolation Message (CIM) PDU is illustrated in Figure 49-6.

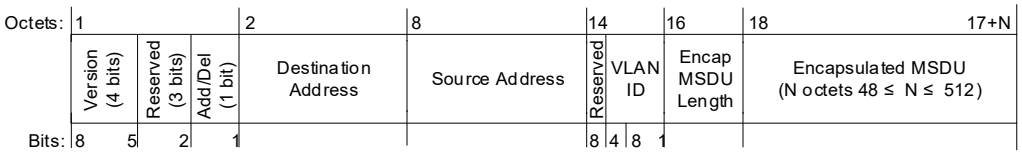


Figure 49-6—CIM PDU

49.4.3.4.1 Version

This field, 4 bits in length, shall be transmitted with the value 0 in this standard. If two Version fields are interpreted as unsigned binary numbers, the greater identifies the more recently defined Version. The Version field occupies the most significant bits of the first octet of the CIM PDU.

49.4.3.4.2 Reserved

This field, 3 bits in length, shall be transmitted as 0 and ignored on receipt.

49.4.3.4.3 Add/Del

This field, 1 bit in length, instructs the peer to add a congesting flow entry to the IEEE Std 802.1CB Stream identity table and the CI Stream Table, or to remove an entry. When the bit is set, the peer is instructed to add, and when the bit is clear, the peer is instructed to delete. The Add/Del bit occupies the least significant bit of the first octet of the CIM PDU.

49.4.3.4.4 destination_address

This field, 6 octets in length, contains the destination MAC address of the frame triggering the transmission of this CIM.

49.4.3.4.5 source_address

This field, 6 octets in length, contains the source MAC address of the frame triggering the transmission of this CIM.

49.4.3.4.6 vlan_identifier

This field, 12 bits in length, contains the VLAN Identifier for the frame triggering the transmission of this CIM.

49.4.3.4.7 Encapsulated MSDU length

This field, 2 octets in length, contains the number of octets returned in the Encapsulated MSDU field. The minimum value is 48. The maximum value is 512.

49.4.3.4.8 Encapsulated MSDU

This field, a maximum of 512 octets in length, contains the initial octets of the mac_service_data_unit of the frame that triggered the transmission of this CIM.

49.4.3.5 CIM Validation

A CIM PDU received by a CIM Demultiplexer (49.3.3) shall be considered invalid and be discarded if:

a) There are fewer than 48 octets in the mac_service_data_unit or greater than 512.

b) The Encapsulated MSDU length is less than 48 or greater than 512.

The following condition shall not cause a received CIM PDU to be considered invalid:

c) There are nonzero bits in the Version (49.4.3.4.1) field.

49.4.4 LLDP Congestion Isolation TLV

The Congestion Isolation TLV (D.2.15) is used to advertise support for Congestion Isolation to peers on the network. It informs the peers of the configuration of local monitored queues and the congesting queue in order to detect potential misconfiguration. It also advertises the desired length of the encapsulated headers sent in a CIM. The source address of a received LLDPDU is used to populate the CI Peer Table (49.3.6) in order to properly form a CIM.

49.4.4.1 LLDP Congestion Isolation TLV procedures

When the congestion isolation aware LLDP agent detects a change in the set of TLVs advertised by a peer it will invoke the relevant LLDP TLV procedures to add or delete entries in the CI Peer Table (12.33.2). The congestion isolation TLV procedures include:

a) addCiPeer() (49.4.4.1.1)

b) delCiPeer() (49.4.4.1.2)

49.4.4.1.1 addCiPeer()

This creates or updates a CI Peer Table entry. The entry is indexed by the port number of the received LLDPDU. The procedure performs the following:

a) Set the table index to the port of the received LLDPDU.
b) Set the ciPeerMacAddress to the MAC Address field (D.2.15.5) of the Congestion Isolation TLV.
c) If the Address Family field (D.2.15.7) of the Congestion Isolation TLV is 1, set the ciPeerIPv4Address to the IP Address field (D.2.15.8) of the Congestion Isolation TLV.
d) If the Address Family field (D.2.15.7) of the Congestion Isolation TLV is 2, set the ciPeerIPv6Address to the IP Address field (D.2.15.8) of the Congestion Isolation TLV.
e) Set the ciPeerUDPPort to the UDP Port Number field (D.2.15.6) of the Congestion Isolation TLV.
f) Set the ciPeerCIMEncapLen to the CIM Encap Length field (D.2.15.4) of the Congestion Isolation TLV.
g) Write the CI Peer Table entry into the CI Peer Table at the table index.

49.4.4.1.2 delCiPeer()

This deletes a CI Peer Table entry. The entry is indexed by the port number of the received LLDPDU that indicates a congestion isolation peer is no longer present or enabled. The procedure performs the following:

a) Set the table index to the port where the missing or disabled CI peer is detected.
b) Delete the CI Peer Table entry at the table index.

49.5 Topology Recognition

Bridges, routers, and end stations in the data center network can determine their level and port orientation within the topology through the use of the LLDP Topology Recognition TLV (D.2.16) and the manipulation of associated managed objects. The level in the topology is relative to non-relay end stations or servers at the edge of the network. Non-relay end stations or servers are at level 0. Bridges or routers attached to non-relay end stations or servers are at level 1 or higher. Virtualization environments, including those that support an edge relay defined by this standard (Clause 40), are end stations that contain a relay and appear at level 1 or higher in the topology. The virtual stations within the virtualization environment appear at level 0.

The systems can determine their level in the topology and the receiving port's orientation by examining the current state of the Topology Recognition (TR) variables and manipulating them based on the received values in the LLDP Topology Recognition TLV. This subclause specifies how to determine a system's level and a port's orientation within the topology. It includes:

a) TR theory of operation (49.5.1)
b) TR variables controlling operation (49.5.2)
c) TR procedures (49.5.3)

49.5.1 TR theory of operation

The TR functionality is supported by a set of procedures and controlling variables that map to attributes of the LLDP Topology Recognition TLV. Changes to the controlling variables will update the associated objects in the IEEE 802.1/LLDP extension MIB (D.5) and the trSet() procedure defined in this clause will cause the transmission of an LLDPDU to occur by invoking the somethingChangedLocal() procedure defined in IEEE Std 802.1AB. When attributes of a received LLDP Topology Recognition TLV change, the somethingChangedRemote() procedure in IEEE Std 802.1AB is invoked and control is passed to the trUpdate() procedure to process the changes. The TR procedures that act upon the changes ensure that the values of the controlling variables converge to a set of consistent values that represent the topology level and port orientation of all participating devices in the network.

The LLDP Topology Recognition TLV contains three attributes that enable the recognition process; the device type, the currently known topology level, and the currently known port orientation. The device type includes non-relay end stations or servers, Bridges, and routers. The topology level attribute contains the level number (0 through 254) or the value of unknown (255). The port orientation indicates whether the port is facing an *uplink, downlink, crosslink*, or whether the orientation is *unknown*. The trDeviceType variable holds the device type of a system and is a known factory setting of the device. The initial value of the level is held in the trLevel variable and the initial value of the port orientation is held in the trPortOrientation variable. These values are known by non-relay end stations or servers because they are at the edge of the network and are always at level 0 with a port orientation of *uplink*. Bridges and routers initially do not know their level or port orientation, but will recognize them when they receive LLDP Topology Recognition TLVs from peers that have non-relay end stations or servers attached. There is a single trLevel variable for the system, but each port contains a trPortOrientation. As TLVs are exchanged and changes are processed by the procedures, the contents of trLevel and trPortOrientation are updated to converge upon the representation of the stable state of the active topology.

49.5.2 TR variables controlling operation

The TR variables controlling operation hold the contents of attributes sent in the LLDP Topology Recognition TLV and can be updated by the TR procedures. The TR variables include:

a) trDeviceType (49.5.2.1)
b) trLevel (49.5.2.2)
c) trPortOrientation (49.5.2.3)

49.5.2.1 trDeviceType

The trDeviceType is a read-only variable that contains the contents of the Device Type field of the LLDP Topology Recognition TLV. The possible values of the trDeviceType are assigned as a factory setting and are specified in Table D-13a.

49.5.2.2 trLevel

A single octet integer holding the currently known level of the system in the topology. Non-relay end stations or servers shall set this variable to 0. Other systems shall initialize this variable to 255 indicating unknown and can set the variable to values between 1 and 254 as determined by the TR procedures (49.5.3). The content of the trLevel variable is used for the Topology Level field of the LLDP Topology Recognition TLV.

49.5.2.3 trPortOrientation

Each port in a participating system has a trPortOrientation variable that holds the contents of the currently known Port Orientation of the LLDP Topology Recognition TLV. The possible values of the trPortOrientation variable are specified in Table D-13b. Non-relay end stations or servers shall set the trPortOrientation variable to *uplink*. Other systems shall initialize this variable to *unknown* and will update the variable to either *uplink, downlink,* or *crosslink* as determined by the TR procedures (49.5.3).

49.5.3 TR procedures

The TR procedures process changes and cause the transmission of LLDP Topology Recognition TLVs. The procedures modify the TR variables and implement the algorithm that allows topology level and port orientation recognition to converge upon a stable set of variables in the topology. The procedures include:

a) trInit() (49.5.3.1)
b) trSet() (49.5.3.2)
c) trUpdate() (49.5.3.3)

49.5.3.1 trInit()

The trInit() procedure initializes the controlling variables to a known state after system initialization or a restart of the TR functionality. The procedure performs the following:

a) If trDeviceType is 0, specifying a non-relay end station or server then:
   1) Set trLevel to 0.
   2) Set trPortOrientation to *uplink*.
b) If trDeviceType is not 0:
   1) Set trLevel to 255, specifying *unknown.*
   2) Set trPortOrientation to 255, specifying *unknown.*
c) Call trSet() to cause the transmission of an LLDPDU to peers.

49.5.3.2 trSet()

This calls the somethingChangedLocal() procedure defined in IEEE Std 802.1AB, which causes the transmission of an LLDPDU. The trLevel and trPortOrientation variables map to objects in the IEEE 802.1/LLDP extension MIB (D.5). A change to the single system wide trLevel variable causes the transmission of an LLDPDU on each participating port. A change to the per-port trPortOrientation variable causes the transmission of an LLDPDU on the associated port.

49.5.3.3 trUpdate()

The trUpdate() procedure is invoked when the somethingChangedRemote() procedure, defined in IEEE Std 802.1AB, determines that fields of a received LLDP Topology Recognition TLV have changed. The procedure is responsible for updating the local TR variables and calling trSet() according to the following algorithm:

a) If trDeviceType is 0, the receiving system is a non-relay end station or server and no action is required. The procedure exits.
b) If trDeviceType is not 0, the following steps are taken depending upon the current state of trLevel and trPortOrientation for the receiving port:
   1) If the received Topology Level is *unknown*, the peer is not providing additional information and no further action is required and the procedure exits.
   2) If the received Topology Level is known with a value of L, where L is the current value of trLevel:
      i) If trPortOrientation is *crosslink*, no further action is required and the procedure exits.
      ii) Set trPortOrientation of the receiving port to *crosslink*.
   3) If the received Topology Level is known with a value of $L + 1$, where L is the current value of trLevel:
      i) If trPortOrientation is *uplink*, no further action is required and the procedure exits.
      ii) Set trPortOrientation of the receiving port to *uplink.*
   4) If the received Topology Level is known with a value of $L - 1$, where L is the current value of trLevel:
      i) If trPortOrientation is *downlink*, no further action is required and the procedure exits.
      ii) Set trPortOrientation of the receiving port to *downlink*.
   5) If the received Topology Level is known and is less than trLevel – 1 or trLevel is *unknown*:
      i) Set tlLevel to the received Topology Level plus one.
      ii) Set trPortOrientation of the receiving port to *downlink.*
      iii) Set trPortOrientation of all other ports to *unknown.*
   6) Call trSet().

Annex A

(normative)

PICS proforma—Bridge implementations[13]

A.5 Major capabilities

Insert the following row at the end of the table in A.5 (unchanged rows not shown):

Item	Feature	Status	References	Support
CI	Does the implementation support Congestion Isolation?	O	5.4.7, Clause 49	Yes [ ] No [ ]

A.7 Relay and filtering of frames

Insert the following rows at the end of the table in A.7 (unchanged rows not shown):

Item	Feature	Status	References	Support
RLY-21	Does the implementation assign colors to frames before processing by flow meters according to 8.6.5.5?	PSFP:M ¬PSFP:O	8.6.5.5	Yes [ ] No [ ]
RLY-22	Is the frame color assigned according to 8.6.5.5, items k) and l)?	RLY-21:M	8.6.5.5, items k) and l)	Yes [ ] N/A [ ]
RLY-23	State the algorithm by which the color of frames prior to processing by flow meters according to 8.6.5.5 is assigned.	¬RLY-22:M	8.6.5.5	A1:Algorithm

[13] *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.14 Bridge management

Insert the following row at the end of the table in A.14 (unchanged rows not shown):

Item	Feature	Status	References	Support
MGT-252	Does the implementation support the management entities defined for congestion isolation in 12.33?	CI: M	5.4.7 item e), 12.33, 49.4	Yes [ ] N/A [ ]

A.47 YANG

Insert a row for "YANG-STREAMS-BRIDGE" before the row for "YANG-ATS", change the row for "YANG-ATS", and insert three rows at the end of the table in A.47 (unchanged rows not shown):

Item	Feature	Status	References	Support
YANG-STREAMS-BRIDGE	Is the *ieee802-dot1q-stream-filters-gates-bridge* module supported?	ATS:O	48.6.12	Yes [ ] No [ ] N/A [ ]
YANG-ATS	Is the *ieee802-dot1q-ats* module supported?	ATS:O	~~48.6.12~~ 48.6.13	Yes [ ] No [ ] N/A [ ]
YANG-ATS-BRIDGE	Is the *ieee802-dot1q-ats-bridge* module supported?	ATS:O	48.6.14	Yes [ ] No [ ] N/A [ ]
YANG-CI	Is the *ieee802-dot1q-congestion-isolation* module supported?	CI:O	48.6.15	Yes [ ] No [ ] N/A [ ]
YANG-CI-BRIDGE	Is the *ieee802-dot1q-congestion-isolation-bridge* module supported?	CI:O	48.6.16	Yes [ ] No [ ] N/A [ ]

Insert A.53 after A.52 as follows:

A.53 Congestion Isolation

Item	Feature	Status	References	Support
	If the functionality of Congestion Isolation (CI of A.5) is not supported, mark N/A and ignore the remainder of this table.		5.4.7, 8.6.5.2.3, 8.6.5.3, 8.6.8.6, 12.33, Clause 49	N/A [ ]
CI-1	Does the Bridge support the creation of at least one CIP on at least one Port?	BRG1 AND CI:M	5.4.7 item a), 49.3	Yes [ ]
CI-2	Does the implementation support IETF RFC 3168 Explicit Congestion Notification?	CI:M	49.2.1, IETF RFC 3168	Yes [ ]
CI-3	Does the implementation support per-stream classification and metering for CI as specified in 8.6.5.2.3?	CI:M	5.4.7 item c), 8.6.5.2.3	Yes [ ]
CI-4	Does the implementation support the variables and procedures of the Congestion Isolation Protocol?	CI:M	49.4	Yes [ ]
CI-5	Does the implementation support the ability to configure the variables controlling the operation of Congestion Isolation?	CI:M	12.33	Yes [ ]
CI-6	Does the implementation support LLDP?	CI:M	IEEE Std 802.1AB	Yes [ ]
CI-7	Does the implementation support the Congestion Isolation TLV in LLDP?	CI:M	D.2.15	Yes [ ]
CI-8	Does the implementation support the ability to monitor more than one queue on a Bridge Port?	CI:O	49.4.1.2.5	Yes [ ] No [ ]
CI-9	Does the implementation support transmission selection algorithms other than strict priority?	CI:O	49.2.3, 49.3.2	Yes [ ] No [ ]
CI-10	Does the implementation support the ability to return a flow to non-congesting status when the congesting queue is not empty?	CI:O	49.2.6	Yes [ ] No [ ]
CI-11	Does the implementation support Topology Recognition?	CI:O	49.5	Yes [ ] No [ ]

Annex B

(normative)

PICS proforma—End station implementations[14]

B.5 Major capabilities

Insert the following row at the end of the table in B.5 (unchanged rows not shown):

Item	Feature	Status	References	Support
CI-S	Does the implementation support the functionality of a Congestion Isolation?	O	5.32, Clause 49	Yes [ ] No [ ]

Insert B.19 after B.18 as follows:

B.19 Congestion Isolation

Item	Feature	Status	References	Support
	If Congestion Isolation (CI-S in B.5) is not supported, mark N/A and ignore the remainder of this table.			N/A[ ]
CI-S-1	Does the implementation support IETF RFC 3168 Explicit Congestion Notification?	CI-S:M	49.2.1, IETF RFC 3168	Yes [ ]
CI-S-2	Does the implementation support the variables and procedures of the Congestion Isolation Protocol?	CI-S:M	49.4	Yes [ ]
CI-S-3	Does the implementation support LLDP?	CI-S:M	IEEE Std 802.1AB	Yes [ ]
CI-S-4	Does the implementation support the Congestion Isolation TLV in LLDP?	CI-S:M	D.2.15	Yes [ ]
CI-S-5	Does the implementation support transmission selection algorithms other than strict priority?	CI-S:O	49.2.3, 49.3.2	Yes [ ] No [ ]
CI-S-6	Does the implementation support the ability to return a flow to non-congesting status when the congesting queue is not empty?	CI-S:O	49.2.6	Yes [ ] No [ ]
CI-S-7	Is the *ieee802-dot1q-congestion-isolation* module supported?	CI-S AND YANG:O	48.2.8	Yes [ ] N/A [ ] No [ ]
CI-S-8	Does the implementation support Topology Recognition	CI-S:O	49.5	Yes [ ] No [ ]

[14] *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.

Annex D

(normative)

IEEE 802.1 Organizationally Specific TLVs

D.1 Requirements of the IEEE 802.1 Organizationally Specific TLV sets

Insert new rows at the end of Table D-1 as follows (unchanged rows not shown):

Table D-1—IEEE 802.1 Organizationally Specific TLVs

IEEE 802.1 subtype	TLV name	TLV set name	TLV reference	Feature clause reference
11	LRP ECP Discovery TLV	lrpSet	IEEE Std 802.1CS	IEEE Std 802.1CS
12	LRP TCP Discovery TLV	lrpSet	IEEE Std 802.1CS	IEEE Std 802.1CS
13	Congestion Isolation TLV	ciSet	D.2.15	49.4.4
14	Topology Recognition TLV	trSet	D.2.16	49.5

D.2 Organizationally Specific TLV definitions

Insert D.2.15 and D.2.16 after D.2.14 as follows:

D.2.15 Congestion Isolation TLV

The Congestion Isolation TLV is an optional TLV that allows an IEEE 802.1Q-compliant Bridge and an IEEE 802.1Q-compatible IEEE 802 LAN station to discover each other and exchange configuration information for congestion isolation.

Figure D-15 shows the Congestion Isolation TLV format.

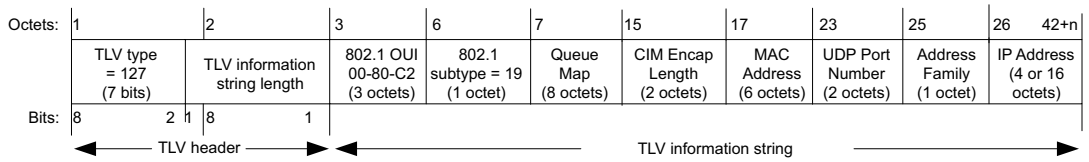


Figure D-15—Congestion Isolation TLV format

D.2.15.1 TLV type

A 7-bit integer value occupying the most-significant bits of the first octet of the TLV. Always contains the value 127.

D.2.15.2 TLV information string length

The TLV information string length field of the Congestion Isolation TLV depends on the Address Family specified for the IP Address field and shall contain the value 25 if the Address Family is 1 (IPv4), the value 37 if the Address Family is 2 (IPv6), or the value 21 if the Address Family is anything other than 1 or 2.

D.2.15.3 Queue Map

Eight octets, one for each traffic class supported by the Bridge or end station. The least significant octet represents traffic class 0 and the most significant octet represents traffic class 7. The content of each octet specifies a signed numeric value that can be translated to the value of the traffic class to be used as either the congesting queue or the monitored queue for the represented traffic class. The contents of each octet is a signed numeric value between –8 and 8. A value of 0 specifies that there is no mapping for the traffic class and that it is not participating in congestion isolation. A positive number specifies a traffic class for a monitored queue that is one less than the value (e.g., a value of 5 represents traffic class 4). A negative number specifies a traffic class for a congesting queue that is one less than the absolute value (e.g., a value of –4 represents traffic class 3).

D.2.15.4 CIM Encap Length

A 2-octet unsigned integer representing the requested length in octets of the data from the frame of a congesting flow to be encapsulated into a CIM by a peer. The default and minimum required value is 48. The maximum value is 512.

D.2.15.5 MAC Address

The 6-octet MAC address that can be used as the destination MAC address for a CIM to the Bridge or end station sending this TLV.

D.2.15.6 UDP Port Number

An integer value indicating the UDP port number to be used by the peer when creating a layer-3 CIM. The value of the UDP port number is within the dynamic port number range of 49152 to 65535 as specified by IETF RFC 6335 (e.g., 58622).

D.2.15.7 Address Family

An integer value indicating the type of address that is listed in the address field. Enumeration for this field is contained in the ianaAddressFamilyNumbers module of the IETF RFC 3232 on-line database that is accessible through a web page (http://www.iana.org). Only two types are recognized with the following definitions; 1=IPv4 and 2=IPv6.

D.2.15.8 IP Address

An octet string with length of 0, 4, or 16 octets dependent upon the Address Family specified. If the Address Family is 1, the address shall be an IPv4 address as specified in IETF RFC 791. If the Address Family is 2, the address shall be an IPv6 address as specified in IETF RFC 8200. No address shall be provided for any other Address Families.

NOTE—If the CIM PDU is layer 2 encapsulated, the MAC address field is already provided and the Address Family should be anything other than 1 or 2. For layer 2 encapsulated CIM PDUs, it is recommended to use the Address Family value of 6 for IEEE 802 addresses.

D.2.15.9 Congestion Isolation TLV usage rules

The priority of a congesting queue shall be lower than the priority of all monitored queues.

D.2.16 Topology Recognition TLV

The Topology Recognition TLV is an optional TLV that allows an IEEE 802.1Q-compliant Bridge and an IEEE 802.1Q-compatible IEEE 802 LAN station to discover and determine the position of the system in the data center topology. End-stations are always at level 0 and Bridges or routers are at levels greater than 0 depending upon the number of links between the Bridge or router and the end-station.

Figure D-16 shows the Topology Recognition TLV format:

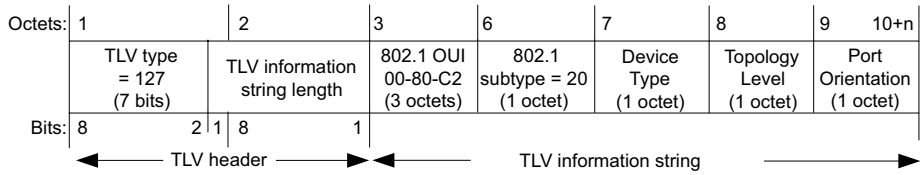


Figure D-16—Topology Recognition TLV Format

D.2.16.1 TLV Type

A 7-bit integer value occupying the most-significant bits of the first octet of the TLV. Always contains the value 127.

D.2.16.2 TLV information string length

The TLV information string length field of the Congestion Isolation TLV is fixed and shall contain the value 7.

D.2.16.3 Device Type

The Device Type field indicates what type of device is sending the Topology Recognition TLV. End-stations or servers that are non-relay systems are at the edge of the topology and shall use the value 0. Table D-13a specifies valid values for the Device Type field.

Table D-13a—Device Type field values

Device Type	Value/meaning
0	end-station/server
1	bridge
2	router
3–254	reserved
255	unknown

D.2.16.4 Topology Level

An integer indicating the system's understanding of its current level in the topology. The value of 0 indicates the edge of the topology and the value 255 indicates the level is currently unknown. Other non-zero values indicate the minimum number of links between the system and the edge of the topology. Initially systems may not know their position in the topology and will use the value of unknown by default. As systems discover the device type and topology level of their peers the topology level of the sending system may change. The procedures that implement the recognition of the topology level are described in 49.5.3.

D.2.16.5 Port Orientation

The Port Orientation field indicates whether the port is facing an *uplink, downlink, crosslink,* or the orientation is *unknown*. An *uplink* is a port that is facing a system that is deeper in the topology (i.e., has a Topology Level greater than the sending system). A *downlink* is a port that is facing a system closer to the edge of the topology (i.e., has a Topology Level less than the sending system). A *crosslink* is a port that is facing a system at the same level of the topology. Initially systems may not know whether the port orientation is an *uplink, downlink*, or *crosslink* and will use the value of *unknown* by default. The procedures that implement the recognition of the Port Orientation are described in 49.5.3. Table D-13b specifies valid values for the Port Orientation field.

Table D-13b—Port Orientation field values

Port Orientation	Value/meaning
0	uplink
1	downlink
2	crosslink
3–254	reserved
255	unknown

D.3 IEEE 802.1 Organizationally Specific TLV management

D.3.2 IEEE 802.1 managed objects—TLV variables

Insert D.3.2.11 and D.3.2.12 after D.3.2.10 as follows:

D.3.2.11 Congestion Isolation TLV managed objects

a) **queue map:** see D.2.15.3.
b) **CIM Encap Length:** see D.2.15.4.
c) **MAC Address:** see D.2.15.5.
d) **Address Family**: see D.2.15.7.
e) **IP Address**: see D.2.15.8.

D.3.2.12 Topology Recognition TLV managed objects

a) **Device Type:** see D.2.16.3.
b) **Topology Level:** see D.2.16.4.
c) **Port Orientation:** see D.2.16.5.

D.4 PICS proforma for IEEE 802.1 Organizationally Specific TLV extensions[15] [16]

D.4.3 Major capabilities and options

Insert the following rows at the end of the table in D.4.3 (unchanged rows not shown):

Item	Feature	Status	References	Support
ciSet	Is the IEEE 802.1 Organizationally Specific TLV ciSet implemented?	O.1	D.2.15, Table D-1	Yes [ ] No [ ]
ciQueuePri	Are the monitored queues higher priority than the congesting queue?	ciSet:M	D.2.15.3	Yes [ ] N/A [ ]
trSet	Is the IEEE 802.1 Organizationally Specific TLV trSet implemented?	O.1	D.2.16, Table D-1	Yes [ ] No [ ]

[15] Instructions for completing the PICS proforma are given in A.3.

[16] *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.

D.5 IEEE 802.1/LLDP extension MIB

D.5.2 Structure of the IEEE 802.1/LLDP extension MIB

Insert new rows at the end of Table D-14 as follows (unchanged rows not shown):

Table D-14—IEEE 802.1 extension MIB object group conformance requirements

MIB group	Rx mode	Tx mode	Tx/Rx mode
lldpXdot1CiGroup	CI:M	CI:M	CI:M
lldpXdot1TrGroup	TR:M	TR:M	TR:M

Insert the following entries at the end of each group in Table D-15. The group headings are shown (in italic) in Table D-15 for reference (other unchanged rows not shown):

Table D-15—IEEE 802.1/LLDP extension MIB object cross reference

MIB table	MIB object	LLDP reference
Configuration group		
lldpXdot1CiConfigCiTable		Augments lldpV2PortConfigEntry
	lldpXdot1CiConfigCiTxEnable	Normal LLPDUs, 9.1.2.1 of IEEE Std 802.1AB
Local system information		
lldpXdot1LocCiBasicTable		D.2.15
	lldpV2LocPortIfIndex	(Table index)
	lldpXdot1LocCiCIMEncapLen	D.2.15.4
	lldpXdot1LocCiMacAddress	D.2.15.5
	lldpXdot1LocCiNetAddressType	D.2.15.7
	lldpXdot1LocCiNetAddress	D.2.15.8
lldpXdot1CiLocQueueMapTable		D.2.15.3
	lldpV2LocPortIfIndex	(Table index)
	lldpXdot1LocCiQueueId	(Table index)
	lldpXdot1LocCiQueueType	D.2.15.3
	lldpXdot1LocCiMappedQueue	D.2.15.3

Table D-15—IEEE 802.1/LLDP extension MIB object cross reference *(continued)*

MIB table	MIB object	LLDP reference
Remote system information		
lldpXdot1RemCiBasicTable		D.2.15
	lldpV2RemTimeMark	(Table index)
	lldpV2RemLocalIfIndex	(Table index)
	lldpV2RemLocalDestMACAddress	(Table index)
	lldpV2RemIndex	(Table index)
	lldpXdot1RemCiCIMEncapLen	D.2.15.4
	lldpXdot1RemCiMacAddress	D.2.15.5
	lldpXdot1RemCiNetAddressType	D.2.15.7
	lldpXdot1RemCiNetAddress	D.2.15.8
lldpXdot1CiRemQueueMapTable		D.2.15
	lldpV2RemTimeMark	(Table index)
	lldpV2RemLocalIfIndex	(Table index)
	lldpV2RemLocalDestMACAddress	(Table index)
	lldpV2RemIndex	(Table index)
	lldpXdot1RemCiQueueId	(Table index)
	lldpXdot1RemCiQueueType	D.2.15.3
	lldpXdot1RemCiMappedQueue	D.2.15.3

D.5.4 Security considerations for IEEE 802.1 LLDP extension MIB module

Change list items g) and h) in D.5.4 as follows:

g) MIB objects that are related to the transmit mode:
   1) lldpV2Xdot1LocPortVlanId
   2) lldpV2Xdot1LocProtoVlanSupported
   3) lldpV2Xdot1LocProtoVlanEnabled
   4) lldpV2Xdot1LocVlanName
   5) lldpV2Xdot1LocProtocolId
   6) lldpV2Xdot1LocVidUsageDigest
   7) lldpV2Xdot1LocManVidTxEnable
   8) lldpV2Xdot1LocLinkAggStatus
   9) lldpV2Xdot1LocLinkAggPortId
   10) lldpXdot1dcbxConfigETSConfigurationEntry
   11) lldpXdot1dcbxConfigPFCTable
   12) lldpXdot1dcbxLocETSBasicConfigurationTable
   13) lldpXdot1dcbxLocETSConPriorityAssignmentTable
   14) lldpXdot1dcbxLocETSRecoTrafficSelectionAlgorithmTable
   15) lldpXdot1dcbxLocPFCBasicTable
   16) lldpXdot1dcbxLocPFCEnableTable
   17) lldpXdot1dcbxAdminETSBasicConfigurationTable

18) lldpXdot1dcbxAdminETSConPriorityAssignmentTable
19) lldpXdot1dcbxAdminETSRecoTrafficSelectionAlgorithmTable
20) lldpXdot1dcbxAdminPFCBasicTable
21) lldpXdot1dcbxAdminPFCEnableTable
22) lldpXdot1dcbxLocApplicationPriorityAppTable
23) lldpXdot1dcbxLocApplicationVlanAppTable
24) lldpXdot1dcbxAdminApplicationPriorityAppTable
25) lldpXdot1dcbxAdminApplicationVlanAppTable
26) lldpXdot1LocCiBasicTable
27) lldpXdot1CiLocQueueMapTable
28) lldpXdot1LocTrTable

h) MIB objects that are related to the receive mode:

1) lldpV2Xdot1RemPortVlanId
2) lldpV2Xdot1RemProtoVlanSupported
3) lldpV2Xdot1RemProtoVlanEnabled
4) lldpV2Xdot1RemVlanName
5) lldpV2Xdot1RemProtocolId
6) lldpV2Xdot1RemVidUsageDigest
7) lldpV2Xdot1RemManVidTxEnable
8) lldpV2Xdot1RemLinkAggStatus
9) lldpV2Xdot1RemLinkAggPortId
10) lldpXdot1dcbxConfigETSConfigurationEntry
11) lldpXdot1dcbxConfigPFCTable
12) lldpXdot1dcbxRemETSBasicConfigurationTable
13) lldpXdot1dcbxRemETSConPriorityAssignmentTable
14) lldpXdot1dcbxRemETSRecoTrafficSelectionAlgorithmTable
15) lldpXdot1dcbxRemPFCBasicTable
16) lldpXdot1dcbxRemPFCEnableTable
17) lldpXdot1dcbxAdminETSBasicConfigurationTable
18) lldpXdot1dcbxAdminETSConPriorityAssignmentTable
19) lldpXdot1dcbxAdminETSRecoTrafficSelectionAlgorithmTable
20) lldpXdot1dcbxAdminPFCBasicTable
21) lldpXdot1dcbxAdminPFCEnableTable
22) lldpXdot1dcbxRemApplicationPriorityAppTable
23) lldpXdot1dcbxRemApplicationVlanAppTable
24) lldpXdot1dcbxAdminApplicationPriorityAppTable
25) lldpXdot1dcbxAdminApplicationVlanAppTable
26) lldpXdot1RemCiBasicTable
27) lldpXdot1CiRemQueueMapTable
28) lldpXdot1RemTrTable

D.5.5 IEEE 802.1 LLDP extension MIB module—version 2[17] [18]

Change D.5.5 as follows:

In the following MIB definition, should any discrepancy between the DESCRIPTION text and the corresponding definition in D.2.1 through D.5 occur, the definition in D.2.1 through D.5 shall take precedence.

```
LLDP-EXT-DOT1-V2-MIB DEFINITIONS ::= BEGIN

IMPORTS
    MODULE-IDENTITY,
    OBJECT-TYPE,
    Unsigned32
        FROM SNMPv2-SMI
    TruthValue,
    TEXTUAL-CONVENTIONCONVENTION,
    MacAddress
        FROM SNMPv2-TC
    SnmpAdminString
        FROM SNMP-FRAMEWORK-MIB
    MODULE-COMPLIANCE,
    OBJECT-GROUP
        FROM SNMPv2-CONF
    ifGeneralInformationGroup
        FROM IF-MIB
    lldpV2Extensions,
    lldpV2LocPortIfIndex,
    lldpV2RemTimeMark,
    lldpV2RemLocalIfIndex,
    lldpV2RemLocalDestMACAddress,
    lldpV2RemIndex,
    lldpV2PortConfigEntry
        FROM LLDP-V2-MIB
    VlanId
        FROM Q-BRIDGE-MIB
    IEEE8021PriorityValue
        FROM IEEE8021-TC-MIB;MIB
    InetPortNumber
        FROM INET-ADDRESS-MIB
    AddressFamilyNumbers
        FROM IANA-ADDRESS-FAMILY-NUMBERS-MIB;

lldpV2Xdot1MIB MODULE-IDENTITY
    LAST-UPDATED "202211080000Z" -- November 8, 2022"202306050000Z" -- June 5, 2023
    ORGANIZATION "IEEE 802.1 Working Group"
    CONTACT-INFO
        "  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
            "The LLDP Management Information Base extension module for
            IEEE 802.1 organizationally defined discovery information.

            In order to ensure the uniqueness of the LLDP-V2-MIB,
            lldpV2Xdot1MIB is branched from lldpV2Extensions using an
            Organizationally Unique Identifier (OUI) value as the node.
```

[17] *Copyright release for MIBs:* Users of this standard may freely reproduce the MIB modules in this standard so that they can be used for their intended purpose.

[18] An ASCII version of this MIB module is attached to the PDF version of this standard, and can be obtained by Web browser from the IEEE 802.1 Website at https://1.ieee802.org/mib-modules/.

```
            An OUI is a 24 bit globally unique number assigned by the
            IEEE Registration Authority - see:

            http://standards.ieee.org/develop/regauth/oui/index.html

        Unless otherwise indicated, the references in this MIB
        module are to IEEE Std 802.1Q-2022 as amended by IEEE Std 802.1Qcz-2023.

        Copyright (C) IEEE (2022)2023).
        This version of this MIB module is part of IEEE Std 802.1Q;
        see that standard for full legal notices."

    REVISION "202306050000Z" -- June 5, 2023
    DESCRIPTION
            "Published as part of IEEE Std 802.1Qcz-2023.
            Congestion Isolation objects added."

    REVISION "202211080000Z" -- November 8, 2022
    DESCRIPTION
            "Published as part of IEEE Std 802.1Q-2022.
            Cross references and contact information updated."

    REVISION "201807010000Z" -- July 1, 2018
    DESCRIPTION
            "Published as part of IEEE Std 802.1Q 2018 revision.
            Cross references updated and corrected.
            Changes introduced by IEEE Std 802.1Qcd-2015 and
            IEEE Std 802.1Q-2014 Cor 1-2015 merged. "

    REVISION "201502160000Z" -- February 16, 2015
    DESCRIPTION
            "Published as part of IEEE Std 802.1Q 2014 Cor-1.
            Updated as a result of maintenance items #0132 and #0152"

    REVISION "201502160000Z" -- February 16, 2015
    DESCRIPTION
            "Published as part of IEEE Std 802.1Qcd.
            Adds Application VLAN TLV objects to the DCBX groups of
            the MIB module."

    REVISION "201412150000Z" -- December 15, 2014
    DESCRIPTION
            "Published as part of IEEE Std 802.1Q 2014 revision.
            Cross references updated and corrected.
            New tables lldpV2Xdot1RemVidUsageDigestV2Table
            and lldpV2Xdot1RemManVidV2Table inserted; old
            versions deprecated. New versions add an index for
            lldpV2RemIndex. "

    REVISION "201103250000Z" -- March 25, 2011
    DESCRIPTION
            "Published as part of IEEE Std 802.1Qaz-2011. Adds the DCBX
            objects to the MIB module"

    REVISION "201103230000Z" -- March 23, 2011
    DESCRIPTION
            "Published as part of IEEE Std 802.1Q-2011 revision.
            This revision contains changes associated with
            relocating the extension MIB from IEEE Std 802.1AB to
            IEEE Std 802.1Q, minor tweaks to the text of the
            DESCRIPTION statement above to fix references to
            IEEE Std 802.1Q, updating of references to refer to
            Annex D, and addition of object definitions for
            Congestion Notification TLVs and corresponding
            compliance statements."

    REVISION "200906080000Z" -- June 08, 2009
    DESCRIPTION
            "Published as part of IEEE Std 802.1AB-2009 revision.
            This revision incorporated changes to the MIB to
            support the use of LLDP with multiple destination MAC
            addresses, and to import the Link Aggregation TLV
```

```
            from the IEEE 802.3 extension MIB"

-- OUI for IEEE 802.1 is 32962 (00-80-C2)
   ::= { lldpV2Extensions 32962 }

--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--
-- Organizationally Defined Information Extension - IEEE 802.1
-- Definitions to support the basicSet TLV set (Table D-1)
--
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------

lldpV2Xdot1Objects    OBJECT IDENTIFIER ::= { lldpV2Xdot1MIB 1 }

-- LLDP IEEE 802.1 extension MIB groups
lldpV2Xdot1Config     OBJECT IDENTIFIER ::= { lldpV2Xdot1Objects 1 }
lldpV2Xdot1LocalData  OBJECT IDENTIFIER ::= { lldpV2Xdot1Objects 2 }
lldpV2Xdot1RemoteData OBJECT IDENTIFIER ::= { lldpV2Xdot1Objects 3 }

--------------------------------------------------------------------------------
-- Textual Convention definitions
--------------------------------------------------------------------------------

LldpV2XLinkAggStatusMap ::= TEXTUAL-CONVENTION
    STATUS      current
    DESCRIPTION
            "This TC describes the link aggregation status.

            The bit 'aggCapable(0)' indicates the link is capable of being
            aggregated if 1, not capable if 0.

            The bit 'aggEnabled(1)' indicates the link is currently in
            an aggregation if 1, not in an aggregation if 0.

            The bits 'portTypeLS(1)' and portTypeMS(2)' form the LS
            and MS bits of a Port Type value respectively:
            00 = no port type specified
            01 = transmitted from Aggregation Port
            10 = transmitted from Aggregator
            11 = transmitted from an Aggregator with a single
                 Aggregation Port.

            The remaining bits are reserved for future standardization."
    SYNTAX  BITS {
            aggCapable(0),
            aggEnabled(1),
            portTypeLS(2),
            portTypeMS(3)
    }

--------------------------------------------------------------------------------
-- IEEE 802.1 - Configuration for the basicSet TLV set
--------------------------------------------------------------------------------

--
-- lldpV2Xdot1ConfigPortVlanTable : configure the transmission of the
--                                  Port VLAN-ID TLVs on set of ports.
--

lldpV2Xdot1ConfigPortVlanTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1ConfigPortVlanEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "A table that controls selection of LLDP Port VLAN-ID TLVs
            to be transmitted on individual ports."
    ::= { lldpV2Xdot1Config 1 }

lldpV2Xdot1ConfigPortVlanEntry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1ConfigPortVlanEntry
```

```
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "LLDP configuration information that controls the
            transmission of IEEE 802.1 organizationally defined Port
            VLAN-ID TLV on LLDP transmission-capable ports.

            This configuration object augments the
            lldpV2PortConfigEntry of the LLDP-MIB, therefore it is only
            present along with the port configuration defined by the
            associated lldpV2PortConfigEntry entry.

            Each active lldpConfigEntry is restored from non-volatile
            storage (along with the corresponding
            lldpV2PortConfigEntry) after a re-initialization of the
            management system."
    AUGMENTS { lldpV2PortConfigEntry }
    ::= { lldpV2Xdot1ConfigPortVlanTable 1 }

LldpV2Xdot1ConfigPortVlanEntry ::= SEQUENCE {
      lldpV2Xdot1ConfigPortVlanTxEnable  TruthValue
}

lldpV2Xdot1ConfigPortVlanTxEnable OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
            "The lldpV2Xdot1ConfigPortVlanTxEnable, which is defined
            as a truth value and configured by the network management,
            determines whether the IEEE 802.1 organizationally defined
            port VLAN TLV transmission is allowed on a given LLDP
            transmission-capable port.

            The value of this object is restored from non-volatile
            storage after a re-initialization of the management system."
    REFERENCE
            "9.1.2.1 of IEEE Std 802.1AB"
    DEFVAL  { false }
    ::= { lldpV2Xdot1ConfigPortVlanEntry 1 }


--
-- lldpV2Xdot1ConfigVlanNameTable : configure the transmission of the
--                                  VLAN name instances on set of ports.
--

lldpV2Xdot1ConfigVlanNameTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1ConfigVlanNameEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The table that controls selection of LLDP VLAN name TLV
            instances to be transmitted on individual ports."
    ::= { lldpV2Xdot1Config 2 }

lldpV2Xdot1ConfigVlanNameEntry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1ConfigVlanNameEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "LLDP configuration information that specifies the set of
            ports (represented as a PortList) on which the Local System
            VLAN name instance is transmitted.

            This configuration object augments the lldpV2LocVlanEntry,
            therefore it is only present along with the VLAN Name
            instance contained in the associated lldpV2LocVlanNameEntry
            entry.

            Each active lldpV2Xdot1ConfigVlanNameEntry is restored
            from non-volatile storage (along with the corresponding
```

```
            lldpV2Xdot1LocVlanNameEntry) after a re-initialization of
            the management system."
    AUGMENTS { lldpV2Xdot1LocVlanNameEntry }
    ::= { lldpV2Xdot1ConfigVlanNameTable 1 }



LldpV2Xdot1ConfigVlanNameEntry ::= SEQUENCE {
      lldpV2Xdot1ConfigVlanNameTxEnable  TruthValue
}

lldpV2Xdot1ConfigVlanNameTxEnable  OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
            "The boolean value that indicates whether the corresponding
            Local System VLAN name instance is transmitted on the
            port defined by the given lldpV2Xdot1LocVlanNameEntry.

            The value of this object is restored from non-volatile
            storage after a re-initialization of the management
            system."
    REFERENCE
            "9.1.2.1 of IEEE Std 802.1AB"
    DEFVAL  { false }
    ::= { lldpV2Xdot1ConfigVlanNameEntry 1 }


--
-- lldpV2Xdot1ConfigProtoVlanTable : configure the transmission of the
--                                   protocol VLAN instances on set
--                                   of ports.
--

lldpV2Xdot1ConfigProtoVlanTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1ConfigProtoVlanEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The table that controls selection of LLDP Port And
            Protocol VLAN ID TLV instances to be transmitted on
            individual ports."
    ::= { lldpV2Xdot1Config 3 }

lldpV2Xdot1ConfigProtoVlanEntry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1ConfigProtoVlanEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "LLDP configuration information that specifies the set of
            ports (represented as a PortList) on which the Local System
            Protocol VLAN instance is transmitted.

            This configuration object augments the
            lldpV2Xdot1LocVlanEntry, therefore it is only present along
            with the Port and Protocol VLAN ID instance contained in
            the associated lldpV2Xdot1LocVlanEntry entry.

            Each active lldpV2Xdot1ConfigProtoVlanEntry is restored
            from non-volatile storage (along with the corresponding
            lldpV2Xdot1LocProtoVlanEntry) after a re-initialization of
            the management system."

    AUGMENTS { lldpV2Xdot1LocProtoVlanEntry }
    ::= { lldpV2Xdot1ConfigProtoVlanTable 1 }


LldpV2Xdot1ConfigProtoVlanEntry ::= SEQUENCE {
      lldpV2Xdot1ConfigProtoVlanTxEnable   TruthValue
}
```

```
lldpV2Xdot1ConfigProtoVlanTxEnable OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
            "The boolean value that indicates whether the corresponding
            Local System Port and Protocol VLAN instance is
            transmitted on the port defined by the given
            lldpV2Xdot1LocProtoVlanEntry.

            The value of this object is restored from non-volatile
            storage after a re-initialization of the management system."
    REFERENCE
            "9.1.2.1 of IEEE Std 802.1AB"
    DEFVAL  { false }
    ::= { lldpV2Xdot1ConfigProtoVlanEntry 1 }


--
-- lldpV2Xdot1ConfigProtocolTable : configure the transmission of the
--                                  protocol instances on set
--                                  of ports.
--

lldpV2Xdot1ConfigProtocolTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1ConfigProtocolEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The table that controls selection of LLDP Protocol
            TLV instances to be transmitted on individual ports."
    ::= { lldpV2Xdot1Config 4 }

lldpV2Xdot1ConfigProtocolEntry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1ConfigProtocolEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "LLDP configuration information that specifies the set of
            ports (represented as a PortList) on which the Local System
            Protocol instance is transmitted.

            This configuration object augments the
            lldpV2Xdot1LocProtoEntry, therefore it is only present
            along with the Protocol instance contained in the
            associated lldpV2Xdot1LocProtoEntry entry.

            Each active lldpV2Xdot1ConfigProtocolEntry is restored
            from non-volatile storage (along with the corresponding
            lldpV2Xdot1LocProtocolEntry) after a re-initialization of
            the management system."
    AUGMENTS { lldpV2Xdot1LocProtocolEntry }
    ::= { lldpV2Xdot1ConfigProtocolTable 1 }


LldpV2Xdot1ConfigProtocolEntry ::= SEQUENCE {
      lldpV2Xdot1ConfigProtocolTxEnable   TruthValue
}

lldpV2Xdot1ConfigProtocolTxEnable  OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
            "The boolean value that indicates whether the corresponding
            Local System Protocol Identity instance is transmitted
            on the port defined by the given
            lldpV2Xdot1LocProtocolEntry.

            The value of this object is restored from non-volatile
            storage after a re-initialization of the management
            system."
```

```
    REFERENCE
            "9.1.2.1 of IEEE Std 802.1AB"
    DEFVAL  { false }
    ::= { lldpV2Xdot1ConfigProtocolEntry 1 }

--
-- lldpV2Xdot1ConfigVidUsageDigestTable: configure the transmission
-- of the VID Usage Digest TLVs on set of ports.
--
lldpV2Xdot1ConfigVidUsageDigestTable OBJECT-TYPE
     SYNTAX SEQUENCE OF LldpV2Xdot1ConfigVidUsageDigestEntry
     MAX-ACCESS not-accessible
     STATUS current
     DESCRIPTION
          "A table that controls selection of LLDP VID Usage Digest
          TLVs to be transmitted on individual ports."
::= { lldpV2Xdot1Config 5 }

lldpV2Xdot1ConfigVidUsageDigestEntry OBJECT-TYPE
     SYNTAX LldpV2Xdot1ConfigVidUsageDigestEntry
     MAX-ACCESS not-accessible
     STATUS current
     DESCRIPTION
          "LLDP configuration information that specifies the set of
          ports (represented as a PortList) on which the local
          system VID Usage Digest instance will be transmitted.
          This configuration object augments the
          lldpLocVidUsageDigestEntry, therefore it is only present
          along with the VID Usage Digest instance
          contained in the associated lldpV2Xdot1LocVidUsageDigestEntry
          entry. Each active lldpConfigVidUsageDigestEntry must be
          restored from non-volatile storage and re-created (along with
          the corresponding lldpV2Xdot1LocVidUsageDigestEntry) after
          a re-initialization of the management system."
     AUGMENTS { lldpV2Xdot1LocVidUsageDigestEntry }
::= { lldpV2Xdot1ConfigVidUsageDigestTable 1 }

LldpV2Xdot1ConfigVidUsageDigestEntry ::= SEQUENCE {
     lldpV2Xdot1ConfigVidUsageDigestTxEnable TruthValue
     }

lldpV2Xdot1ConfigVidUsageDigestTxEnable OBJECT-TYPE
     SYNTAX TruthValue
     MAX-ACCESS read-write
     STATUS current
     DESCRIPTION
          "The boolean value that indicates whether the corresponding
          Local System VID Usage Digest instance will be transmitted
          on the port defined by the given
          lldpV2Xdot1LocVidUsageDigestEntry. The value of this object
          must be restored from non-volatile storage after a
          reinitialization of the management system."
     REFERENCE
          "9.1.2.1 of IEEE Std 802.1AB"
     DEFVAL { false }
::= { lldpV2Xdot1ConfigVidUsageDigestEntry 1 }


--
-- lldpV2Xdot1ConfigManVidTable : configure the transmission of the
-- Management VID TLVs on set of ports.
--
lldpV2Xdot1ConfigManVidTable OBJECT-TYPE
     SYNTAX SEQUENCE OF LldpV2Xdot1ConfigManVidEntry
     MAX-ACCESS not-accessible
     STATUS current
     DESCRIPTION
          "A table that controls selection of LLDP Management VID
          TLVs to be transmitted on individual ports."
::= { lldpV2Xdot1Config 6 }

lldpV2Xdot1ConfigManVidEntry OBJECT-TYPE
```

```
     SYNTAX LldpV2Xdot1ConfigManVidEntry
     MAX-ACCESS not-accessible
     STATUS current
     DESCRIPTION
          "LLDP configuration information that specifies the set of
          port/destination address pairs on which the Local
          System Management VID will be transmitted.
          This configuration object augments the
          lldpV2Xdot1LocManVidEntry, therefore it is
          only present along with the Management VID contained
          in the associated lldpV2Xdot1LocManVidEntry entry.
          Each active lldpV2Xdot1ConfigManVidEntry must be
          restored from non-volatile storage (along with the
          corresponding lldpV2Xdot1LocManVidEntry) after a
          re-initialization of the management system."
     AUGMENTS { lldpV2Xdot1LocManVidEntry }
::= { lldpV2Xdot1ConfigManVidTable 1 }

LldpV2Xdot1ConfigManVidEntry ::= SEQUENCE {
     lldpV2Xdot1ConfigManVidTxEnable TruthValue
     }

lldpV2Xdot1ConfigManVidTxEnable OBJECT-TYPE
     SYNTAX TruthValue
     MAX-ACCESS read-write
     STATUS current
     DESCRIPTION
          "The lldpV2Xdot1ConfigManVidTxEnable, which is defined as a
          truth value and configured by the network management,
          determines whether the IEEE 802.1 organizationally
          defined Management VID TLV transmission is allowed on a given
          LLDP transmission-capable port.
          The value of this object must be restored from
          non-volatile storage after a re-initialization of the
          management system."
     REFERENCE
          "9.1.2.1 of IEEE Std 802.1AB"
     DEFVAL { false }
::= { lldpV2Xdot1ConfigManVidEntry 1 }


--------------------------------------------------------------------------
-- IEEE 802.1 - Local System Information
--------------------------------------------------------------------------

--
-- lldpV2Xdot1LocTable - indexed by ifIndex.
--

lldpV2Xdot1LocTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1LocEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one row per port for IEEE 802.1
            organizationally defined LLDP extension on the local system
            known to this agent."
    ::= { lldpV2Xdot1LocalData 1 }

lldpV2Xdot1LocEntry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1LocEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Information about IEEE 802.1 organizationally defined
            LLDP extension."
    INDEX   { lldpV2LocPortIfIndex }
    ::= { lldpV2Xdot1LocTable 1 }

LldpV2Xdot1LocEntry ::= SEQUENCE {
         lldpV2Xdot1LocPortVlanId       Unsigned32
}
```

```
lldpV2Xdot1LocPortVlanId OBJECT-TYPE
    SYNTAX      Unsigned32(0|1..4094)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The integer value used to identify the port's VLAN
            identifier Identifier associated with the local system.   A value
            of zero shall be used if the system either does not know
            the PVID or does
            not support Port-based VLAN operation."
    REFERENCE
            "D.2.1.1"
    ::= { lldpV2Xdot1LocEntry 1 }



--
-- lldpV2Xdot1LocProtoVlanTable: Port and Protocol VLAN information
-- re-indexed by ifIndex.
--

lldpV2Xdot1LocProtoVlanTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1LocProtoVlanEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one or more rows per Port and Protocol
            VLAN information about the local system."
    ::= { lldpV2Xdot1LocalData 2 }

lldpV2Xdot1LocProtoVlanEntry OBJECT-TYPE
    SYNTAX      LldpV2Xdot1LocProtoVlanEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Port and protocol VLAN ID Information about a particular
            port component.  There may be multiple port and protocol
            VLANs, identified by a particular
            lldpV2Xdot1LocProtoVlanId, configured on the given port."
    INDEX   { lldpV2LocPortIfIndex,
              lldpV2Xdot1LocProtoVlanId }
    ::= { lldpV2Xdot1LocProtoVlanTable 1 }

LldpV2Xdot1LocProtoVlanEntry ::= SEQUENCE {
      lldpV2Xdot1LocProtoVlanId        Unsigned32,
      lldpV2Xdot1LocProtoVlanSupported TruthValue,
      lldpV2Xdot1LocProtoVlanEnabled   TruthValue
}

lldpV2Xdot1LocProtoVlanId  OBJECT-TYPE
    SYNTAX      Unsigned32(0|1..4094)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The integer value used to identify the port and protocol
            VLANs associated with the given port associated with the
            local system.  A value of zero shall be used if the system
            either does not know the protocol VLAN ID (PPVID) or does
            not support port and protocol VLAN operation."
    REFERENCE
            "D.2.2.2"
    ::= { lldpV2Xdot1LocProtoVlanEntry 1 }

lldpV2Xdot1LocProtoVlanSupported  OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The truth value used to indicate whether the given port
            (associated with the local system) supports port and
            protocol VLANs."
```

```
    REFERENCE
            "D.2.2.1"
    ::= { lldpV2Xdot1LocProtoVlanEntry 2 }

lldpV2Xdot1LocProtoVlanEnabled  OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The truth value used to indicate whether the port and
            protocol VLANs are enabled on the given port associated
            with the local system."
    REFERENCE
            "D.2.2.1"
    ::= { lldpV2Xdot1LocProtoVlanEntry 3 }



--
-- lldpV2Xdot1LocVlanNameTable : VLAN name information about the local
-- system indexed by ifIndex.
--

lldpV2Xdot1LocVlanNameTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1LocVlanNameEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one or more rows per IEEE 802.1Q VLAN
            name information on the local system known to this agent."
    ::= { lldpV2Xdot1LocalData 3 }

lldpV2Xdot1LocVlanNameEntry OBJECT-TYPE
    SYNTAX      LldpV2Xdot1LocVlanNameEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "VLAN name Information about a particular port component.
            There may be multiple VLANs, identified by a particular
            lldpV2Xdot1LocVlanId, configured on the given port."
    INDEX   { lldpV2LocPortIfIndex,
              lldpV2Xdot1LocVlanId }
    ::= { lldpV2Xdot1LocVlanNameTable 1 }

LldpV2Xdot1LocVlanNameEntry ::= SEQUENCE {
      lldpV2Xdot1LocVlanId             VlanId,
      lldpV2Xdot1LocVlanName           SnmpAdminString
}

lldpV2Xdot1LocVlanId  OBJECT-TYPE
    SYNTAX      VlanId
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The integer value used to identify the IEEE 802.1Q
            VLAN IDs with which the given port is compatible."
    REFERENCE
            "D.2.3.2"
    ::= { lldpV2Xdot1LocVlanNameEntry 1 }

lldpV2Xdot1LocVlanName  OBJECT-TYPE
    SYNTAX      SnmpAdminString (SIZE(1..32))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The string value used to identify VLAN name identified
            by the Vlan Id associated with the given port on the
            local system.

            This object should contain the value of the
            dot1QVLANStaticName object (defined in IETF RFC 4363)
            identified with the given lldpV2Xdot1LocVlanId."
```

```
    REFERENCE
            "D.2.3.4"
    ::= { lldpV2Xdot1LocVlanNameEntry 2 }



--
-- lldpV2Xdot1LocProtocolTable : Protocol Identity information
-- re-indexed by ifIndex and destination address
--

lldpV2Xdot1LocProtocolTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1LocProtocolEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one or more rows per protocol identity
            information on the local system known to this agent."
    REFERENCE
            "D.2.4"
    ::= { lldpV2Xdot1LocalData 4 }

lldpV2Xdot1LocProtocolEntry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1LocProtocolEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Information about particular protocols that are accessible
            through the given port component.

            There may be multiple protocols, identified by particular
            lldpV2Xdot1ProtocolIndex, lldpV2LocPortIfIndex"
    REFERENCE
            "D.2.4"
    INDEX   { lldpV2LocPortIfIndex,
              lldpV2Xdot1LocProtocolIndex }
    ::= { lldpV2Xdot1LocProtocolTable 1 }

LldpV2Xdot1LocProtocolEntry ::= SEQUENCE {
      lldpV2Xdot1LocProtocolIndex Unsigned32,
      lldpV2Xdot1LocProtocolId    OCTET STRING
}


lldpV2Xdot1LocProtocolIndex  OBJECT-TYPE
    SYNTAX      Unsigned32(1..2147483647)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This object represents an arbitrary local integer value
            used by this agent to identify a particular protocol
            identity."
    ::= { lldpV2Xdot1LocProtocolEntry 1 }

lldpV2Xdot1LocProtocolId  OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE (1..255))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The octet string value used to identify the protocols
            associated with the given port of the local system."
    REFERENCE
            "D.2.4.3"
    ::= { lldpV2Xdot1LocProtocolEntry 2 }

--
-- lldpV2Xdot1LocVidUsageDigestTable: Table of hash values of
-- system VID Usage Table transmitted
-- via VID Usage Digest TLV.
--
```

```
lldpV2Xdot1LocVidUsageDigestTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1LocVidUsageDigestEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one row per ifIndex/
            destination MAC address pair for usage digest
            information on the local system known to this agent."
    REFERENCE
            "D.2.5"
    ::= { lldpV2Xdot1LocalData 5 }

lldpV2Xdot1LocVidUsageDigestEntry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1LocVidUsageDigestEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Usage digest information to be transmitted
            through the given port."
    REFERENCE
            "D.2.5"
    INDEX   { lldpV2LocPortIfIndex }
    ::= { lldpV2Xdot1LocVidUsageDigestTable 1 }

LldpV2Xdot1LocVidUsageDigestEntry ::= SEQUENCE {
      lldpV2Xdot1LocVidUsageDigest Unsigned32
}


lldpV2Xdot1LocVidUsageDigest OBJECT-TYPE
    SYNTAX Unsigned32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The integer value obtained by applying the CRC32 function
        to the 128-octet VID Usage Table. A bit of the VID Usage
        Table contains the value PBB-TE-USAGE (binary 1) if the
        corresponding element of the MST Configuration Table
        (IEEE Std 802.1Q 8.9.1) contains the value PBB-TE MSTID
        (hex FFE) and otherwise contains the value NON-PBB-TE-USAGE
        (binary 0)."
    REFERENCE
        "D.2.5.1"
::= { lldpV2Xdot1LocVidUsageDigestEntry 1 }

--
-- lldpV2Xdot1LocManVidTable: Table of values configured on the Local
-- system for the Management VID, or the value 0 if a Management VID
-- has not been provisioned.
--

lldpV2Xdot1LocManVidTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1LocManVidEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one row per ifIndex/
            destination MAC address pair for usage digest
            information on the local system known to this agent."
    REFERENCE
            "D.2.6"
    ::= { lldpV2Xdot1LocalData 6 }

lldpV2Xdot1LocManVidEntry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1LocManVidEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Usage digest information to be transmitted
            through the given port."
    REFERENCE
            "D.2.6"
```

```
    INDEX   { lldpV2LocPortIfIndex }
    ::= { lldpV2Xdot1LocManVidTable 1 }

LldpV2Xdot1LocManVidEntry ::= SEQUENCE {
      lldpV2Xdot1LocManVid Unsigned32
}

lldpV2Xdot1LocManVid OBJECT-TYPE
    SYNTAX Unsigned32 (0|1..4094)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The integer value configured on the Local system for
        the Management VID, or
        the value 0 if a Management VID has not been provisioned."
    REFERENCE
        "D.2.6.1"
::= { lldpV2Xdot1LocManVidEntry 1 }


--------------------------------------------------------------------------
-- IEEE 802.1 - Local System Information - Link Aggregation
--------------------------------------------------------------------------

---
---
--- lldpV2Xdot1LocLinkAggTable: Link Aggregation Information Table
---
---
lldpV2Xdot1LocLinkAggTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1LocLinkAggEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one row per port of link aggregation
            information (as a part of the LLDP 802.1 organizational
            extension) on the local system known to this agent."
    ::= { lldpV2Xdot1LocalData 7 }

lldpV2Xdot1LocLinkAggEntry OBJECT-TYPE
    SYNTAX      LldpV2Xdot1LocLinkAggEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Link Aggregation information about a particular port
            component."
    INDEX   { lldpV2LocPortIfIndex }
    ::= { lldpV2Xdot1LocLinkAggTable 1 }

LldpV2Xdot1LocLinkAggEntry ::= SEQUENCE {
      lldpV2Xdot1LocLinkAggStatus       LldpV2XLinkAggStatusMap,
      lldpV2Xdot1LocLinkAggPortId       Unsigned32
}

lldpV2Xdot1LocLinkAggStatus OBJECT-TYPE
    SYNTAX      LldpV2XLinkAggStatusMap
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The bitmap value contains the link aggregation
            capabilities and the current aggregation status of the
            link."
    REFERENCE
            "IEEE Std 802.1AX"
    ::= { lldpV2Xdot1LocLinkAggEntry 1 }

lldpV2Xdot1LocLinkAggPortId OBJECT-TYPE
    SYNTAX      Unsigned32(0|1..2147483647)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "This object contains the IEEE 802.1 aggregated port
```

```
            identifier, aAggPortID (IEEE Std 802.1AX, 6.3.2.1.1),
            derived from the ifNumber of the  ifIndex for the port
            component in link aggregation.

            If the port is not in link aggregation state and/or it
            does not support link aggregation, this value should be set
            to zero."
    REFERENCE
            "IEEE Std 802.1AX"
    ::= { lldpV2Xdot1LocLinkAggEntry 2 }



--------------------------------------------------------------------------
-- IEEE 802.1 - Remote System Information
--------------------------------------------------------------------------

--
-- lldpV2Xdot1RemTable - re-indexed for ifIndex and destination MAC
-- address

lldpV2Xdot1RemTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1RemEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one or more rows per physical network
            connection known to this agent.  The agent may wish to
            ensure that only one lldpV2Xdot1RemEntry is present for
            each local port, or it may choose to maintain multiple
            lldpV2Xdot1RemEntries for the same local port."
    ::= { lldpV2Xdot1RemoteData 1 }

lldpV2Xdot1RemEntry OBJECT-TYPE
    SYNTAX      LldpV2Xdot1RemEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Information about a particular port component."
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress,
              lldpV2RemIndex }
    ::= { lldpV2Xdot1RemTable 1 }

LldpV2Xdot1RemEntry ::= SEQUENCE {
            lldpV2Xdot1RemPortVlanId           Unsigned32
}

lldpV2Xdot1RemPortVlanId OBJECT-TYPE
    SYNTAX      Unsigned32(0|1..4094)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The integer value used to identify the port's VLAN
            identifier Identifier associated with the remote system.  if the
            remote system either does not know the PVID or does not
            support Port-based VLAN operation, the value of
            lldpV2Xdot1RemPortVlanId should be zero."
    REFERENCE
            "D.2.1.1"
    ::= { lldpV2Xdot1RemEntry 1 }



--
-- lldpV2Xdot1RemProtoVlanTable - re-indexed by ifIndex and
-- destination MAC address
--

lldpV2Xdot1RemProtoVlanTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1RemProtoVlanEntry
```

```
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one or more rows per Port and Protocol
            VLAN information about the remote system, received on the
            given port."
    ::= { lldpV2Xdot1RemoteData 2 }

lldpV2Xdot1RemProtoVlanEntry OBJECT-TYPE
    SYNTAX      LldpV2Xdot1RemProtoVlanEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Port and protocol VLAN name Information about a particular
            port component.  There may be multiple protocol VLANs,
            identified by a particular lldpV2Xdot1RemProtoVlanId,
            configured on the remote system."
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress,
              lldpV2RemIndex,
              lldpV2Xdot1RemProtoVlanId }
    ::= { lldpV2Xdot1RemProtoVlanTable 1 }

LldpV2Xdot1RemProtoVlanEntry ::= SEQUENCE {
            lldpV2Xdot1RemProtoVlanId          Unsigned32,
            lldpV2Xdot1RemProtoVlanSupported   TruthValue,
            lldpV2Xdot1RemProtoVlanEnabled     TruthValue
}

lldpV2Xdot1RemProtoVlanId  OBJECT-TYPE
    SYNTAX      Unsigned32(0|1..4094)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The integer value used to identify the port and protocol
            VLANs associated with the given port associated with the
            remote system.

            If port and protocol VLANs are not supported on the given
            port associated with the remote system, or if the port is
            not enabled with any port and protocol VLAN, the value of
            lldpV2Xdot1RemProtoVlanId should be zero."
    REFERENCE
            "D.2.2.2"
    ::= { lldpV2Xdot1RemProtoVlanEntry 1 }

lldpV2Xdot1RemProtoVlanSupported  OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The truth value used to indicate whether the given port
            (associated with the remote system) is capable of
            supporting port and protocol VLANs."
    REFERENCE
            "D.2.2.1"
    ::= { lldpV2Xdot1RemProtoVlanEntry 2 }

lldpV2Xdot1RemProtoVlanEnabled  OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The truth value used to indicate whether the port and
            protocol VLANs are enabled on the given port associated
            with
            the remote system."
    REFERENCE
            "D.2.2.1"
    ::= { lldpV2Xdot1RemProtoVlanEntry 3 }
```

```
--
-- lldpV2Xdot1RemVlanNameTable : VLAN name information of the remote
--                               systems
-- Re-indexed by ifIndex and destination MAC address
--

lldpV2Xdot1RemVlanNameTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1RemVlanNameEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one or more rows per IEEE 802.1Q VLAN
            name information about the remote system, received on the
            given port."
    REFERENCE
            "D.2.3"
    ::= { lldpV2Xdot1RemoteData 3 }

lldpV2Xdot1RemVlanNameEntry OBJECT-TYPE
    SYNTAX      LldpV2Xdot1RemVlanNameEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "VLAN name Information about a particular port component.
            There may be multiple VLANs, identified by a particular
            lldpV2Xdot1RemVlanId, received on the given port."
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress,
              lldpV2RemIndex,
              lldpV2Xdot1RemVlanId }
    ::= { lldpV2Xdot1RemVlanNameTable 1 }

LldpV2Xdot1RemVlanNameEntry ::= SEQUENCE {
            lldpV2Xdot1RemVlanId       VlanId,
            lldpV2Xdot1RemVlanName     SnmpAdminString
}


lldpV2Xdot1RemVlanId  OBJECT-TYPE
    SYNTAX      VlanId
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The integer value used to identify the IEEE 802.1Q
            VLAN IDs with which the given port of the remote system
            is compatible."
    REFERENCE
            "D.2.3.2"
    ::= { lldpV2Xdot1RemVlanNameEntry 1 }

lldpV2Xdot1RemVlanName  OBJECT-TYPE
    SYNTAX      SnmpAdminString (SIZE(1..32))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The string value used to identify VLAN name identified
            by the VLAN Id associated with the remote system."
    REFERENCE
            "D.2.3.4"
    ::= { lldpV2Xdot1RemVlanNameEntry 2 }



--
-- lldpV2Xdot1RemProtocolTable : Protocol information of the remote
-- systems Re-indexed by ifIndex and destination MAC address
--

lldpV2Xdot1RemProtocolTable  OBJECT-TYPE
```

```
    SYNTAX      SEQUENCE OF LldpV2Xdot1RemProtocolEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one or more rows per protocol
            information about the remote system, received on
            the given port."
    ::= { lldpV2Xdot1RemoteData 4 }

lldpV2Xdot1RemProtocolEntry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1RemProtocolEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Protocol information about a particular port component.
            There may be multiple protocols, identified by a particular
            lldpV2Xdot1ProtocolIndex, received on the given port."
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress,
              lldpV2RemIndex,
              lldpV2Xdot1RemProtocolIndex }
    ::= { lldpV2Xdot1RemProtocolTable 1 }

LldpV2Xdot1RemProtocolEntry ::= SEQUENCE {
            lldpV2Xdot1RemProtocolIndex     Unsigned32,
            lldpV2Xdot1RemProtocolId        OCTET STRING
}

lldpV2Xdot1RemProtocolIndex  OBJECT-TYPE
    SYNTAX      Unsigned32(1..2147483647)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This object represents an arbitrary local integer value
            used by this agent to identify a particular protocol
            identity."
    ::= { lldpV2Xdot1RemProtocolEntry 1 }

lldpV2Xdot1RemProtocolId  OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE (1..255))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The octet string value used to identify the protocols
            associated with the given port of remote system."
    REFERENCE
            "D.2.4.3"
    ::= { lldpV2Xdot1RemProtocolEntry 2 }



--
-- lldpV2Xdot1RemVidUsageDigestTable: Table of hash values of
-- system VID Usage Table received
-- via VID Usage Digest TLV.
-- This version replaced by a reindexed version (V2).
--


lldpV2Xdot1RemVidUsageDigestTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1RemVidUsageDigestEntry
    MAX-ACCESS  not-accessible
    STATUS      deprecated
    DESCRIPTION
            "This table contains one row per ifIndex/
            destination MAC address pair for usage digest
            information received by the local system."
    REFERENCE
            "D.2.5"
    ::= { lldpV2Xdot1RemoteData 5 }
```

```
lldpV2Xdot1RemVidUsageDigestEntry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1RemVidUsageDigestEntry
    MAX-ACCESS  not-accessible
    STATUS      deprecated
    DESCRIPTION
            "Usage digest information received on
            the given port/destination address pair."
    REFERENCE
            "D.2.5"
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress }
    ::= { lldpV2Xdot1RemVidUsageDigestTable 1 }

LldpV2Xdot1RemVidUsageDigestEntry ::= SEQUENCE {
      lldpV2Xdot1RemVidUsageDigest  Unsigned32
}


lldpV2Xdot1RemVidUsageDigest OBJECT-TYPE
    SYNTAX Unsigned32
    MAX-ACCESS read-only
    STATUS deprecated
    DESCRIPTION
        "The integer value obtained by applying the CRC32 function
        to the 128-octet VID Usage Table. A bit of the VID Usage
        Table contains the value PBB-TE-USAGE (binary 1) if the
        corresponding element of the MST Configuration Table
        (IEEE Std 802.1Q 8.9.1) contains the value PBB-TE MSTID
        (hex FFE) and otherwise contains the value NON-PBB-TE-USAGE
        (binary 0)."
    REFERENCE
        "D.2.5.1"
::= { lldpV2Xdot1RemVidUsageDigestEntry 1 }

--
-- lldpV2Xdot1RemManVidTable: Table of values configured on remote
-- systems for the Management VID, or the value 0 if a Management
-- VID has not been provisioned.
-- This version replaced by a reindexed version (V2).
--


lldpV2Xdot1RemManVidTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1RemManVidEntry
    MAX-ACCESS  not-accessible
    STATUS      deprecated
    DESCRIPTION
            "This table contains one row per ifIndex/
            destination MAC address pair for management VID
            information received from remote systems."
    REFERENCE
            "D.2.6"
    ::= { lldpV2Xdot1RemoteData 6 }

lldpV2Xdot1RemManVidEntry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1RemManVidEntry
    MAX-ACCESS  not-accessible
    STATUS      deprecated
    DESCRIPTION
            "Management VID information received
            through the given port/destination address pair."
    REFERENCE
            "D.2.6"
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress }
    ::= { lldpV2Xdot1RemManVidTable 1 }

LldpV2Xdot1RemManVidEntry ::= SEQUENCE {
      lldpV2Xdot1RemManVid            Unsigned32
}
```

```
lldpV2Xdot1RemManVid OBJECT-TYPE
    SYNTAX Unsigned32 (0|1..4094)
    MAX-ACCESS read-only
    STATUS deprecated
    DESCRIPTION
        "The integer value configured on a system for
        the Management VID, or
        the value 0 if a Management VID has not been provisioned."
    REFERENCE
        "D.2.6.1"
::= { lldpV2Xdot1RemManVidEntry 1 }



--
-- lldpV2Xdot1RemVidUsageDigestV2Table: Table of hash values of
-- system VID Usage Table received
-- via VID Usage Digest TLV.
--


lldpV2Xdot1RemVidUsageDigestV2Table  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1RemVidUsageDigestV2Entry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one row per ifIndex/
            destination MAC address pair for usage digest
            information received by the local system."
    REFERENCE
            "D.2.5"
    ::= { lldpV2Xdot1RemoteData 8 }

lldpV2Xdot1RemVidUsageDigestV2Entry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1RemVidUsageDigestV2Entry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Usage digest information received on
            the given port/destination address pair."
    REFERENCE
            "D.2.5"
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress,
              lldpV2RemIndex }
    ::= { lldpV2Xdot1RemVidUsageDigestV2Table 1 }

LldpV2Xdot1RemVidUsageDigestV2Entry ::= SEQUENCE {
      lldpV2Xdot1RemVidUsageDigestV2  Unsigned32
}


lldpV2Xdot1RemVidUsageDigestV2 OBJECT-TYPE
    SYNTAX Unsigned32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The integer value obtained by applying the CRC32 function
        to the 128-octet VID Usage Table. A bit of the VID Usage
        Table contains the value PBB-TE-USAGE (binary 1) if the
        corresponding element of the MST Configuration Table
        (IEEE Std 802.1Q 8.9.1) contains the value PBB-TE MSTID
        (hex FFE) and otherwise contains the value NON-PBB-TE-USAGE
        (binary 0)."
    REFERENCE
        "D.2.5.1"
::= { lldpV2Xdot1RemVidUsageDigestV2Entry 1 }


--
```

```
-- lldpV2Xdot1RemManVidV2Table: Table of values configured on remote
-- systems for the Management VID, or the value 0 if a Management
-- VID has not been provisioned.
--

lldpV2Xdot1RemManVidV2Table  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1RemManVidV2Entry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one row per ifIndex/
            destination MAC address pair for management VID
            information received from remote systems."
    REFERENCE
            "D.2.6"
    ::= { lldpV2Xdot1RemoteData 9 }

lldpV2Xdot1RemManVidV2Entry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1RemManVidV2Entry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Management VID information received
            through the given port/destination address pair."
    REFERENCE
            "D.2.6"
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress,
              lldpV2RemIndex }
    ::= { lldpV2Xdot1RemManVidV2Table 1 }

LldpV2Xdot1RemManVidV2Entry ::= SEQUENCE {
      lldpV2Xdot1RemManVidV2            Unsigned32
}

lldpV2Xdot1RemManVidV2 OBJECT-TYPE
    SYNTAX Unsigned32 (0|1..4094)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The integer value configured on a system for
        the Management VID, or
        the value 0 if a Management VID has not been provisioned."
    REFERENCE
        "D.2.6.1"
::= { lldpV2Xdot1RemManVidV2Entry 1 }



-----------------------------------------------------------------------
-- Remote System Information - Link Aggregation
-----------------------------------------------------------------------

---
---
--- lldpV2Xdot1RemLinkAggTable: Link Aggregation Information Table
---
---
lldpV2Xdot1RemLinkAggTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1RemLinkAggEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains port link aggregation information
            (as a part of the LLDP IEEE 802.1 organizational extension)
            of the remote system."
    ::= { lldpV2Xdot1RemoteData 7 }

lldpV2Xdot1RemLinkAggEntry OBJECT-TYPE
    SYNTAX      LldpV2Xdot1RemLinkAggEntry
    MAX-ACCESS  not-accessible
```

```
    STATUS      current
    DESCRIPTION
            "Link Aggregation information about remote system's port
            component."
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress,
              lldpV2RemIndex }
    ::= { lldpV2Xdot1RemLinkAggTable 1 }

LldpV2Xdot1RemLinkAggEntry ::= SEQUENCE {
            lldpV2Xdot1RemLinkAggStatus        LldpV2XLinkAggStatusMap,
            lldpV2Xdot1RemLinkAggPortId        Unsigned32
}

lldpV2Xdot1RemLinkAggStatus OBJECT-TYPE
    SYNTAX      LldpV2XLinkAggStatusMap
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The bitmap value contains the link aggregation capabilities
            and the current aggregation status of the link."
    REFERENCE
            "IEEE Std 802.1AX"
    ::= { lldpV2Xdot1RemLinkAggEntry 1 }

lldpV2Xdot1RemLinkAggPortId OBJECT-TYPE
    SYNTAX      Unsigned32(0|1..2147483647)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "This object contains the IEEE 802.1 aggregated port
            identifier, aAggPortID (IEEE Std 802.1AX, 7.3.2.1.1~~6.3.2.1.1~~),
            derived from the ifNumber of the  ifIndex for the port
            component associated with the remote system.

            If the remote port is not in link aggregation state and/or
            it does not support link aggregation, this value should be
            zero."
    REFERENCE
            "IEEE Std 802.1AX"
    ::= { lldpV2Xdot1RemLinkAggEntry 2 }


-- ----------------------------------------------------------------------
-- Conformance Information for the basicSet TLV set
-- ----------------------------------------------------------------------

lldpV2Xdot1Conformance
    OBJECT IDENTIFIER ::= { lldpV2Xdot1MIB 2 }
lldpV2Xdot1Compliances
    OBJECT IDENTIFIER ::= { lldpV2Xdot1Conformance 1 }
lldpV2Xdot1Groups
    OBJECT IDENTIFIER ::= { lldpV2Xdot1Conformance 2 }

-- compliance statements


lldpV2Xdot1TxRxCompliance MODULE-COMPLIANCE
    STATUS  current
    DESCRIPTION
            "A compliance statement for SNMP entities that implement
            the IEEE 802.1 organizationally defined LLDP extension MIB.

            This group is mandatory for all agents that implement the
            LLDP 802.1 organizational extension in TX and/or RX mode
            for the basicSet TLV set.

            This version defines compliance requirements for
            V2 of the LLDP MIB."
    MODULE  -- this module
        MANDATORY-GROUPS { lldpV2Xdot1ConfigGroup,
```

```
                            ifGeneralInformationGroup
        }
    ::= { lldpV2Xdot1Compliances 1 }


lldpV2Xdot1TxCompliance MODULE-COMPLIANCE
    STATUS  current
    DESCRIPTION
            "A compliance statement for SNMP entities that implement
            the IEEE 802.1 organizationally defined LLDP extension MIB.

            This group is mandatory for agents that implement the
            LLDP 802.1 organizational extension in the RX mode
            for the basicSet TLV set.

            This version defines compliance requirements for
            V2 of the LLDP MIB."
    MODULE  -- this module
        MANDATORY-GROUPS { lldpV2Xdot1LocSysGroup }

    ::= { lldpV2Xdot1Compliances 2 }

lldpV2Xdot1RxCompliance MODULE-COMPLIANCE
    STATUS  deprecated
    DESCRIPTION
            "A compliance statement for SNMP entities that implement
            the IEEE 802.1 organizationally defined LLDP extension MIB.

            This group is mandatory for agents that implement the
            LLDP 802.1 organizational extension in the RX mode
            for the basicSet TLV set.

            This version defines compliance requirements for
            V2 of the LLDP MIB."
    MODULE  -- this module
        MANDATORY-GROUPS { lldpV2Xdot1RemSysGroup }

    ::= { lldpV2Xdot1Compliances 3 }

lldpV2Xdot1RxComplianceV2 MODULE-COMPLIANCE
    STATUS    current
    DESCRIPTION
            "A compliance statement for SNMP entities that implement
            the IEEE 802.1 organizationally defined LLDP extension MIB.

            This group is mandatory for agents that implement the
            LLDP 802.1 organizational extension in the RX mode
            for the basicSet TLV set.

            This version defines compliance requirements for
            V2 of the LLDP MIB."
    MODULE  -- this module
        MANDATORY-GROUPS { lldpV2Xdot1RemSysV2Group }

    ::= { lldpV2Xdot1Compliances 4 }


-- MIB groupings for the basicSet TLV set

lldpV2Xdot1ConfigGroup    OBJECT-GROUP
    OBJECTS {
        lldpV2Xdot1ConfigPortVlanTxEnable,
        lldpV2Xdot1ConfigVlanNameTxEnable,
        lldpV2Xdot1ConfigProtoVlanTxEnable,
        lldpV2Xdot1ConfigProtocolTxEnable,
        lldpV2Xdot1ConfigVidUsageDigestTxEnable,
        lldpV2Xdot1ConfigManVidTxEnable
    }
    STATUS  current
    DESCRIPTION
            "The collection of objects that are used to configure the
            IEEE 802.1 organizationally defined LLDP extension
```

```
            implementation behavior for the basicSet TLV set."
    ::= { lldpV2Xdot1Groups 1 }

lldpV2Xdot1LocSysGroup  OBJECT-GROUP
    OBJECTS {
        lldpV2Xdot1LocPortVlanId,
        lldpV2Xdot1LocProtoVlanSupported,
        lldpV2Xdot1LocProtoVlanEnabled,
        lldpV2Xdot1LocVlanName,
        lldpV2Xdot1LocProtocolId,
        lldpV2Xdot1LocVidUsageDigest,
        lldpV2Xdot1LocManVid,
        lldpV2Xdot1LocLinkAggStatus,
        lldpV2Xdot1LocLinkAggPortId
    }
    STATUS  current
    DESCRIPTION
            "The collection of objects that are used to represent
            IEEE 802.1 organizationally defined LLDP extension
            associated with the Local Device Information for the
            basicSet TLV set."
    ::= { lldpV2Xdot1Groups 2 }

lldpV2Xdot1RemSysGroup  OBJECT-GROUP
    OBJECTS {
        lldpV2Xdot1RemPortVlanId,
        lldpV2Xdot1RemProtoVlanSupported,
        lldpV2Xdot1RemProtoVlanEnabled,
        lldpV2Xdot1RemVlanName,
        lldpV2Xdot1RemProtocolId,
        lldpV2Xdot1RemVidUsageDigest,
        lldpV2Xdot1RemManVid,
        lldpV2Xdot1RemLinkAggStatus,
        lldpV2Xdot1RemLinkAggPortId
    }
    STATUS  deprecated
    DESCRIPTION
            "The collection of objects that are used to represent LLDP
            802.1 organizational extension Remote Device Information
            for the basicSet TLV set."
    ::= { lldpV2Xdot1Groups 3 }

lldpV2Xdot1RemSysV2Group  OBJECT-GROUP
    OBJECTS {
        lldpV2Xdot1RemPortVlanId,
        lldpV2Xdot1RemProtoVlanSupported,
        lldpV2Xdot1RemProtoVlanEnabled,
        lldpV2Xdot1RemVlanName,
        lldpV2Xdot1RemProtocolId,
        lldpV2Xdot1RemVidUsageDigestV2,
        lldpV2Xdot1RemManVidV2,
        lldpV2Xdot1RemLinkAggStatus,
        lldpV2Xdot1RemLinkAggPortId
    }
    STATUS  current
    DESCRIPTION
            "The collection of objects that are used to represent LLDP
            802.1 organizational extension Remote Device Information
            for the basicSet TLV set."
    ::= { lldpV2Xdot1Groups 4 }

-- ----------------------------------------------------------------------
-- ----------------------------------------------------------------------
--
-- Organizationally Defined Information Extension - IEEE 802.1
-- Definitions to support the cnSet TLV set (Table D-1)
-- for Congestion Notification
--
-- ----------------------------------------------------------------------
-- ----------------------------------------------------------------------

lldpXdot1CnMIB OBJECT IDENTIFIER ::= { lldpV2Xdot1MIB 3 }
```

```
lldpXdot1CnObjects OBJECT IDENTIFIER ::= { lldpXdot1CnMIB 1 }

-- CN 802.1 MIB Extension groups

lldpXdot1CnConfig OBJECT IDENTIFIER ::= { lldpXdot1CnObjects 1 }
lldpXdot1CnLocalData OBJECT IDENTIFIER ::= { lldpXdot1CnObjects 2 }
lldpXdot1CnRemoteData OBJECT IDENTIFIER ::= { lldpXdot1CnObjects 3 }

-----------------------------------------------------------------
-- Textual conventions for Congestion Notification
-----------------------------------------------------------------

LldpV2CnBitVector ::= TEXTUAL-CONVENTION
    STATUS      current
    DESCRIPTION
            "This TC describes a bit vector used in the Congestion
            Notification objects. Each bit represents a Boolean status
            associated with a priority code point. A bit value of 0
            represents FALSE, 1 represents TRUE.

            The bit 'pri0status(0)' indicates the status for priority 0
            The bit 'pri1status(1)' indicates the status for priority 1
            The bit 'pri2status(2)' indicates the status for priority 2
            The bit 'pri3status(3)' indicates the status for priority 3
            The bit 'pri4status(4)' indicates the status for priority 4
            The bit 'pri5status(5)' indicates the status for priority 5
            The bit 'pri6status(6)' indicates the status for priority 6
            The bit 'pri7status(7)' indicates the status for priority 7"

    SYNTAX  BITS {
            pri0status(0),
            pri1status(1),
            pri2status(2),
            pri3status(3),
            pri4status(4),
            pri5status(5),
            pri6status(6),
            pri7status(7)
    }

-----------------------------------------------------------------
-- IEEE 802.1 - Congestion Notification Configuration
-----------------------------------------------------------------

--
--  lldpXdot1CnConfigCnTable : configure the
--  transmission of the Congestion Notification TLV on a set of ports
--

lldpXdot1CnConfigCnTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF LldpXdot1CnConfigCnEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "A table that controls selection of Congestion Notification
         TLVs to be transmitted on individual ports."
    ::= { lldpXdot1CnConfig 1 }

lldpXdot1CnConfigCnEntry OBJECT-TYPE
    SYNTAX        LldpXdot1CnConfigCnEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "LLDP configuration information that controls the
        transmission of IEEE 802.1 organizationally defined
        Congestion Notification TLV on LLDP transmission-capable ports.

        This configuration object augments the lldpV2PortConfigEntry of
        the LLDP-MIB, therefore it is only present along with the port
        configuration defined by the associated lldpV2PortConfigEntry
        entry.
```

```
        Each active lldpConfigEntry is restored from non-volatile
        storage (along with the corresponding lldpV2PortConfigEntry)
        after a re-initialization of the management system."
    AUGMENTS      { lldpV2PortConfigEntry }
    ::= { lldpXdot1CnConfigCnTable 1 }

LldpXdot1CnConfigCnEntry ::= SEQUENCE {
    lldpXdot1CnConfigCnTxEnable TruthValue
}

lldpXdot1CnConfigCnTxEnable OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "The lldpXdot1CnConfigCnTxEnable, which is
        defined as a truth value and configured by the network
        management, determines whether the IEEE 802.1 organizationally
        defined Congestion Notification TLV transmission is allowed
        on a given LLDP transmission-capable port.

        The value of this object is restored from non-volatile
        storage after a re-initialization of the management system."
    REFERENCE
        "D.2.7"
    DEFVAL         { false }
    ::= { lldpXdot1CnConfigCnEntry 1 }

-- ------------------------------------------------------------------------
-- IEEE 802.1 - Congestion Notification Local System Information
-- ------------------------------------------------------------------------

---
---
--- lldpV2Xdot1LocCnTable: Port Extension Information Table
---
---
lldpV2Xdot1LocCnTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1LocCnEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one row per port of Congestion
            Notification information (as a part of the LLDP
            802.1 organizational extension) on the local system
            known to this agent."
    ::= { lldpXdot1CnLocalData 1 }

lldpV2Xdot1LocCnEntry OBJECT-TYPE
    SYNTAX      LldpV2Xdot1LocCnEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Congestion Notification information about a
            particular port component."
    INDEX   { lldpV2LocPortIfIndex }
    ::= { lldpV2Xdot1LocCnTable 1 }

LldpV2Xdot1LocCnEntry ::= SEQUENCE {
      lldpV2Xdot1LocCNPVIndicators    LldpV2CnBitVector,
      lldpV2Xdot1LocReadyIndicators   LldpV2CnBitVector
}

lldpV2Xdot1LocCNPVIndicators OBJECT-TYPE
    SYNTAX      LldpV2CnBitVector
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "This object contains the CNPV indicators
            for the Port."
    REFERENCE
            "D.2.7.3"
```

```
    ::= { lldpV2Xdot1LocCnEntry 1 }

lldpV2Xdot1LocReadyIndicators OBJECT-TYPE
    SYNTAX      LldpV2CnBitVector
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "This object contains the Ready indicators
            for the Port."
    REFERENCE
            "D.2.7.4"
    ::= { lldpV2Xdot1LocCnEntry 2 }

-- ------------------------------------------------------------------------
-- IEEE 802.1 - Congestion Notification Remote System Information
-- ------------------------------------------------------------------------

---
---
--- lldpV2Xdot1RemCnTable: Port Extension Information Table
---
---
lldpV2Xdot1RemCnTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1RemCnEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains Congestion Notification information
            (as a part of the LLDP IEEE 802.1 organizational extension)
            of the remote system."
    ::= { lldpXdot1CnRemoteData 1 }

lldpV2Xdot1RemCnEntry OBJECT-TYPE
    SYNTAX      LldpV2Xdot1RemCnEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Port Extension information about remote systems port
            component."
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress,
              lldpV2RemIndex }
    ::= { lldpV2Xdot1RemCnTable 1 }

LldpV2Xdot1RemCnEntry ::= SEQUENCE {
      lldpV2Xdot1RemCNPVIndicators    LldpV2CnBitVector,
      lldpV2Xdot1RemReadyIndicators   LldpV2CnBitVector
}

lldpV2Xdot1RemCNPVIndicators OBJECT-TYPE
    SYNTAX      LldpV2CnBitVector
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "This object contains the CNPV indicators
            for the Port."
    REFERENCE
            "D.2.7.3"
    ::= { lldpV2Xdot1RemCnEntry 1 }

lldpV2Xdot1RemReadyIndicators OBJECT-TYPE
    SYNTAX      LldpV2CnBitVector
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "This object contains the Ready indicators
            for the Port."
    REFERENCE
            "D.2.7.4"
    ::= { lldpV2Xdot1RemCnEntry 2 }
```

```
-- ------------------------------------------------------------------------
-- IEEE 802.1 - Congestion Notification Conformance Information
-- ------------------------------------------------------------------------

lldpXdot1CnConformance OBJECT IDENTIFIER ::= { lldpV2Xdot1MIB 4 }

lldpXdot1CnCompliances
    OBJECT IDENTIFIER ::= { lldpXdot1CnConformance 1 }
lldpXdot1CnGroups OBJECT IDENTIFIER ::= { lldpXdot1CnConformance 2 }

--
-- Congestion Notification - Compliance Statements
--

lldpXdot1CnCompliance MODULE-COMPLIANCE
    STATUS        current
    DESCRIPTION
         "A compliance statement for SNMP entities that implement
         the IEEE 802.1 organizationally defined Congestion
         Notification group in the LLDP extension MIB.

         This group is mandatory for agents that implement the
         Congestion Notification cnSet TLV set."
    MODULE        -- this module
        MANDATORY-GROUPS  { lldpXdot1CnGroup,
                            ifGeneralInformationGroup }
    ::= { lldpXdot1CnCompliances 1 }


--
-- Congestion Notification - MIB groupings
--

lldpXdot1CnGroup  OBJECT-GROUP
    OBJECTS {
        lldpXdot1CnConfigCnTxEnable,
        lldpV2Xdot1LocCNPVIndicators,
        lldpV2Xdot1LocReadyIndicators,
        lldpV2Xdot1RemCNPVIndicators,
        lldpV2Xdot1RemReadyIndicators
    }
    STATUS  current
    DESCRIPTION
        "The collection of objects that support the
        Congestion Notification cnSet TLV set."
    ::= { lldpXdot1CnGroups 1 }

-- ------------------------------------------------------------------------
-- ------------------------------------------------------------------------
--
-- Organizationally Defined Information Extension - IEEE 802.1
-- Definitions to support the Data Center eXchange Protocol
-- (DCBX) TLV set (Table D-1)
--
-- ------------------------------------------------------------------------
-- ------------------------------------------------------------------------
lldpXdot1dcbxMIB OBJECT IDENTIFIER ::= { lldpV2Xdot1MIB 5 }
lldpXdot1dcbxObjects       OBJECT IDENTIFIER ::= { lldpXdot1dcbxMIB 1 }

-- DCBX 802.1 MIB Extension groups

lldpXdot1dcbxConfig     OBJECT IDENTIFIER ::= { lldpXdot1dcbxObjects 1 }
lldpXdot1dcbxLocalData  OBJECT IDENTIFIER ::= { lldpXdot1dcbxObjects 2 }
lldpXdot1dcbxRemoteData OBJECT IDENTIFIER ::= { lldpXdot1dcbxObjects 3 }
lldpXdot1dcbxAdminData  OBJECT IDENTIFIER ::= { lldpXdot1dcbxObjects 4 }

-- ------------------------------------------------------------------
-- IEEE 802.1 - DCBX Textual Conventions
-- ------------------------------------------------------------------

LldpXdot1dcbxTrafficClassValue ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "d"
```

```
    STATUS    current
    DESCRIPTION
        "Indicates a traffic class.  Values 0-7 correspond to
        traffic classes."
    SYNTAX    Unsigned32 (0..7)

LldpXdot1dcbxTrafficClassBandwidthValue ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "d"
    STATUS    current
    DESCRIPTION
        "Indicates the bandwidth in percent assigned to a
        traffic class."
    SYNTAX    Unsigned32 (0..100)

LldpXdot1dcbxAppSelector ::= TEXTUAL-CONVENTION
    STATUS    current
    DESCRIPTION
        "Indicates the contents of a protocol object
        1: EtherType
        2: Well Known Port number over TCP, or SCTP
        3: Well Known Port number over UDP, or DCCP
        4: Well Known Port number over TCP, SCTP, UDP, and DCCP
        5: Differentiated Services Code Point (DSCP) value. The
           6 bit DSCP value is stored in the low order 6 bits of the
           protocol object. The higher order bits are set to zero.
           (See IETF RFC 2474 for the definition of the DSCP value.)"
    SYNTAX INTEGER {
        asEtherType(1),
        asTCPPortNumber(2),
        asUDPPortNumber(3),
        asTCPUDPPortNumber(4),
        asDSCPValue(5)
    }

 LldpXdot1dcbxAppProtocol ::= TEXTUAL-CONVENTION
     DISPLAY-HINT "d"
     STATUS        current
     DESCRIPTION
         "Contains the application protocol indicator the
         type of which is specified by an object with
         the syntax of
         LldpXdot1dcbxAppSelector"
     SYNTAX Unsigned32 (0..65535)

LldpXdot1dcbxSupportedCapacity ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "d"
    STATUS    current
    DESCRIPTION
        "Indicates the supported capacity of a given feature,
        for example, the number of traffic classes supported.
        This TC is used for features that have a maximum
        capacity of eight and a minimum of one."
    SYNTAX Unsigned32 (1..8)

LldpXdot1dcbxTrafficSelectionAlgorithm ::= TEXTUAL-CONVENTION
    STATUS    current
    DESCRIPTION
        "Indicates the Traffic Selection Algorithm
        0: Strict Priority
        1: Credit-based shaper
        2: Enhanced transmission selection
        3-254: Reserved for future standardization
        255: Vendor specific"
    SYNTAX INTEGER {
        tsaStrictPriority(0),
        tsaCreditBasedShaper(1),
        tsaEnhancedTransmission(2),
        tsaVendorSpecific(255)
    }

-----------------------------------------------------------------
-- IEEE 802.1 - DCBX Configuration
```

```
-- ------------------------------------------------------------------

--
--  lldpXdot1dcbxConfigETSConfigurationTable : configure the
--  transmission of the ETS Configuration TLV on a set of ports
--

lldpXdot1dcbxConfigETSConfigurationTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF LldpXdot1dcbxConfigETSConfigurationEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "A table that controls selection of ETS Configuration
         TLVs to be transmitted on individual ports."
    ::= { lldpXdot1dcbxConfig 1 }

lldpXdot1dcbxConfigETSConfigurationEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxConfigETSConfigurationEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "LLDP configuration information that controls the
        transmission of IEEE 802.1 organizationally defined
        ETS Configuration TLV on LLDP transmission-capable ports.

        This configuration object augments the lldpV2PortConfigEntry of
        the LLDP-MIB, therefore it is only present along with the port
        configuration defined by the associated lldpV2PortConfigEntry
        entry.

        Each active lldpConfigEntry is restored from non-volatile
        storage (along with the corresponding lldpV2PortConfigEntry)
        after a re-initialization of the management system."
    AUGMENTS      { lldpV2PortConfigEntry }
    ::= { lldpXdot1dcbxConfigETSConfigurationTable 1 }

LldpXdot1dcbxConfigETSConfigurationEntry ::= SEQUENCE {
    lldpXdot1dcbxConfigETSConfigurationTxEnable TruthValue
}

lldpXdot1dcbxConfigETSConfigurationTxEnable OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "The lldpXdot1dcbxConfigETSConfigurationTxEnable, which is
        defined as a truth value and configured by the network
        management, determines whether the IEEE 802.1 organizationally
        defined ETS Configuration TLV transmission is allowed on a
        given LLDP transmission-capable port.

        The value of this object is restored from non-volatile
        storage after a re-initialization of the management system."
    REFERENCE
        "D.2.8"
    DEFVAL         { false }
    ::= { lldpXdot1dcbxConfigETSConfigurationEntry 1 }

--
--  lldpXdot1dcbxConfigETSRecommendationTable : configure the
--  transmission of the ETS Recommendation TLV on a set of ports
--

lldpXdot1dcbxConfigETSRecommendationTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF LldpXdot1dcbxConfigETSRecommendationEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "A table that controls selection of ETS Recommendation
        TLVs to be transmitted on individual ports."
    ::= { lldpXdot1dcbxConfig 2 }
```

```
lldpXdot1dcbxConfigETSRecommendationEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxConfigETSRecommendationEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "LLDP configuration information that controls the
        transmission of IEEE 802.1 organizationally defined
        ETS Recommendation TLV on LLDP transmission-capable ports.

        This configuration object augments the lldpV2PortConfigEntry of
        the LLDP-MIB, therefore it is only present along with the port
        configuration defined by the associated lldpV2PortConfigEntry
        entry.

        Each active lldpConfigEntry is restored from non-volatile
        storage (along with the corresponding lldpV2PortConfigEntry)
        after a re-initialization of the management system."
    AUGMENTS     { lldpV2PortConfigEntry }
    ::= { lldpXdot1dcbxConfigETSRecommendationTable 1 }

LldpXdot1dcbxConfigETSRecommendationEntry ::= SEQUENCE {
    lldpXdot1dcbxConfigETSRecommendationTxEnable TruthValue
}

lldpXdot1dcbxConfigETSRecommendationTxEnable OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "The lldpXdot1dcbxConfigETSRecommendationTxEnable, which is
        defined as a truth value and configured by the network
        management, determines whether the IEEE 802.1 organizationally
        defined ETS Recommendation TLV transmission is allowed on a
        given LLDP transmission-capable port.

        The value of this object is restored from non-volatile
        storage after a re-initialization of the management system."
    REFERENCE
        "D.2.9"
    DEFVAL         { false }
    ::= { lldpXdot1dcbxConfigETSRecommendationEntry 1 }
--
--  lldpXdot1dcbxConfigPFCTable : configure the transmission of the
--  Priority-based Flow Control Configuration TLV on a set of ports
--

lldpXdot1dcbxConfigPFCTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF LldpXdot1dcbxConfigPFCEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "A table that controls selection of Priority-based
        Flow Control Configuration TLVs to be transmitted on individual ports."
    ::= { lldpXdot1dcbxConfig 3 }

lldpXdot1dcbxConfigPFCEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxConfigPFCEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "LLDP configuration information that controls the
        transmission of IEEE 802.1 organizationally defined
        Priority-based Flow Control Configuration TLV on LLDP
        transmission-capable ports.

        This configuration object augments the lldpV2PortConfigEntry of
        the LLDP-MIB, therefore it is only present along with the port
        configuration defined by the associated lldpV2PortConfigEntry
        entry.

        Each active lldpConfigEntry is restored from non-volatile
        storage (along with the corresponding lldpV2PortConfigEntry)
```

```
        after a re-initialization of the management system."
    AUGMENTS     { lldpV2PortConfigEntry }
    ::= { lldpXdot1dcbxConfigPFCTable 1 }

LldpXdot1dcbxConfigPFCEntry ::= SEQUENCE {
    lldpXdot1dcbxConfigPFCTxEnable TruthValue
}

lldpXdot1dcbxConfigPFCTxEnable OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "The lldpXdot1dcbxConfigPFCTxEnable, which is defined
        as a truth value and configured by the network management,
        determines whether the IEEE 802.1 organizationally defined
        Priority-based Flow Control Configuration TLV transmission is allowed on
        a given LLDP transmission-capable port.

        The value of this object is restored from non-volatile
        storage after a re-initialization of the management system."
    REFERENCE
        "D.2.10"
    DEFVAL         { false }
    ::= { lldpXdot1dcbxConfigPFCEntry 1 }

--
--  lldpXdot1dcbxConfigApplicationPriorityTable : configure the
--  transmission of the Application Priority TLV on a set of ports
--

lldpXdot1dcbxConfigApplicationPriorityTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxConfigApplicationPriorityEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "A table that controls selection of Priority-based
        Flow Control Configuration TLVs to be transmitted on individual ports."
    ::= { lldpXdot1dcbxConfig 4 }

lldpXdot1dcbxConfigApplicationPriorityEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxConfigApplicationPriorityEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "LLDP configuration information that controls the
        transmission of IEEE 802.1 organizationally defined
        Application Priority TLV on LLDP transmission-capable ports.

        This configuration object augments the lldpV2PortConfigEntry of
        the LLDP-MIB, therefore it is only present along with the port
        configuration defined by the associated lldpV2PortConfigEntry
        entry.

        Each active lldpConfigEntry is restored from non-volatile
        storage (along with the corresponding lldpV2PortConfigEntry)
        after a re-initialization of the management system."
    AUGMENTS     { lldpV2PortConfigEntry }
    ::= { lldpXdot1dcbxConfigApplicationPriorityTable 1 }

LldpXdot1dcbxConfigApplicationPriorityEntry ::= SEQUENCE {
    lldpXdot1dcbxConfigApplicationPriorityTxEnable TruthValue
}

lldpXdot1dcbxConfigApplicationPriorityTxEnable OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "The lldpXdot1dcbxConfigApplicationPriorityTxEnable, which
        is defined as a truth value and configured by the network
```

```
        management, determines whether the IEEE 802.1 organizationally
        defined Application Priority TLV transmission is allowed on
        a given LLDP transmission-capable port.

        The value of this object is restored from non-volatile
        storage after a re-initialization of the management system."
    REFERENCE
        "D.2.11"
    DEFVAL         { false }
    ::= { lldpXdot1dcbxConfigApplicationPriorityEntry 1 }

--
--  lldpXdot1dcbxConfigApplicationVlanTable : configure the
--  transmission of the Application VLAN TLV on a set of ports
--

lldpXdot1dcbxConfigApplicationVlanTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxConfigApplicationVlanEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "A table that controls selection of Application VLAN
        TLVs to be transmitted on individual ports."
    ::= { lldpXdot1dcbxConfig 5 }

lldpXdot1dcbxConfigApplicationVlanEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxConfigApplicationVlanEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "LLDP configuration information that controls the
        transmission of IEEE 802.1 organizationally defined
        Application VLAN TLV on LLDP transmission-capable ports.

        This configuration object augments the lldpV2PortConfigEntry of
        the LLDP-MIB, therefore it is only present along with the port
        configuration defined by the associated lldpV2PortConfigEntry
        entry.

        Each active lldpConfigEntry is restored from non-volatile
        storage (along with the corresponding lldpV2PortConfigEntry)
        after a re-initialization of the management system."
    AUGMENTS     { lldpV2PortConfigEntry }
    ::= { lldpXdot1dcbxConfigApplicationVlanTable 1 }

LldpXdot1dcbxConfigApplicationVlanEntry ::= SEQUENCE {
    lldpXdot1dcbxConfigApplicationVlanTxEnable TruthValue
}

lldpXdot1dcbxConfigApplicationVlanTxEnable OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "The lldpXdot1dcbxConfigApplicationVlanTxEnable, which
        is defined as a truth value and configured by the network
        management, determines whether the IEEE 802.1 organizationally
        defined Application VLAN TLV transmission is allowed on
        a given LLDP transmission-capable port.

        The value of this object is restored from non-volatile
        storage after a re-initialization of the management system."
    REFERENCE
        "D.2.14"
    DEFVAL         { false }
    ::= { lldpXdot1dcbxConfigApplicationVlanEntry 1 }

-------------------------------------------------------------------------
-- IEEE 802.1 - DCBX Local System Information
-------------------------------------------------------------------------
```

```
--
-- lldpXdot1dcbxLocETSConfigurationTable - Contains the information
-- for the ETS Configuration TLV.
--
lldpXdot1dcbxLocETSConfiguration OBJECT IDENTIFIER
    ::= { lldpXdot1dcbxLocalData 1 }

lldpXdot1dcbxLocETSBasicConfigurationTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF LldpXdot1dcbxLocETSBasicConfigurationEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table contains one row per port for the IEEE 802.1
        organizationally defined LLDP ETS Configuration TLV on
        the local system known to this~~ agent~~ agent."
    ::= { lldpXdot1dcbxLocETSConfiguration 1 }

lldpXdot1dcbxLocETSBasicConfigurationEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxLocETSBasicConfigurationEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Information about the IEEE 802.1 organizational defined
        ETS Configuration TLV LLDP extension."
    INDEX         { lldpV2LocPortIfIndex }
    ::= { lldpXdot1dcbxLocETSBasicConfigurationTable 1 }

LldpXdot1dcbxLocETSBasicConfigurationEntry ::= SEQUENCE {
    lldpXdot1dcbxLocETSConCreditBasedShaperSupport TruthValue,
    lldpXdot1dcbxLocETSConTrafficClassesSupported
        LldpXdot1dcbxSupportedCapacity,
    lldpXdot1dcbxLocETSConWilling    TruthValue
}

lldpXdot1dcbxLocETSConCreditBasedShaperSupport OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates if the credit-based shaper Traffic Selection
        Algorithm is supported on the local system."
    REFERENCE
        "D.2.8.4"
    ::= { lldpXdot1dcbxLocETSBasicConfigurationEntry 1 }

lldpXdot1dcbxLocETSConTrafficClassesSupported OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxSupportedCapacity
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates the number of traffic classes supported."
    REFERENCE
        "D.2.8.5"
    ::= { lldpXdot1dcbxLocETSBasicConfigurationEntry 2 }

lldpXdot1dcbxLocETSConWilling OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates if the local system is willing to accept the
        ETS configuration recommended by the remote system."
    REFERENCE
        "D.2.8.3"
    ::= { lldpXdot1dcbxLocETSBasicConfigurationEntry 3 }

lldpXdot1dcbxLocETSConPriorityAssignmentTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxLocETSConPriorityAssignmentEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
```

```
        "This table contains one row per priority.  The entry in each
        row indicates the traffic class to which the priority is
        assigned."
    ::= { lldpXdot1dcbxLocETSConfiguration 2 }

lldpXdot1dcbxLocETSConPriorityAssignmentEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxLocETSConPriorityAssignmentEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates a priority to traffic class assignment."
    INDEX        {
                lldpV2LocPortIfIndex,
                lldpXdot1dcbxLocETSConPriority
    }
    ::= { lldpXdot1dcbxLocETSConPriorityAssignmentTable 1 }

LldpXdot1dcbxLocETSConPriorityAssignmentEntry ::= SEQUENCE {
    lldpXdot1dcbxLocETSConPriority      IEEE8021PriorityValue,
    lldpXdot1dcbxLocETSConPriTrafficClass
        LldpXdot1dcbxTrafficClassValue
}

lldpXdot1dcbxLocETSConPriority OBJECT-TYPE
    SYNTAX        IEEE8021PriorityValue
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates the priority that is assigned to a traffic
        class."
    REFERENCE
        "D.2.8.6"
    ::= { lldpXdot1dcbxLocETSConPriorityAssignmentEntry 1 }

lldpXdot1dcbxLocETSConPriTrafficClass OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficClassValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates the traffic class to which this priority is
        to be assigned."
    REFERENCE
        "D.2.8.6"
    ::= { lldpXdot1dcbxLocETSConPriorityAssignmentEntry 2 }

lldpXdot1dcbxLocETSConTrafficClassBandwidthTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxLocETSConTrafficClassBandwidthEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table contains one row per traffic class.  The
        entry in each row indicates the traffic class to
        which the bandwidth is assigned."
    ::= { lldpXdot1dcbxLocETSConfiguration 3 }

lldpXdot1dcbxLocETSConTrafficClassBandwidthEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxLocETSConTrafficClassBandwidthEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates a traffic class to Bandwidth assignment."
    INDEX        {
                lldpV2LocPortIfIndex,
                lldpXdot1dcbxLocETSConTrafficClass
    }
    ::= { lldpXdot1dcbxLocETSConTrafficClassBandwidthTable 1 }

LldpXdot1dcbxLocETSConTrafficClassBandwidthEntry ::= SEQUENCE {
    lldpXdot1dcbxLocETSConTrafficClass
        LldpXdot1dcbxTrafficClassValue,
    lldpXdot1dcbxLocETSConTrafficClassBandwidth
```

```
        LldpXdot1dcbxTrafficClassBandwidthValue
}

lldpXdot1dcbxLocETSConTrafficClass OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficClassValue
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates the traffic class to
        which this bandwidth ~~applies~~ applies."
    REFERENCE
        "D.2.8.7"
    ::= { lldpXdot1dcbxLocETSConTrafficClassBandwidthEntry 1 }

lldpXdot1dcbxLocETSConTrafficClassBandwidth OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficClassBandwidthValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates the bandwidth assigned to this traffic class."
    REFERENCE
        "D.2.8.7"
    ::= { lldpXdot1dcbxLocETSConTrafficClassBandwidthEntry 2 }


lldpXdot1dcbxLocETSConTrafficSelectionAlgorithmTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxLocETSConTrafficSelectionAlgorithmEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table contains one row per traffic class.  The entry
        in each row indicates the traffic selection algorithm to be
        used by the traffic class."
    ::= { lldpXdot1dcbxLocETSConfiguration 4 }

lldpXdot1dcbxLocETSConTrafficSelectionAlgorithmEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxLocETSConTrafficSelectionAlgorithmEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates a traffic class to traffic selection algorithm
         assignment."
    INDEX        {
                 lldpV2LocPortIfIndex,
                 lldpXdot1dcbxLocETSConTSATrafficClass
    }
    ::= { lldpXdot1dcbxLocETSConTrafficSelectionAlgorithmTable 1 }

LldpXdot1dcbxLocETSConTrafficSelectionAlgorithmEntry ::= SEQUENCE {
    lldpXdot1dcbxLocETSConTSATrafficClass
        LldpXdot1dcbxTrafficClassValue,
    lldpXdot1dcbxLocETSConTrafficSelectionAlgorithm
        LldpXdot1dcbxTrafficSelectionAlgorithm
}

lldpXdot1dcbxLocETSConTSATrafficClass OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficClassValue
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates the traffic class that is assigned to a traffic
        selection algorithm."
    REFERENCE
        "D.2.8.8"
    ::= { lldpXdot1dcbxLocETSConTrafficSelectionAlgorithmEntry 1 }

lldpXdot1dcbxLocETSConTrafficSelectionAlgorithm OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficSelectionAlgorithm
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
```

```
        "Indicates the Traffic Selection Algorithm to which this
        traffic class is to be assigned."
    REFERENCE
        "D.2.8.8"
    ::= { lldpXdot1dcbxLocETSConTrafficSelectionAlgorithmEntry 2 }

--
-- lldpXdot1dcbxLocETSRecommendationTable - Contains the information for
-- the ETS Recommendation TLV.
--
lldpXdot1dcbxLocETSReco OBJECT IDENTIFIER ::=
  { lldpXdot1dcbxLocalData 2 }

lldpXdot1dcbxLocETSRecoTrafficClassBandwidthTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxLocETSRecoTrafficClassBandwidthEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table contains one row per traffic class.  The
        entry in each row indicates the traffic class to
        which the bandwidth is assigned."
    ::= { lldpXdot1dcbxLocETSReco 1 }

lldpXdot1dcbxLocETSRecoTrafficClassBandwidthEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxLocETSRecoTrafficClassBandwidthEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates a traffic class to Bandwidth assignment."
    INDEX        {
                 lldpV2LocPortIfIndex,
                 lldpXdot1dcbxLocETSRecoTrafficClass
    }
    ::= { lldpXdot1dcbxLocETSRecoTrafficClassBandwidthTable 1 }

LldpXdot1dcbxLocETSRecoTrafficClassBandwidthEntry ::= SEQUENCE {
    lldpXdot1dcbxLocETSRecoTrafficClass
        LldpXdot1dcbxTrafficClassValue,
    lldpXdot1dcbxLocETSRecoTrafficClassBandwidth
        LldpXdot1dcbxTrafficClassBandwidthValue
}

lldpXdot1dcbxLocETSRecoTrafficClass OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficClassValue
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates the traffic class to
        which this bandwidth~~ applies~~ applies."
    REFERENCE
        "D.2.9.3"
    ::= { lldpXdot1dcbxLocETSRecoTrafficClassBandwidthEntry 1 }

lldpXdot1dcbxLocETSRecoTrafficClassBandwidth OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficClassBandwidthValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates the bandwidth assigned to this traffic class."
    REFERENCE
        "D.2.9.4"
    ::= { lldpXdot1dcbxLocETSRecoTrafficClassBandwidthEntry 2 }

lldpXdot1dcbxLocETSRecoTrafficSelectionAlgorithmTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxLocETSRecoTrafficSelectionAlgorithmEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table contains one row per priority.  The entry in each
        row indicates the traffic selection algorithm to be used
```

```
        by the traffic class."
    ::= { lldpXdot1dcbxLocETSReco 2 }

lldpXdot1dcbxLocETSRecoTrafficSelectionAlgorithmEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxLocETSRecoTrafficSelectionAlgorithmEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates a priority to traffic selection algorithm
         assignment."
    INDEX        {
                lldpV2LocPortIfIndex,
                lldpXdot1dcbxLocETSRecoTSATrafficClass
    }
    ::= { lldpXdot1dcbxLocETSRecoTrafficSelectionAlgorithmTable 1 }

LldpXdot1dcbxLocETSRecoTrafficSelectionAlgorithmEntry ::= SEQUENCE {
    lldpXdot1dcbxLocETSRecoTSATrafficClass
        LldpXdot1dcbxTrafficClassValue,
    lldpXdot1dcbxLocETSRecoTrafficSelectionAlgorithm
        LldpXdot1dcbxTrafficSelectionAlgorithm
}

lldpXdot1dcbxLocETSRecoTSATrafficClass OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficClassValue
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates the traffic class that is assigned to a traffic
        selection algorithm."
    REFERENCE
        "D.2.9.5"
    ::= { lldpXdot1dcbxLocETSRecoTrafficSelectionAlgorithmEntry 1 }

lldpXdot1dcbxLocETSRecoTrafficSelectionAlgorithm OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficSelectionAlgorithm
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates the Traffic Selection Algorithm to which this
        traffic class is to be assigned."
    REFERENCE
        "D.2.9.5"
    ::= { lldpXdot1dcbxLocETSRecoTrafficSelectionAlgorithmEntry 2 }

--
-- lldpXdot1dcbxLocPFCTable - Contains the information for the PFC
-- Configuration TLV.
--
lldpXdot1dcbxLocPFC OBJECT IDENTIFIER ::= { lldpXdot1dcbxLocalData 3 }

lldpXdot1dcbxLocPFCBasicTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF LldpXdot1dcbxLocPFCBasicEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table contains one row per port for the IEEE 802.1
        organizationally defined LLDP PFC TLV on the local
        system known to this agent agent."
    ::= { lldpXdot1dcbxLocPFC 1 }

lldpXdot1dcbxLocPFCBasicEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxLocPFCBasicEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Information about the IEEE 802.1 organizational defined
        PFC TLV LLDP extension."
    INDEX         { lldpV2LocPortIfIndex }
    ::= { lldpXdot1dcbxLocPFCBasicTable 1 }

LldpXdot1dcbxLocPFCBasicEntry ::= SEQUENCE {
```

```
    lldpXdot1dcbxLocPFCWilling    TruthValue,
    lldpXdot1dcbxLocPFCMBC           TruthValue,
    lldpXdot1dcbxLocPFCCap        LldpXdot1dcbxSupportedCapacity
}

lldpXdot1dcbxLocPFCWilling OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates if the local system is willing to accept the
        PFC configuration of the remote system."
    REFERENCE
        "D.2.10.3"
    ::= { lldpXdot1dcbxLocPFCBasicEntry 1}

lldpXdot1dcbxLocPFCMBC OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates if the local system is capable of bypassing
        MACsec processing when MACsec is disabled."
    REFERENCE
        "D.2.10.4"
    ::= { lldpXdot1dcbxLocPFCBasicEntry 2}

lldpXdot1dcbxLocPFCCap OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxSupportedCapacity
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates the number of traffic classes on the local device
        that may simultaneously have PFC enabled."
    REFERENCE
        "D.2.10.5"
    ::= { lldpXdot1dcbxLocPFCBasicEntry 3}

lldpXdot1dcbxLocPFCEnableTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF LldpXdot1dcbxLocPFCEnableEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table contains eight entries, one entry per priority,
        indicating if PFC is enabled on the corresponding priority."
    ::= { lldpXdot1dcbxLocPFC 2 }

lldpXdot1dcbxLocPFCEnableEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxLocPFCEnableEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Each entry indicates if PFC is enabled on the
        ~~correponding~~ corresponding priority"
    INDEX {
        lldpV2LocPortIfIndex,
        lldpXdot1dcbxLocPFCEnablePriority
    }
    ::= { lldpXdot1dcbxLocPFCEnableTable 1 }

LldpXdot1dcbxLocPFCEnableEntry ::= SEQUENCE {
    lldpXdot1dcbxLocPFCEnablePriority   IEEE8021PriorityValue,
    lldpXdot1dcbxLocPFCEnableEnabled    TruthValue
}

lldpXdot1dcbxLocPFCEnablePriority OBJECT-TYPE
    SYNTAX        IEEE8021PriorityValue
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "~~Prioity~~ Priority for which PFC is enabled / disabled"
    ::= { lldpXdot1dcbxLocPFCEnableEntry 1 }
```

```
lldpXdot1dcbxLocPFCEnableEnabled OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates if PFC is enabled on the corresponding ~~priority~~ priority."
    REFERENCE
        "D.2.10.6"
    ::= { lldpXdot1dcbxLocPFCEnableEntry 2 }
--
-- lldpXdot1dcbxLocApplicationPriorityTable - Contains the information
-- for the Application Priority TLV.
--

lldpXdot1dcbxLocApplicationPriorityAppTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxLocApplicationPriorityAppEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Table containing entries indicating the priority to be used
        for a given ~~application~~ application."
    ::= { lldpXdot1dcbxLocalData 4 }

lldpXdot1dcbxLocApplicationPriorityAppEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxLocApplicationPriorityAppEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Entry that indicates the priority to be used for a
        given application."
    INDEX         {
                  lldpV2LocPortIfIndex,
                  lldpXdot1dcbxLocApplicationPriorityAESelector,
                  lldpXdot1dcbxLocApplicationPriorityAEProtocol
    }
    ::= { lldpXdot1dcbxLocApplicationPriorityAppTable 1 }

LldpXdot1dcbxLocApplicationPriorityAppEntry ::= SEQUENCE {
    lldpXdot1dcbxLocApplicationPriorityAESelector
        LldpXdot1dcbxAppSelector,
    lldpXdot1dcbxLocApplicationPriorityAEProtocol
        LldpXdot1dcbxAppProtocol,
    lldpXdot1dcbxLocApplicationPriorityAEPriority
        IEEE8021PriorityValue
}

lldpXdot1dcbxLocApplicationPriorityAESelector OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxAppSelector
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates the contents of the protocol object
        (lldpXdot1dcbxLocApplicationPriorityAEProtocol)
        1: EtherType
        2: Well Known Port number over TCP, or SCTP
        3: Well Known Port number over UDP, or DCCP
        4: Well Known Port number over TCP, SCTP, UDP, and DCCP
        5: Differentiated Services Code Point (DSCP) value. The
           6 bit DSCP value is stored in the low order 6 bits of the
           protocol object. The higher order bits are set to zero.
           (See IETF RFC 2474 for the definition of the DSCP value.)"
    REFERENCE
        "D.2.11.3"
    ::= { lldpXdot1dcbxLocApplicationPriorityAppEntry 1 }

lldpXdot1dcbxLocApplicationPriorityAEProtocol OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxAppProtocol
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
```

```
        "The protocol indicator of the type indicated by
        lldpXdot1dcbxLocApplicationPriorityAESelector."
    REFERENCE
        "D.2.11.3"
    ::= { lldpXdot1dcbxLocApplicationPriorityAppEntry 2 }

lldpXdot1dcbxLocApplicationPriorityAEPriority OBJECT-TYPE
    SYNTAX        IEEE8021PriorityValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The priority code point that should be used in
        frames transporting the protocol indicated by
        lldpXdot1dcbxLocApplicationPriorityAESelector and
        lldpXdot1dcbxLocApplicationPriorityAEProtocol."
    REFERENCE
        "D.2.11.3"
    ::= { lldpXdot1dcbxLocApplicationPriorityAppEntry 3 }

--
-- lldpXdot1dcbxLocApplicationVlanAppTable - Contains the information
-- for the Application VLAN TLV.
--

lldpXdot1dcbxLocApplicationVlanAppTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxLocApplicationVlanAppEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Table containing entries indicating the VLAN to be used
        for a given application."
    ::= { lldpXdot1dcbxLocalData 5 }

lldpXdot1dcbxLocApplicationVlanAppEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxLocApplicationVlanAppEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Entry that indicates the VLAN to be used for a
        given application."
    INDEX         {
                  lldpV2LocPortIfIndex,
                  lldpXdot1dcbxLocApplicationVlanAESelector,
                  lldpXdot1dcbxLocApplicationVlanAEProtocol
    }
    ::= { lldpXdot1dcbxLocApplicationVlanAppTable 1 }

LldpXdot1dcbxLocApplicationVlanAppEntry ::= SEQUENCE {
    lldpXdot1dcbxLocApplicationVlanAESelector
        LldpXdot1dcbxAppSelector,
    lldpXdot1dcbxLocApplicationVlanAEProtocol
        LldpXdot1dcbxAppProtocol,
    lldpXdot1dcbxLocApplicationVlanAEVlanId
        VlanId
}

lldpXdot1dcbxLocApplicationVlanAESelector OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxAppSelector
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates the contents of the protocol object
        (lldpXdot1dcbxLocApplicationVlanAEProtocol)
        1: EtherType
        2: Well Known Port number over TCP, or SCTP
        3: Well Known Port number over UDP, or DCCP
        4: Well Known Port number over TCP, SCTP, UDP, and DCCP
        5: Differentiated Services Code Point (DSCP) value. The
           6 bit DSCP value is stored in the low order 6 bits of the
           protocol object. The higher order bits are set to zero.
           (See IETF RFC 2474 for the definition of the DSCP value.)"
```

```
    REFERENCE
        "D.2.11.3"
    ::= { lldpXdot1dcbxLocApplicationVlanAppEntry 1 }

lldpXdot1dcbxLocApplicationVlanAEProtocol OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxAppProtocol
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "The protocol indicator of the type indicated by
        lldpXdot1dcbxLocApplicationVlanAESelector."
    REFERENCE
        "D.2.11.3"
    ::= { lldpXdot1dcbxLocApplicationVlanAppEntry 2 }

lldpXdot1dcbxLocApplicationVlanAEVlanId OBJECT-TYPE
    SYNTAX        VlanId
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The VLAN Identifier that should be used in
        frames transporting the protocol indicated by
        lldpXdot1dcbxLocApplicationVlanAESelector and
        lldpXdot1dcbxLocApplicationVlanAEProtocol."
    REFERENCE
        "D.2.14.3"
    ::= { lldpXdot1dcbxLocApplicationVlanAppEntry 3 }


--------------------------------------------------------------------------
-- IEEE 802.1 - DCBX Remote System Information
--------------------------------------------------------------------------

--
-- lldpXdot1dcbxRemETSConfigurationTable - Contains the information
-- for the remote system ETS Configuration TLV.
--
lldpXdot1dcbxRemETSConfiguration OBJECT IDENTIFIER
    ::= { lldpXdot1dcbxRemoteData 1 }

lldpXdot1dcbxRemETSBasicConfigurationTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF LldpXdot1dcbxRemETSBasicConfigurationEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table contains one row per port for the IEEE 802.1
        organizationally defined LLDP ETS Configuration TLV on
        the local system known to this agent agent."
    ::= { lldpXdot1dcbxRemETSConfiguration 1 }

lldpXdot1dcbxRemETSBasicConfigurationEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxRemETSBasicConfigurationEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Information about the IEEE 802.1 organizational defined
        ETS Configuration TLV LLDP extension."
    INDEX         {
                  lldpV2RemTimeMark,
                  lldpV2RemLocalIfIndex,
                  lldpV2RemLocalDestMACAddress,
                  lldpV2RemIndex
    }
    ::= { lldpXdot1dcbxRemETSBasicConfigurationTable 1 }

LldpXdot1dcbxRemETSBasicConfigurationEntry ::= SEQUENCE {
    lldpXdot1dcbxRemETSConCreditBasedShaperSupport     TruthValue,
    lldpXdot1dcbxRemETSConTrafficClassesSupported
        LldpXdot1dcbxSupportedCapacity,
    lldpXdot1dcbxRemETSConWilling    TruthValue
}
```

```
lldpXdot1dcbxRemETSConCreditBasedShaperSupport OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates if the credit-based shaper Traffic Selection
        algorithm is supported on the remote system."
    REFERENCE
        "D.2.8.4"
    ::= { lldpXdot1dcbxRemETSBasicConfigurationEntry 1 }

lldpXdot1dcbxRemETSConTrafficClassesSupported OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxSupportedCapacity
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates the number of traffic classes supported."
    REFERENCE
        "D.2.8.5"
    ::= { lldpXdot1dcbxRemETSBasicConfigurationEntry 2 }

lldpXdot1dcbxRemETSConWilling OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates if the remote system is willing to accept the
        ETS configuration recommended by the remote system."
    REFERENCE
        "D.2.8.3"
    ::= { lldpXdot1dcbxRemETSBasicConfigurationEntry 3 }

lldpXdot1dcbxRemETSConPriorityAssignmentTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxRemETSConPriorityAssignmentEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table contains one row per priority.  The entry in
        each row indicates the traffic class to which the
        priority is assigned."
    ::= { lldpXdot1dcbxRemETSConfiguration 2 }

lldpXdot1dcbxRemETSConPriorityAssignmentEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxRemETSConPriorityAssignmentEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates a priority to traffic class assignment."
    INDEX        {
                 lldpV2RemTimeMark,
                 lldpV2RemLocalIfIndex,
                 lldpV2RemLocalDestMACAddress,
                 lldpV2RemIndex,
                 lldpXdot1dcbxRemETSConPriority
    }
    ::= { lldpXdot1dcbxRemETSConPriorityAssignmentTable 1 }

LldpXdot1dcbxRemETSConPriorityAssignmentEntry ::= SEQUENCE {
    lldpXdot1dcbxRemETSConPriority      IEEE8021PriorityValue,
    lldpXdot1dcbxRemETSConPriTrafficClass
        LldpXdot1dcbxTrafficClassValue
}

lldpXdot1dcbxRemETSConPriority OBJECT-TYPE
    SYNTAX        IEEE8021PriorityValue
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates the priority that is assigned to a traffic
        class."
    REFERENCE
```

```
        "D.2.8.6"
    ::= { lldpXdot1dcbxRemETSConPriorityAssignmentEntry 1 }

lldpXdot1dcbxRemETSConPriTrafficClass OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficClassValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates the traffic class to which this priority is
        to be assigned."
    REFERENCE
        "D.2.8.6"
    ::= { lldpXdot1dcbxRemETSConPriorityAssignmentEntry 2 }

lldpXdot1dcbxRemETSConTrafficClassBandwidthTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxRemETSConTrafficClassBandwidthEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table contains one row per traffic class.  The
        entry in each row indicates the traffic class to
        which the bandwidth is assigned."
    ::= { lldpXdot1dcbxRemETSConfiguration 3 }

lldpXdot1dcbxRemETSConTrafficClassBandwidthEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxRemETSConTrafficClassBandwidthEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates a traffic class to Bandwidth assignment."
    INDEX        {
                 lldpV2RemTimeMark,
                 lldpV2RemLocalIfIndex,
                 lldpV2RemLocalDestMACAddress,
                 lldpV2RemIndex,
                 lldpXdot1dcbxRemETSConTrafficClass
    }
    ::= { lldpXdot1dcbxRemETSConTrafficClassBandwidthTable 1 }

LldpXdot1dcbxRemETSConTrafficClassBandwidthEntry ::= SEQUENCE {
    lldpXdot1dcbxRemETSConTrafficClass
        LldpXdot1dcbxTrafficClassValue,
    lldpXdot1dcbxRemETSConTrafficClassBandwidth
        LldpXdot1dcbxTrafficClassBandwidthValue
}

lldpXdot1dcbxRemETSConTrafficClass OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficClassValue
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates the traffic class to
        which this bandwidth~~ applies~~ applies."
    REFERENCE
        "D.2.8.7"
    ::= { lldpXdot1dcbxRemETSConTrafficClassBandwidthEntry 1 }

lldpXdot1dcbxRemETSConTrafficClassBandwidth OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficClassBandwidthValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates the bandwidth assigned to this traffic class."
    REFERENCE
        "D.2.8.7"
    ::= { lldpXdot1dcbxRemETSConTrafficClassBandwidthEntry 2 }


lldpXdot1dcbxRemETSConTrafficSelectionAlgorithmTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxRemETSConTrafficSelectionAlgorithmEntry
```

```
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table contains one row per traffic class.  The
        entry in each row indicates the traffic selection
        algorithm to be used by the traffic class."
    ::= { lldpXdot1dcbxRemETSConfiguration 4 }

lldpXdot1dcbxRemETSConTrafficSelectionAlgorithmEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxRemETSConTrafficSelectionAlgorithmEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates a traffic class to traffic selection
        algorithm assignment."
    INDEX       {
                lldpV2RemTimeMark,
                lldpV2RemLocalIfIndex,
                lldpV2RemLocalDestMACAddress,
                lldpV2RemIndex,
                lldpXdot1dcbxRemETSConTSATrafficClass
    }
    ::= { lldpXdot1dcbxRemETSConTrafficSelectionAlgorithmTable 1 }

LldpXdot1dcbxRemETSConTrafficSelectionAlgorithmEntry ::= SEQUENCE {
    lldpXdot1dcbxRemETSConTSATrafficClass
        LldpXdot1dcbxTrafficClassValue,
    lldpXdot1dcbxRemETSConTrafficSelectionAlgorithm
        LldpXdot1dcbxTrafficSelectionAlgorithm
}

lldpXdot1dcbxRemETSConTSATrafficClass OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficClassValue
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates the traffic class that is assigned to a traffic
        selection algorithm."
    REFERENCE
        "D.2.8.8"
    ::= { lldpXdot1dcbxRemETSConTrafficSelectionAlgorithmEntry 1 }

lldpXdot1dcbxRemETSConTrafficSelectionAlgorithm OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficSelectionAlgorithm
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates the Traffic Selection Algorithm to which this
        traffic class is to be assigned."
    REFERENCE
        "D.2.8.8"
    ::= { lldpXdot1dcbxRemETSConTrafficSelectionAlgorithmEntry 2 }

--
-- lldpXdot1dcbxRemETSRecommendationTable - Contains the information for
-- the remote system ETS Recommendation TLV.
--
lldpXdot1dcbxRemETSReco OBJECT IDENTIFIER ::=
  { lldpXdot1dcbxRemoteData 2 }

lldpXdot1dcbxRemETSRecoTrafficClassBandwidthTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxRemETSRecoTrafficClassBandwidthEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table contains one row per traffic class.  The
        entry in each row indicates the traffic class to
        which the bandwidth is assigned."
    ::= { lldpXdot1dcbxRemETSReco 1 }

lldpXdot1dcbxRemETSRecoTrafficClassBandwidthEntry OBJECT-TYPE
```

```
    SYNTAX        LldpXdot1dcbxRemETSRecoTrafficClassBandwidthEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates a traffic class to Bandwidth assignment."
    INDEX        {
                 lldpV2RemTimeMark,
                 lldpV2RemLocalIfIndex,
                 lldpV2RemLocalDestMACAddress,
                 lldpV2RemIndex,
                 lldpXdot1dcbxRemETSRecoTrafficClass
    }
    ::= { lldpXdot1dcbxRemETSRecoTrafficClassBandwidthTable 1 }

LldpXdot1dcbxRemETSRecoTrafficClassBandwidthEntry ::= SEQUENCE {
    lldpXdot1dcbxRemETSRecoTrafficClass
        LldpXdot1dcbxTrafficClassValue,
    lldpXdot1dcbxRemETSRecoTrafficClassBandwidth
        LldpXdot1dcbxTrafficClassBandwidthValue
}

lldpXdot1dcbxRemETSRecoTrafficClass OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficClassValue
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates the traffic class to
        which this bandwidth ~~applies~~ applies."
    REFERENCE
        "D.2.9.4"
    ::= { lldpXdot1dcbxRemETSRecoTrafficClassBandwidthEntry 1 }

lldpXdot1dcbxRemETSRecoTrafficClassBandwidth OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficClassBandwidthValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates the bandwidth assigned to this traffic class."
    REFERENCE
        "D.2.9.4"
    ::= { lldpXdot1dcbxRemETSRecoTrafficClassBandwidthEntry 2 }

lldpXdot1dcbxRemETSRecoTrafficSelectionAlgorithmTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxRemETSRecoTrafficSelectionAlgorithmEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table contains one row per traffic class.  The
        entry in each row indicates the traffic selection
        algorithm to be used by the priority."
    ::= { lldpXdot1dcbxRemETSReco 2 }

lldpXdot1dcbxRemETSRecoTrafficSelectionAlgorithmEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxRemETSRecoTrafficSelectionAlgorithmEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates a priority to traffic selection algorithm
         assignment."
    INDEX        {
                  lldpV2RemTimeMark,
                  lldpV2RemLocalIfIndex,
                  lldpV2RemLocalDestMACAddress,
                  lldpV2RemIndex,
                  lldpXdot1dcbxRemETSRecoTSATrafficClass
    }
    ::= { lldpXdot1dcbxRemETSRecoTrafficSelectionAlgorithmTable 1 }

LldpXdot1dcbxRemETSRecoTrafficSelectionAlgorithmEntry ::= SEQUENCE {
    lldpXdot1dcbxRemETSRecoTSATrafficClass
        LldpXdot1dcbxTrafficClassValue,
```

```
    lldpXdot1dcbxRemETSRecoTrafficSelectionAlgorithm
        LldpXdot1dcbxTrafficSelectionAlgorithm
}

lldpXdot1dcbxRemETSRecoTSATrafficClass OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficClassValue
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates the traffic class that is assigned to a traffic
        selection algorithm."
    REFERENCE
        "D.2.9.5"
    ::= { lldpXdot1dcbxRemETSRecoTrafficSelectionAlgorithmEntry 1 }

lldpXdot1dcbxRemETSRecoTrafficSelectionAlgorithm OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficSelectionAlgorithm
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates the Traffic Selection Algorithm to which this
        traffic class is to be assigned."
    REFERENCE
        "D.2.9.5"
    ::= { lldpXdot1dcbxRemETSRecoTrafficSelectionAlgorithmEntry 2 }

--
-- lldpXdot1dcbxRemPFCTable - Contains the information for the remote
-- system PFC TLV.
--
lldpXdot1dcbxRemPFC OBJECT IDENTIFIER ::= { lldpXdot1dcbxRemoteData 3 }

lldpXdot1dcbxRemPFCBasicTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF LldpXdot1dcbxRemPFCBasicEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table contains one row per port for the IEEE 802.1
        organizationally defined LLDP PFC TLV on the local
        system known to this~~ agent~~ agent."
    ::= { lldpXdot1dcbxRemPFC 1 }

lldpXdot1dcbxRemPFCBasicEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxRemPFCBasicEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Information about the IEEE 802.1 organizational defined
        PFC TLV LLDP extension."
    INDEX         {
                  lldpV2RemTimeMark,
                  lldpV2RemLocalIfIndex,
                  lldpV2RemLocalDestMACAddress,
                  lldpV2RemIndex
    }
    ::= { lldpXdot1dcbxRemPFCBasicTable 1 }

LldpXdot1dcbxRemPFCBasicEntry ::= SEQUENCE {
    lldpXdot1dcbxRemPFCWilling    TruthValue,
    lldpXdot1dcbxRemPFCMBC        TruthValue,
    lldpXdot1dcbxRemPFCCap        LldpXdot1dcbxSupportedCapacity
}

lldpXdot1dcbxRemPFCWilling OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates if the remote system is willing to accept the
        PFC configuration of the local system."
    REFERENCE
        "D.2.10.3"
```

```
    ::= { lldpXdot1dcbxRemPFCBasicEntry 1}

lldpXdot1dcbxRemPFCMBC OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates if the remote system is capable of bypassing
        MACsec processing when MACsec is disabled."
    REFERENCE
        "D.2.10.4"
    ::= { lldpXdot1dcbxRemPFCBasicEntry 2}

lldpXdot1dcbxRemPFCCap OBJECT-TYPE
    SYNTAX         LldpXdot1dcbxSupportedCapacity
    MAX-ACCESS     read-only
    STATUS         current
    DESCRIPTION
        "Indicates the number of traffic classes on the remote device
        that may simultaneously have PFC enabled."
    REFERENCE
        "D.2.10.5"
    ::= { lldpXdot1dcbxRemPFCBasicEntry 3}

lldpXdot1dcbxRemPFCEnableTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF LldpXdot1dcbxRemPFCEnableEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table contains eight entries, one entry per priority,
        indicating if PFC is enabled on the corresponding priority."
    ::= { lldpXdot1dcbxRemPFC 2 }

lldpXdot1dcbxRemPFCEnableEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxRemPFCEnableEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Each entry indicates if PFC is enabled on the
        corresponding priority priority."
    INDEX         {
                  lldpV2RemTimeMark,
                  lldpV2RemLocalIfIndex,
                  lldpV2RemLocalDestMACAddress,
                  lldpV2RemIndex,
                  lldpXdot1dcbxRemPFCEnablePriority
    }
    ::= { lldpXdot1dcbxRemPFCEnableTable 1 }

LldpXdot1dcbxRemPFCEnableEntry ::= SEQUENCE {
    lldpXdot1dcbxRemPFCEnablePriority   IEEE8021PriorityValue,
    lldpXdot1dcbxRemPFCEnableEnabled    TruthValue
}

lldpXdot1dcbxRemPFCEnablePriority OBJECT-TYPE
    SYNTAX        IEEE8021PriorityValue
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Prioity Priority for which PFC is enabled / disabled"
    ::= { lldpXdot1dcbxRemPFCEnableEntry 1 }

lldpXdot1dcbxRemPFCEnableEnabled OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates if PFC is enabled on the corresponding priority priority."
    REFERENCE
        "D.2.10.6"
    ::= { lldpXdot1dcbxRemPFCEnableEntry 2 }
```

```
--
-- lldpXdot1dcbxRemApplicationPriorityTable - Contains the information
-- for the remote system Application Priority TLV.
--

lldpXdot1dcbxRemApplicationPriorityAppTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxRemApplicationPriorityAppEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Table containing entries indicating the priority to be used
        for a given ~~application~~ application."
    ::= { lldpXdot1dcbxRemoteData 4 }

lldpXdot1dcbxRemApplicationPriorityAppEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxRemApplicationPriorityAppEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Entry that indicates the priority to be used for a
        given application."
    INDEX         {
                  lldpV2RemTimeMark,
                  lldpV2RemLocalIfIndex,
                  lldpV2RemLocalDestMACAddress,
                  lldpV2RemIndex,
                  lldpXdot1dcbxRemApplicationPriorityAESelector,
                  lldpXdot1dcbxRemApplicationPriorityAEProtocol
    }
    ::= { lldpXdot1dcbxRemApplicationPriorityAppTable 1 }

LldpXdot1dcbxRemApplicationPriorityAppEntry ::= SEQUENCE {
    lldpXdot1dcbxRemApplicationPriorityAESelector
        LldpXdot1dcbxAppSelector,
    lldpXdot1dcbxRemApplicationPriorityAEProtocol
        LldpXdot1dcbxAppProtocol,
    lldpXdot1dcbxRemApplicationPriorityAEPriority
        IEEE8021PriorityValue
}

lldpXdot1dcbxRemApplicationPriorityAESelector OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxAppSelector
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates the contents of the protocol object
        (lldpXdot1dcbxRemApplicationPriorityAEProtocol)
        1: EtherType
        2: Well Known Port number over TCP, or SCTP
        3: Well Known Port number over UDP, or DCCP
        4: Well Known Port number over TCP, SCTP, UDP, and DCCP
        5: Differentiated Services Code Point (DSCP) value. The
           6 bit DSCP value is stored in the low order 6 bits of the
           protocol object. The higher order bits are set to zero.
           (See IETF RFC 2474 for the definition of the DSCP value.)"
    REFERENCE
        "D.2.11.3"
    ::= { lldpXdot1dcbxRemApplicationPriorityAppEntry 1 }

lldpXdot1dcbxRemApplicationPriorityAEProtocol OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxAppProtocol
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "The protocol indicator of the type indicated by
        lldpXdot1dcbxRemApplicationPriorityAESelector."
    REFERENCE
        "D.2.11.3"
    ::= { lldpXdot1dcbxRemApplicationPriorityAppEntry 2 }

lldpXdot1dcbxRemApplicationPriorityAEPriority OBJECT-TYPE
```

```
    SYNTAX        IEEE8021PriorityValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The priority code point that should be used in
        frames transporting the protocol indicated by
        lldpXdot1dcbxRemApplicationPriorityAESelector and
        lldpXdot1dcbxRemApplicationPriorityAEProtocol."
    REFERENCE
        "D.2.11.3"
    ::= { lldpXdot1dcbxRemApplicationPriorityAppEntry 3 }

--
-- lldpXdot1dcbxRemApplicationVlanAppTable - Contains the information
-- for the remote system Application VLAN TLV.
--

lldpXdot1dcbxRemApplicationVlanAppTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxRemApplicationVlanAppEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Table containing entries indicating the VLAN to be used
        for a given application."
    ::= { lldpXdot1dcbxRemoteData 5 }

lldpXdot1dcbxRemApplicationVlanAppEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxRemApplicationVlanAppEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Entry that indicates the VLAN to be used for a
        given application."
    INDEX         {
                  lldpV2RemTimeMark,
                  lldpV2RemLocalIfIndex,
                  lldpV2RemLocalDestMACAddress,
                  lldpV2RemIndex,
                  lldpXdot1dcbxRemApplicationVlanAESelector,
                  lldpXdot1dcbxRemApplicationVlanAEProtocol
    }
    ::= { lldpXdot1dcbxRemApplicationVlanAppTable 1 }

LldpXdot1dcbxRemApplicationVlanAppEntry ::= SEQUENCE {
    lldpXdot1dcbxRemApplicationVlanAESelector
        LldpXdot1dcbxAppSelector,
    lldpXdot1dcbxRemApplicationVlanAEProtocol
        LldpXdot1dcbxAppProtocol,
    lldpXdot1dcbxRemApplicationVlanAEVlanId
        VlanId
}

lldpXdot1dcbxRemApplicationVlanAESelector OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxAppSelector
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates the contents of the protocol object
        (lldpXdot1dcbxRemApplicationVlanAEProtocol)
        1: EtherType
        2: Well Known Port number over TCP, or SCTP
        3: Well Known Port number over UDP, or DCCP
        4: Well Known Port number over TCP, SCTP, UDP, and DCCP
        5: Differentiated Services Code Point (DSCP) value. The
           6 bit DSCP value is stored in the low order 6 bits of the
           protocol object. The higher order bits are set to zero.
           (See IETF RFC 2474 for the definition of the DSCP value.)"
    REFERENCE
        "D.2.11.3"
    ::= { lldpXdot1dcbxRemApplicationVlanAppEntry 1 }
```

```
lldpXdot1dcbxRemApplicationVlanAEProtocol OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxAppProtocol
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "The protocol indicator of the type indicated by
        lldpXdot1dcbxRemApplicationVlanAESelector."
    REFERENCE
        "D.2.11.3"
    ::= { lldpXdot1dcbxRemApplicationVlanAppEntry 2 }

lldpXdot1dcbxRemApplicationVlanAEVlanId OBJECT-TYPE
    SYNTAX        VlanId
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The VLAN Identifier that should be used in
        frames transporting the protocol indicated by
        lldpXdot1dcbxRemApplicationVlanAESelector and
        lldpXdot1dcbxRemApplicationVlanAEProtocol."
    REFERENCE
        "D.2.14.3"
    ::= { lldpXdot1dcbxRemApplicationVlanAppEntry 3 }


--------------------------------------------------------------------------
-- IEEE 802.1 - DCBX Administrative Information
--------------------------------------------------------------------------

--
-- lldpXdot1dcbxAdminETSConfigurationTable - Contains the information
-- for the ETS Configuration TLV.
--
lldpXdot1dcbxAdminETSConfiguration OBJECT IDENTIFIER
    ::= { lldpXdot1dcbxAdminData 1 }

lldpXdot1dcbxAdminETSBasicConfigurationTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxAdminETSBasicConfigurationEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table contains one row per port for the IEEE 802.1
        organizationally defined LLDP ETS Configuration TLV
        on the local system known to this agent agent."
    ::= { lldpXdot1dcbxAdminETSConfiguration 1 }

lldpXdot1dcbxAdminETSBasicConfigurationEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxAdminETSBasicConfigurationEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Information about the IEEE 802.1 organizational defined
        ETS Configuration TLV LLDP extension."
    INDEX         { lldpV2LocPortIfIndex }
    ::= { lldpXdot1dcbxAdminETSBasicConfigurationTable 1 }

LldpXdot1dcbxAdminETSBasicConfigurationEntry ::= SEQUENCE {
    lldpXdot1dcbxAdminETSConCreditBasedShaperSupport      TruthValue,
    lldpXdot1dcbxAdminETSConTrafficClassesSupported
        LldpXdot1dcbxSupportedCapacity,
    lldpXdot1dcbxAdminETSConWilling    TruthValue
}

lldpXdot1dcbxAdminETSConCreditBasedShaperSupport OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates support for the credit-based shaper Traffic
        Selection Algorithm."
    REFERENCE
```

```
        "D.2.8.4"
    ::= { lldpXdot1dcbxAdminETSBasicConfigurationEntry 1 }

lldpXdot1dcbxAdminETSConTrafficClassesSupported OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxSupportedCapacity
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates the number of traffic classes supported."
    REFERENCE
        "D.2.8.5"
    ::= { lldpXdot1dcbxAdminETSBasicConfigurationEntry 2 }

lldpXdot1dcbxAdminETSConWilling OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "Indicates if the local system is willing to accept the
        ETS configuration recommended by the remote system."
    REFERENCE
        "D.2.8.3"
    DEFVAL         { false }
    ::= { lldpXdot1dcbxAdminETSBasicConfigurationEntry 3 }

lldpXdot1dcbxAdminETSConPriorityAssignmentTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxAdminETSConPriorityAssignmentEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table contains one row per priority.  The entry in each
        row indicates the traffic class to which the priority is
        assigned."
    ::= { lldpXdot1dcbxAdminETSConfiguration 2 }

lldpXdot1dcbxAdminETSConPriorityAssignmentEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxAdminETSConPriorityAssignmentEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates a priority to traffic class assignment."
    INDEX        {
                lldpV2LocPortIfIndex,
                lldpXdot1dcbxAdminETSConPriority
    }
    ::= { lldpXdot1dcbxAdminETSConPriorityAssignmentTable 1 }

LldpXdot1dcbxAdminETSConPriorityAssignmentEntry ::= SEQUENCE {
    lldpXdot1dcbxAdminETSConPriority        IEEE8021PriorityValue,
    lldpXdot1dcbxAdminETSConPriTrafficClass
        LldpXdot1dcbxTrafficClassValue
}

lldpXdot1dcbxAdminETSConPriority OBJECT-TYPE
    SYNTAX        IEEE8021PriorityValue
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates the priority that is assigned to a traffic
        class."
    REFERENCE
        "D.2.8.6"
    ::= { lldpXdot1dcbxAdminETSConPriorityAssignmentEntry 1 }

lldpXdot1dcbxAdminETSConPriTrafficClass OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficClassValue
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "Indicates the traffic class to which this priority is
        to be assigned."
```

```
    REFERENCE
        "D.2.8.6"
    DEFVAL      { 0 }
    ::= { lldpXdot1dcbxAdminETSConPriorityAssignmentEntry 2 }

lldpXdot1dcbxAdminETSConTrafficClassBandwidthTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxAdminETSConTrafficClassBandwidthEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table contains one row per traffic class.  The
        entry in each row indicates the traffic class to
        which the bandwidth is assigned."
    ::= { lldpXdot1dcbxAdminETSConfiguration 3 }

lldpXdot1dcbxAdminETSConTrafficClassBandwidthEntry OBJECT-TYPE
    SYNTAX      LldpXdot1dcbxAdminETSConTrafficClassBandwidthEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates a traffic class to Bandwidth assignment."
    INDEX        {
                lldpV2LocPortIfIndex,
                lldpXdot1dcbxAdminETSConTrafficClass
    }
    ::= { lldpXdot1dcbxAdminETSConTrafficClassBandwidthTable 1 }

LldpXdot1dcbxAdminETSConTrafficClassBandwidthEntry ::= SEQUENCE {
    lldpXdot1dcbxAdminETSConTrafficClass
        LldpXdot1dcbxTrafficClassValue,
    lldpXdot1dcbxAdminETSConTrafficClassBandwidth
        LldpXdot1dcbxTrafficClassBandwidthValue
}

lldpXdot1dcbxAdminETSConTrafficClass OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficClassValue
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates the traffic class to
        which this bandwidth~~ applies~~ applies."
    REFERENCE
        "D.2.8.7"
    ::= { lldpXdot1dcbxAdminETSConTrafficClassBandwidthEntry 1 }

lldpXdot1dcbxAdminETSConTrafficClassBandwidth OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficClassBandwidthValue
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "Indicates the bandwidth assigned to this traffic class.
        The sum of the bandwidths assigned to a given port is
        required at all times to equal 100.  An operation that
        attempts to change this table such that the bandwidth
        entires do not total 100 shall be rejected. An implication
        of this is that modification of this table requires that
        multiple set operations be included in a single SNMP PDU,
        commonly referred to as an MSET operation, to perform
        simultaneous set operations to keep the sum at 100.  Any
        attempt to change a single entry in this table will result
        in the operation being rejected since entries in the
        table referring to the given port will no longer
        sum to 100."
    REFERENCE
        "D.2.8.7"
    ::= { lldpXdot1dcbxAdminETSConTrafficClassBandwidthEntry 2 }

lldpXdot1dcbxAdminETSConTrafficSelectionAlgorithmTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxAdminETSConTrafficSelectionAlgorithmEntry
    MAX-ACCESS    not-accessible
```

```
    STATUS        current
    DESCRIPTION
        "This table contains one row per traffic class.  The entry
        in each row indicates the traffic selection algorithm to
        be used by the priority."
    ::= { lldpXdot1dcbxAdminETSConfiguration 4 }

lldpXdot1dcbxAdminETSConTrafficSelectionAlgorithmEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxAdminETSConTrafficSelectionAlgorithmEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates a traffic class to traffic selection
        algorithm assignment."
    INDEX       {
                lldpV2LocPortIfIndex,
                lldpXdot1dcbxAdminETSConTSATrafficClass
    }
    ::= { lldpXdot1dcbxAdminETSConTrafficSelectionAlgorithmTable 1 }

LldpXdot1dcbxAdminETSConTrafficSelectionAlgorithmEntry ::= SEQUENCE {
    lldpXdot1dcbxAdminETSConTSATrafficClass
        LldpXdot1dcbxTrafficClassValue,
    lldpXdot1dcbxAdminETSConTrafficSelectionAlgorithm
        LldpXdot1dcbxTrafficSelectionAlgorithm
}

lldpXdot1dcbxAdminETSConTSATrafficClass OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficClassValue
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates the traffic class that is assigned
        to a traffic selection algorithm."
    REFERENCE
        "D.2.8.8"
    ::= { lldpXdot1dcbxAdminETSConTrafficSelectionAlgorithmEntry 1 }

lldpXdot1dcbxAdminETSConTrafficSelectionAlgorithm OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficSelectionAlgorithm
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "Indicates the Traffic Selection Algorithm to which this
        traffic class is to be assigned."
    REFERENCE
        "D.2.8.8"
    ::= { lldpXdot1dcbxAdminETSConTrafficSelectionAlgorithmEntry 2 }


--
-- lldpXdot1dcbxAdminETSRecommendationTable - Contains the information
-- for the ETS Recommendation TLV.
--
lldpXdot1dcbxAdminETSReco OBJECT IDENTIFIER ::=
  { lldpXdot1dcbxAdminData 2 }

lldpXdot1dcbxAdminETSRecoTrafficClassBandwidthTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxAdminETSRecoTrafficClassBandwidthEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table contains one row per traffic class.  The
        entry in each row indicates the traffic class to
        which the bandwidth is assigned."
    ::= { lldpXdot1dcbxAdminETSReco 1 }

lldpXdot1dcbxAdminETSRecoTrafficClassBandwidthEntry OBJECT-TYPE
    SYNTAX      LldpXdot1dcbxAdminETSRecoTrafficClassBandwidthEntry
    MAX-ACCESS    not-accessible
    STATUS        current
```

```
    DESCRIPTION
        "Indicates a traffic class to Bandwidth assignment."
    INDEX        {
                lldpV2LocPortIfIndex,
                lldpXdot1dcbxAdminETSRecoTrafficClass
    }
    ::= { lldpXdot1dcbxAdminETSRecoTrafficClassBandwidthTable 1 }

LldpXdot1dcbxAdminETSRecoTrafficClassBandwidthEntry ::= SEQUENCE {
    lldpXdot1dcbxAdminETSRecoTrafficClass
        LldpXdot1dcbxTrafficClassValue,
    lldpXdot1dcbxAdminETSRecoTrafficClassBandwidth
        LldpXdot1dcbxTrafficClassBandwidthValue
}

lldpXdot1dcbxAdminETSRecoTrafficClass OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficClassValue
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates the traffic class to
        which this bandwidth~~ applies~~ applies."
    REFERENCE
        "D.2.9.4"
    ::= { lldpXdot1dcbxAdminETSRecoTrafficClassBandwidthEntry 1 }

lldpXdot1dcbxAdminETSRecoTrafficClassBandwidth OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficClassBandwidthValue
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "Indicates the bandwidth assigned to this traffic class.
        The sum of the bandwidths assigned to a given port is
        required at all times to equal 100.  An operation that
        attempts to change this table such that the bandwidth
        entires do not total 100 shall be rejected. An implication
        of this is that modification of this table requires that
        multiple set operations be included in a single SNMP PDU,
        commonly referred to as an MSET operation, to perform
        simultaneous set operations to keep the sum at 100.  Any
        attempt to change a single entry in this table will result
        in the operation being rejected since entries in the
        table referring to the given port will no longer
        sum to 100."

    REFERENCE
        "D.2.9.4"
    ::= { lldpXdot1dcbxAdminETSRecoTrafficClassBandwidthEntry 2 }

lldpXdot1dcbxAdminETSRecoTrafficSelectionAlgorithmTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxAdminETSRecoTrafficSelectionAlgorithmEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table contains one row per traffic class.  The entry
        in each row indicates the traffic selection algorithm to
        be used by the traffic class."
    ::= { lldpXdot1dcbxAdminETSReco 2 }

lldpXdot1dcbxAdminETSRecoTrafficSelectionAlgorithmEntry OBJECT-TYPE
    SYNTAX    LldpXdot1dcbxAdminETSRecoTrafficSelectionAlgorithmEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates a traffic class to traffic selection
        algorithm assignment."
    INDEX        {
                lldpV2LocPortIfIndex,
                lldpXdot1dcbxAdminETSRecoTSATrafficClass
    }
    ::= { lldpXdot1dcbxAdminETSRecoTrafficSelectionAlgorithmTable 1 }
```

```
LldpXdot1dcbxAdminETSRecoTrafficSelectionAlgorithmEntry ::= SEQUENCE {
    lldpXdot1dcbxAdminETSRecoTSATrafficClass
        LldpXdot1dcbxTrafficClassValue,
    lldpXdot1dcbxAdminETSRecoTrafficSelectionAlgorithm
        LldpXdot1dcbxTrafficSelectionAlgorithm
}

lldpXdot1dcbxAdminETSRecoTSATrafficClass OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficClassValue
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates the traffic class that is assigned to a traffic
        selection algorithm."
    REFERENCE
        "D.2.9.5"
    ::= { lldpXdot1dcbxAdminETSRecoTrafficSelectionAlgorithmEntry 1 }

lldpXdot1dcbxAdminETSRecoTrafficSelectionAlgorithm OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxTrafficSelectionAlgorithm
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "Indicates the Traffic Selection Algorithm to which this
        traffic class is to be assigned."
    REFERENCE
        "D.2.9.5"
    ::= { lldpXdot1dcbxAdminETSRecoTrafficSelectionAlgorithmEntry 2 }

--
-- lldpXdot1dcbxAdminPFCTable - Contains the information for the PFC
-- Configuration TLV.
--
lldpXdot1dcbxAdminPFC OBJECT IDENTIFIER ::= { lldpXdot1dcbxAdminData 3 }

lldpXdot1dcbxAdminPFCBasicTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF LldpXdot1dcbxAdminPFCBasicEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table contains one row per port for the IEEE 802.1
        organizationally defined LLDP PFC TLV on the local
        system known to this~~ agent~~ agent."
    ::= { lldpXdot1dcbxAdminPFC 1 }

lldpXdot1dcbxAdminPFCBasicEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxAdminPFCBasicEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Information about the IEEE 802.1 organizational defined
        PFC TLV LLDP extension."
    INDEX         { lldpV2LocPortIfIndex }
    ::= { lldpXdot1dcbxAdminPFCBasicTable 1 }

LldpXdot1dcbxAdminPFCBasicEntry ::= SEQUENCE {
    lldpXdot1dcbxAdminPFCWilling    TruthValue,
    lldpXdot1dcbxAdminPFCMBC        TruthValue,
    lldpXdot1dcbxAdminPFCCap        LldpXdot1dcbxSupportedCapacity
}

lldpXdot1dcbxAdminPFCWilling OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "Indicates if the local system is willing to accept the
        PFC configuration of the remote system."
    REFERENCE
        "D.2.10.3"
    DEFVAL      { false }
```

```
    ::= { lldpXdot1dcbxAdminPFCBasicEntry 1}

lldpXdot1dcbxAdminPFCMBC OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates if the local system is capable of bypassing
        MACsec processing when MACsec is disabled."
    REFERENCE
        "D.2.10.4"
    ::= { lldpXdot1dcbxAdminPFCBasicEntry 2}

lldpXdot1dcbxAdminPFCCap OBJECT-TYPE
    SYNTAX         LldpXdot1dcbxSupportedCapacity
    MAX-ACCESS    read-only
    STATUS    current
    DESCRIPTION
        "Indicates the number of traffic classes on the local device
        that may simultaneously have PFC enabled.

        Note that this typically indicates a physical limitation of the
        device.  However, some devices may allow this parameter to be
        administratively configured, in which case the MAX-ACCESS
        should be changed to read-write with and an appropriate
        DEFVAL added."
    REFERENCE
        "D.2.10.5"
    ::= { lldpXdot1dcbxAdminPFCBasicEntry 3}

lldpXdot1dcbxAdminPFCEnableTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF LldpXdot1dcbxAdminPFCEnableEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table contains eight entries, one entry per priority,
        indicating if PFC is enabled on the corresponding priority."
    ::= { lldpXdot1dcbxAdminPFC 2 }

lldpXdot1dcbxAdminPFCEnableEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxAdminPFCEnableEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Each entry indicates if PFC is enabled on the
        corresponding ~~priority~~ priority."
    INDEX {
        lldpV2LocPortIfIndex,
        lldpXdot1dcbxAdminPFCEnablePriority
    }
    ::= { lldpXdot1dcbxAdminPFCEnableTable 1 }

LldpXdot1dcbxAdminPFCEnableEntry ::= SEQUENCE {
    lldpXdot1dcbxAdminPFCEnablePriority    IEEE8021PriorityValue,
    lldpXdot1dcbxAdminPFCEnableEnabled    TruthValue
    }

lldpXdot1dcbxAdminPFCEnablePriority OBJECT-TYPE
    SYNTAX        IEEE8021PriorityValue
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "~~Prioity~~ Priority for which PFC is enabled / disabled"
    ::= { lldpXdot1dcbxAdminPFCEnableEntry 1 }

lldpXdot1dcbxAdminPFCEnableEnabled OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "Indicates if PFC is enabled on the corresponding ~~priority~~ priority."
    REFERENCE
```

```
        "D.2.10.6"
    DEFVAL      { false }
    ::= { lldpXdot1dcbxAdminPFCEnableEntry 2 }

--
-- lldpXdot1dcbxAdminApplicationPriorityTable - Contains the
-- information for the Application Priority TLV.
--

lldpXdot1dcbxAdminApplicationPriorityAppTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxAdminApplicationPriorityAppEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Table containing entries indicating the ~~priorty~~ priority to be used
        for a given ~~application~~ application."
    ::= { lldpXdot1dcbxAdminData 4 }

lldpXdot1dcbxAdminApplicationPriorityAppEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxAdminApplicationPriorityAppEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Entry that indicates the priority to be used for a
        given application."
    INDEX         {
                  lldpV2LocPortIfIndex,
                  lldpXdot1dcbxAdminApplicationPriorityAESelector,
                  lldpXdot1dcbxAdminApplicationPriorityAEProtocol
    }
    ::= { lldpXdot1dcbxAdminApplicationPriorityAppTable 1 }

LldpXdot1dcbxAdminApplicationPriorityAppEntry ::= SEQUENCE {
    lldpXdot1dcbxAdminApplicationPriorityAESelector
        LldpXdot1dcbxAppSelector,
    lldpXdot1dcbxAdminApplicationPriorityAEProtocol
        LldpXdot1dcbxAppProtocol,
    lldpXdot1dcbxAdminApplicationPriorityAEPriority
        IEEE8021PriorityValue
}

lldpXdot1dcbxAdminApplicationPriorityAESelector OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxAppSelector
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates the contents of the protocol object
        (lldpXdot1dcbxAdminApplicationPriorityAEProtocol)
        1: EtherType
        2: Well Known Port number over TCP, or SCTP
        3: Well Known Port number over UDP, or DCCP
        4: Well Known Port number over TCP, SCTP, UDP, and DCCP
        5: Differentiated Services Code Point (DSCP) value. The
           6 bit DSCP value is stored in the low order 6 bits of the
           protocol object. The higher order bits are set to zero.
           (See IETF RFC 2474 for the definition of the DSCP value.)"
    REFERENCE
        "D.2.10.6"
    ::= { lldpXdot1dcbxAdminApplicationPriorityAppEntry 1 }

lldpXdot1dcbxAdminApplicationPriorityAEProtocol OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxAppProtocol
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "The protocol indicator of the type indicated by
        lldpXdot1dcbxAdminApplicationPriorityAESelector."
    REFERENCE
        "D.2.10.6"
    ::= { lldpXdot1dcbxAdminApplicationPriorityAppEntry 2 }
```

```
lldpXdot1dcbxAdminApplicationPriorityAEPriority OBJECT-TYPE
    SYNTAX        IEEE8021PriorityValue
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "The priority code point that should be used in
        frames transporting the protocol indicated by
        lldpXdot1dcbxAdminApplicationPriorityAESelector and
        lldpXdot1dcbxAdminApplicationPriorityAEProtocol."
    REFERENCE
        "D.2.10.6"
    ::= { lldpXdot1dcbxAdminApplicationPriorityAppEntry 3 }

--
-- lldpXdot1dcbxAdminApplicationVlanAppTable - Contains the
-- information for the Application VLAN TLV.
--

lldpXdot1dcbxAdminApplicationVlanAppTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF
        LldpXdot1dcbxAdminApplicationVlanAppEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Table containing entries indicating the VLAN to be used
        for a given application."
    ::= { lldpXdot1dcbxAdminData 5 }

lldpXdot1dcbxAdminApplicationVlanAppEntry OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxAdminApplicationVlanAppEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Entry that indicates the VLAN to be used for a
        given application."
    INDEX         {
                  lldpV2LocPortIfIndex,
                  lldpXdot1dcbxAdminApplicationVlanAESelector,
                  lldpXdot1dcbxAdminApplicationVlanAEProtocol
    }
    ::= { lldpXdot1dcbxAdminApplicationVlanAppTable 1 }

LldpXdot1dcbxAdminApplicationVlanAppEntry ::= SEQUENCE {
    lldpXdot1dcbxAdminApplicationVlanAESelector
        LldpXdot1dcbxAppSelector,
    lldpXdot1dcbxAdminApplicationVlanAEProtocol
        LldpXdot1dcbxAppProtocol,
    lldpXdot1dcbxAdminApplicationVlanAEVlanId
        VlanId
}

lldpXdot1dcbxAdminApplicationVlanAESelector OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxAppSelector
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Indicates the contents of the protocol object
        (lldpXdot1dcbxAdminApplicationVlanAEProtocol)
        1: EtherType
        2: Well Known Port number over TCP, or SCTP
        3: Well Known Port number over UDP, or DCCP
        4: Well Known Port number over TCP, SCTP, UDP, and DCCP
        5: Differentiated Services Code Point (DSCP) value. The
           6 bit DSCP value is stored in the low order 6 bits of the
           protocol object. The higher order bits are set to zero.
           (See IETF RFC 2474 for the definition of the DSCP value.)"
    REFERENCE
        "D.2.12.3"
    ::= { lldpXdot1dcbxAdminApplicationVlanAppEntry 1 }

lldpXdot1dcbxAdminApplicationVlanAEProtocol OBJECT-TYPE
    SYNTAX        LldpXdot1dcbxAppProtocol
```

```
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "The protocol indicator of the type indicated by
        lldpXdot1dcbxAdminApplicationVlanAESelector."
    REFERENCE
        "D.2.14.3"
    ::= { lldpXdot1dcbxAdminApplicationVlanAppEntry 2 }

lldpXdot1dcbxAdminApplicationVlanAEVlanId OBJECT-TYPE
    SYNTAX        VlanId
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "The VLAN Identifier that should be used in
        frames transporting the protocol indicated by
        lldpXdot1dcbxAdminApplicationVlanAESelector and
        lldpXdot1dcbxAdminApplicationVlanAEProtocol."
    REFERENCE
        "D.2.14.3"
    ::= { lldpXdot1dcbxAdminApplicationVlanAppEntry 3 }

-- ------------------------------------------------------------------------
-- IEEE 802.1 - DCBX Conformance Information
-- ------------------------------------------------------------------------
lldpXdot1dcbxConformance OBJECT IDENTIFIER ::= { lldpV2Xdot1MIB 6 }
lldpXdot1dcbxCompliances
    OBJECT IDENTIFIER ::= { lldpXdot1dcbxConformance 1 }
lldpXdot1dcbxGroups
    OBJECT IDENTIFIER ::= { lldpXdot1dcbxConformance 2 }

--
-- Compliance Statements
--

lldpXdot1dcbxCompliance MODULE-COMPLIANCE
    STATUS        current
    DESCRIPTION
         "A compliance statement for SNMP entities that implement
         the IEEE 802.1 organizationally defined DCBX group in the
         LLDP extension MIB.

         This group is mandatory for agents that implement Enhanced
         Transmission Selection."
    MODULE        -- this module
        MANDATORY-GROUPS  { lldpXdot1dcbxETSGroup,
                            lldpXdot1dcbxPFCGroup,
                            lldpXdot1dcbxApplicationPriorityGroup,
                            lldpXdot1dcbxApplicationVlanGroup,
                            ifGeneralInformationGroup
        }
    ::= { lldpXdot1dcbxCompliances 1 }

--
-- MIB Groupings
--

lldpXdot1dcbxETSGroup  OBJECT-GROUP
    OBJECTS {
        lldpXdot1dcbxConfigETSConfigurationTxEnable,
        lldpXdot1dcbxConfigETSRecommendationTxEnable,
        lldpXdot1dcbxLocETSConCreditBasedShaperSupport,
        lldpXdot1dcbxLocETSConTrafficClassesSupported,
        lldpXdot1dcbxLocETSConWilling,
        lldpXdot1dcbxLocETSConPriTrafficClass,
        lldpXdot1dcbxLocETSConTrafficClassBandwidth,
        lldpXdot1dcbxLocETSConTrafficSelectionAlgorithm,
        lldpXdot1dcbxLocETSRecoTrafficClassBandwidth,
        lldpXdot1dcbxLocETSRecoTrafficSelectionAlgorithm,
        lldpXdot1dcbxRemETSConCreditBasedShaperSupport,
        lldpXdot1dcbxRemETSConTrafficClassesSupported,
        lldpXdot1dcbxRemETSConWilling,
```

```
        lldpXdot1dcbxRemETSConPriTrafficClass,
        lldpXdot1dcbxRemETSConTrafficClassBandwidth,
        lldpXdot1dcbxRemETSConTrafficSelectionAlgorithm,
        lldpXdot1dcbxRemETSRecoTrafficClassBandwidth,
        lldpXdot1dcbxRemETSRecoTrafficSelectionAlgorithm,
        lldpXdot1dcbxAdminETSConCreditBasedShaperSupport,
        lldpXdot1dcbxAdminETSConTrafficClassesSupported,
        lldpXdot1dcbxAdminETSConWilling,
        lldpXdot1dcbxAdminETSConPriTrafficClass,
        lldpXdot1dcbxAdminETSConTrafficClassBandwidth,
        lldpXdot1dcbxAdminETSConTrafficSelectionAlgorithm,
        lldpXdot1dcbxAdminETSRecoTrafficClassBandwidth,
        lldpXdot1dcbxAdminETSRecoTrafficSelectionAlgorithm
    }
    STATUS  current
    DESCRIPTION
        "The collection of objects used for Enhanced
        Transmission Selection."
    ::= { lldpXdot1dcbxGroups 1 }

lldpXdot1dcbxPFCGroup  OBJECT-GROUP
    OBJECTS {
        lldpXdot1dcbxConfigPFCTxEnable,
        lldpXdot1dcbxLocPFCWilling,
        lldpXdot1dcbxLocPFCMBC,
        lldpXdot1dcbxLocPFCCap,
        lldpXdot1dcbxLocPFCEnableEnabled,
        lldpXdot1dcbxRemPFCWilling,
        lldpXdot1dcbxRemPFCMBC,
        lldpXdot1dcbxRemPFCCap,
        lldpXdot1dcbxRemPFCEnableEnabled,
        lldpXdot1dcbxAdminPFCWilling,
        lldpXdot1dcbxAdminPFCMBC,
        lldpXdot1dcbxAdminPFCCap,
        lldpXdot1dcbxAdminPFCEnableEnabled
    }
    STATUS  current
    DESCRIPTION
        "The collection of objects used for Priority-
        base Flow Control."
    ::= { lldpXdot1dcbxGroups 2 }

lldpXdot1dcbxApplicationPriorityGroup  OBJECT-GROUP
    OBJECTS {
        lldpXdot1dcbxConfigApplicationPriorityTxEnable,
        lldpXdot1dcbxLocApplicationPriorityAEPriority,
        lldpXdot1dcbxRemApplicationPriorityAEPriority,
        lldpXdot1dcbxAdminApplicationPriorityAEPriority
    }
    STATUS  current
    DESCRIPTION
        "The collection of objects used for Application
        priority."
    ::= { lldpXdot1dcbxGroups 3 }

lldpXdot1dcbxApplicationVlanGroup  OBJECT-GROUP
    OBJECTS {
        lldpXdot1dcbxConfigApplicationVlanTxEnable,
        lldpXdot1dcbxLocApplicationVlanAEVlanId,
        lldpXdot1dcbxRemApplicationVlanAEVlanId,
        lldpXdot1dcbxAdminApplicationVlanAEVlanId
    }
    STATUS  current
    DESCRIPTION
        "The collection of objects used for Application
        VLAN."
    ::= { lldpXdot1dcbxGroups 4 }


-- ----------------------------------------------------------------------
-- ----------------------------------------------------------------------
-- ----------------------------------------------------------------------
--
```

```
-- Organizationally Defined Information Extension - IEEE 802.1
-- Definitions to support the ciSet TLV set (Table D-1)
-- for Congestion Isolation
--
-----------------------------------------------------------------------
-----------------------------------------------------------------------

lldpXdot1CiMIB OBJECT IDENTIFIER ::= { lldpV2Xdot1MIB 8 }
lldpXdot1CiObjects OBJECT IDENTIFIER ::= { lldpXdot1CiMIB 1 }

-- CI 802.1 MIB Extension groups

lldpXdot1CiConfig OBJECT IDENTIFIER ::= { lldpXdot1CiObjects 1 }
lldpXdot1CiLocalData OBJECT IDENTIFIER ::= { lldpXdot1CiObjects 2 }
lldpXdot1CiRemoteData OBJECT IDENTIFIER ::= { lldpXdot1CiObjects 3 }

-----------------------------------------------------------------------
-- Textual conventions for Congestion Isolation
-----------------------------------------------------------------------

CiQueueType ::= TEXTUAL-CONVENTION
    STATUS     current
    DESCRIPTION
        "Indicates whether a queue is a monitored queue, a congesting
         queue or not participating in Congestion Isolation.  The
         queue type is used when building the queue map field of the
         Congestion Isolation TLV.
         0: The queue is not participating in Congestion Isolation
         1: The queue is a monitored queue
         2: The queue is a congesting queue"
    SYNTAX  INTEGER {
         ciQNone(0),
         ciQMonitor(1),
         ciQCongesting(2)
    }

-----------------------------------------------------------------------
-- IEEE 802.1 - Congestion Isolation Configuration
-----------------------------------------------------------------------

--
--  lldpXdot1CiConfigCiTable : configure the
--  transmission of the Congestion Isolation TLV on a set of ports
--

lldpXdot1CiConfigCiTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF LldpXdot1CiConfigCiEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "A table that controls selection of Congestion Isolation
         TLVs to be transmitted on individual ports."
    ::= { lldpXdot1CiConfig 1 }

lldpXdot1CiConfigCiEntry OBJECT-TYPE
    SYNTAX        LldpXdot1CiConfigCiEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "LLDP configuration information that controls the
        transmission of IEEE 802.1 organizationally defined
        Congestion Isolation TLV on LLDP transmission-capable ports.

        This configuration object augments the lldpV2PortConfigEntry of
        the LLDP-MIB, therefore it is only present along with the port
        configuration defined by the associated lldpV2PortConfigEntry
        entry.

        Each active lldpConfigEntry is restored from non-volatile
        storage (along with the corresponding lldpV2PortConfigEntry)
        after a re-initialization of the management system."
    AUGMENTS      { lldpV2PortConfigEntry }
```

```
    ::= { lldpXdot1CiConfigCiTable 1 }

LldpXdot1CiConfigCiEntry ::= SEQUENCE {
    lldpXdot1CiConfigCiTxEnable TruthValue
}

lldpXdot1CiConfigCiTxEnable OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "The lldpXdot1CiConfigCiTxEnable, which is
        defined as a truth value and configured by the network
        management, determines whether the IEEE 802.1 organizationally
        defined Congestion Isolation TLV transmission is allowed
        on a given LLDP transmission-capable port.

        The value of this object is restored from non-volatile
        storage after a re-initialization of the management system."
    REFERENCE
        "D.2.15"
    DEFVAL         { false }
    ::= { lldpXdot1CiConfigCiEntry 1 }

-- ------------------------------------------------------------------------
-- IEEE 802.1 - Congestion Isolation Local System Information
-- ------------------------------------------------------------------------

---
---
--- lldpXdot1CiLocalData: Contains the information for the CI TLV
---
---
lldpXdot1LocCiBasicTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpXdot1LocCiBasicEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This table contains one row per port of basic Congestion Isolation
        information (as a part of the LLDP 802.1 organizational extension)
        on the local system known to this agent."
    ::= { lldpXdot1CiLocalData 1 }

lldpXdot1LocCiBasicEntry OBJECT-TYPE
    SYNTAX      LldpXdot1LocCiBasicEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "Basic Congestion Isolation information about a particular port
        component."
    INDEX   { lldpV2LocPortIfIndex }
    ::= { lldpXdot1LocCiBasicTable 1 }

LldpXdot1LocCiBasicEntry ::= SEQUENCE {
      lldpXdot1LocCiCIMEncapLen     Unsigned32,
      lldpXdot1LocCiMacAddress      MacAddress,
      lldpXdot1LocCiNetAddressType  AddressFamilyNumbers,
      lldpXdot1LocCiNetAddress      OCTET STRING,
      lldpXdot1LocCiUDPPort         InetPortNumber
}

lldpXdot1LocCiCIMEncapLen OBJECT-TYPE
    SYNTAX      Unsigned32 (60..512)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The requested length in octets of the data encapsulated into
        a CIM by a peer. The default and minimum required value is 60.
        The maximum value is 512."
    REFERENCE
        "D.2.15.4"
    ::= { lldpXdot1LocCiBasicEntry 1 }
```

```
lldpXdot1LocCiMacAddress  OBJECT-TYPE
    SYNTAX      MacAddress
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The MAC address that is to be used as the destination MAC address
        for a CIM to the Bridge or end station."
    REFERENCE
        "D.2.15.5"
    ::= { lldpXdot1LocCiBasicEntry 2 }

lldpXdot1LocCiNetAddressType  OBJECT-TYPE
    SYNTAX      AddressFamilyNumbers
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The type of network address identifier encoding used in the
        associated 'lldpXdot1LocCiNetAddress' object.  Only the IPv4
        and IPv6 address type encodings enumerated in AddressFamilyNumbers
        are used in the Congestion Isolation TLV."
    REFERENCE
        "D.2.15.7"
    ::= { lldpXdot1LocCiBasicEntry 3 }

lldpXdot1LocCiNetAddress OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE(1..31))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The string value used to identify the network address component
        associated with the local system. This address is to be used as
        the destination network address of a layer-3 CIM."
    REFERENCE
        "D.2.15.8"
    ::= { lldpXdot1LocCiBasicEntry 4 }

lldpXdot1LocCiUDPPort OBJECT-TYPE
    SYNTAX      InetPortNumber
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
       "The UDP port number to be used in layer 3 CIMs sent by the peer."
    REFERENCE
       "D.2.15.6"
    ::= { lldpXdot1LocCiBasicEntry 5 }

--
-- The table specifying, the queue map to advertise in the
-- Congestion Isolation TLV.
--

lldpXdot1LocCiQueueMapTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpXdot1LocCiQueueMapEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
       "A table specifying whether the queue of a priority is to
        be a monitored queue, congesting queue, or not participating.
        For each participating queue there is a mapped queue.  This
        information can be transmitted in the Congestion Isolation TLV.
       "
    REFERENCE
       "D.2.15.3"
    ::= { lldpXdot1CiLocalData 2 }

lldpXdot1LocCiQueueMapEntry OBJECT-TYPE
    SYNTAX      LldpXdot1LocCiQueueMapEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
       "A table specifying whether the queue of a priority is to
```

```
        be a monitored queue, congesting queue, or not participating.
        For each participating queue there is a mapped queue.  This
        information can be transmitted in the Congestion Isolation TLV.
      "
    INDEX { lldpV2LocPortIfIndex,
            lldpXdot1LocCiQueueId }
    ::= { lldpXdot1LocCiQueueMapTable 1 }

LldpXdot1LocCiQueueMapEntry ::= SEQUENCE {
        lldpXdot1LocCiQueueId      IEEE8021PriorityValue,
        lldpXdot1LocCiQueueType    CiQueueType,
        lldpXdot1LocCiMappedQueue  IEEE8021PriorityValue
    }

lldpXdot1LocCiQueueId OBJECT-TYPE
    SYNTAX      IEEE8021PriorityValue
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
       "The priority for a frame received on this port."
    REFERENCE
       "D.2.15.3"
    ::= { lldpXdot1LocCiQueueMapEntry 1 }

lldpXdot1LocCiQueueType OBJECT-TYPE
    SYNTAX      CiQueueType
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
       "monitored, congesting, or not used
        The value of this object is restored from non-volatile
        storage after a re-initialization of the management system.
       "
    REFERENCE
       "D.2.15.3"
    ::= { lldpXdot1LocCiQueueMapEntry 2 }

lldpXdot1LocCiMappedQueue OBJECT-TYPE
    SYNTAX      IEEE8021PriorityValue
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
       "The remapped priority for frames received on this port
        at the received priority.

        The value of this object is restored from non-volatile
        storage after a re-initialization of the management system.
       "
    REFERENCE
       "D.2.15.3"
    ::= { lldpXdot1LocCiQueueMapEntry 3 }

--------------------------------------------------------------------------
-- IEEE 802.1 - Congestion Isolation Remote System Information
--------------------------------------------------------------------------

---
---
--- lldpXdot1CiRemoteData: Contains the received information for the CI TLV
---
---
lldpXdot1RemCiBasicTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpXdot1RemCiBasicEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This table contains one row per port of basic Congestion Isolation
        information (as a part of the LLDP 802.1 organizational extension)
        of the remote system."
    ::= { lldpXdot1CiRemoteData 1 }

lldpXdot1RemCiBasicEntry OBJECT-TYPE
```

```
    SYNTAX      LldpXdot1RemCiBasicEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "Basic Congestion Isolation information about a particular port
        component."
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress,
              lldpV2RemIndex }
    ::= { lldpXdot1RemCiBasicTable 1 }

LldpXdot1RemCiBasicEntry ::= SEQUENCE {
      lldpXdot1RemCiCIMEncapLen     Unsigned32,
      lldpXdot1RemCiMacAddress      MacAddress,
      lldpXdot1RemCiNetAddressType  AddressFamilyNumbers,
      lldpXdot1RemCiNetAddress      OCTET STRING,
      lldpXdot1RemCiUDPPort         InetPortNumber
}

lldpXdot1RemCiCIMEncapLen OBJECT-TYPE
    SYNTAX      Unsigned32 (60..512)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The requested length in octets of the data encapsulated into
        a CIM by a peer. The default and minimum required value is 60.
        The maximum value is 512."
    REFERENCE
        "D.2.15.4"
    ::= { lldpXdot1RemCiBasicEntry 1 }

lldpXdot1RemCiMacAddress  OBJECT-TYPE
    SYNTAX      MacAddress
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The MAC address that is to be used as the destination MAC address
        for a CIM to the Bridge or end station."
    REFERENCE
        "D.2.15.5"
    ::= { lldpXdot1RemCiBasicEntry 2 }

lldpXdot1RemCiNetAddressType  OBJECT-TYPE
    SYNTAX      AddressFamilyNumbers
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The type of network address identifier encoding used in the
        associated 'lldpXdot1RemCiNetAddress' object.  Only the IPv4
        and IPv6 address type encodings enumerated in AddressFamilyNumbers
        are used in the Congestion Isolation TLV."
    REFERENCE
        "D.2.15.7"
    ::= { lldpXdot1RemCiBasicEntry 3 }

lldpXdot1RemCiNetAddress OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE(1..31))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The string value used to identify the network address component
        associated with the local system. This address is to be used as
        the destination network address of a layer-3 CIM."
    REFERENCE
        "D.2.15.8"
    ::= { lldpXdot1RemCiBasicEntry 4 }

lldpXdot1RemCiUDPPort OBJECT-TYPE
    SYNTAX      InetPortNumber
    MAX-ACCESS  read-only
    STATUS      current
```

```
    DESCRIPTION
        "The UDP port number to be used in layer 3 CIMs sent by the peer."
    REFERENCE
        "D.2.15.6"
    ::= { lldpXdot1RemCiBasicEntry 5 }

--
-- The table specifying, the queue map to advertise in the
-- Congestion Isolation TLV.
--

lldpXdot1RemCiQueueMapTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpXdot1RemCiQueueMapEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A table specifying whether the queue of a priority is to
         be a monitored queue, congesting queue, or not participating.
         For each participating queue there is a mapped queue.  This
         information can be transmitted in the Congestion Isolation TLV.
        "
    REFERENCE
        "D.2.15.3"
    ::= { lldpXdot1CiRemoteData 2 }

lldpXdot1RemCiQueueMapEntry OBJECT-TYPE
    SYNTAX      LldpXdot1RemCiQueueMapEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A table specifying whether the queue of a priority is to
         be a monitored queue, congesting queue, or not participating.
         For each participating queue there is a mapped queue.  This
         information can be transmitted in the Congestion Isolation TLV.
        "
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress,
              lldpV2RemIndex,
              lldpXdot1RemCiQueueId }
    ::= { lldpXdot1RemCiQueueMapTable 1 }

LldpXdot1RemCiQueueMapEntry ::= SEQUENCE {
        lldpXdot1RemCiQueueId       IEEE8021PriorityValue,
        lldpXdot1RemCiQueueType     CiQueueType,
        lldpXdot1RemCiMappedQueue   IEEE8021PriorityValue
    }

lldpXdot1RemCiQueueId OBJECT-TYPE
    SYNTAX      IEEE8021PriorityValue
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The priority for a frame received on this port."
    REFERENCE
        "D.2.15.3"
    ::= { lldpXdot1RemCiQueueMapEntry 1 }

lldpXdot1RemCiQueueType OBJECT-TYPE
    SYNTAX      CiQueueType
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "monitored, congesting, or not used
         The value of this object is restored from non-volatile
         storage after a re-initialization of the management system.
        "
    REFERENCE
        "D.2.15.3"
    ::= { lldpXdot1RemCiQueueMapEntry 2 }

lldpXdot1RemCiMappedQueue OBJECT-TYPE
```

```
    SYNTAX      IEEE8021PriorityValue
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "The remapped priority for frames received on this port
         at the received priority.

         The value of this object is restored from non-volatile
         storage after a re-initialization of the management system.
        "
    REFERENCE
        "D.2.15.3"
    ::= { lldpXdot1RemCiQueueMapEntry 3 }


-- ------------------------------------------------------------------------
-- IEEE 802.1 - Congestion Isolation Conformance Information
-- ------------------------------------------------------------------------

lldpXdot1CiConformance OBJECT IDENTIFIER ::= { lldpV2Xdot1MIB 9 }

lldpXdot1CiCompliances
    OBJECT IDENTIFIER ::= { lldpXdot1CiConformance 1 }
lldpXdot1CiGroups OBJECT IDENTIFIER ::= { lldpXdot1CiConformance 2 }

--
-- Congestion Isolation - Compliance Statements
--

lldpXdot1CiCompliance MODULE-COMPLIANCE
    STATUS        current
    DESCRIPTION
         "A compliance statement for SNMP entities that implement
         the IEEE 802.1 organizationally defined Congestion
         Isolation group in the LLDP extension MIB.

         This group is mandatory for agents that implement the
         Congestion Isolation cnSet TLV set."
    MODULE        -- this module
        MANDATORY-GROUPS  { lldpXdot1CiGroup,
                            ifGeneralInformationGroup }
    ::= { lldpXdot1CiCompliances 1 }


--
-- Congestion Isolation - MIB groupings
--

lldpXdot1CiGroup  OBJECT-GROUP
    OBJECTS {
        lldpXdot1CiConfigCiTxEnable,
        lldpXdot1LocCiCIMEncapLen,
        lldpXdot1LocCiMacAddress,
        lldpXdot1LocCiNetAddressType,
        lldpXdot1LocCiNetAddress,
        lldpXdot1LocCiUDPPort,
        lldpXdot1LocCiQueueType,
        lldpXdot1LocCiMappedQueue,
        lldpXdot1RemCiCIMEncapLen,
        lldpXdot1RemCiMacAddress,
        lldpXdot1RemCiNetAddressType,
        lldpXdot1RemCiNetAddress,
        lldpXdot1RemCiUDPPort,
        lldpXdot1RemCiQueueType,
        lldpXdot1RemCiMappedQueue
    }
    STATUS  current
    DESCRIPTION
        "The collection of objects that support the
        Congestion Isolation ciSet TLV set."
    ::= { lldpXdot1CiGroups 1 }
```

```
-------------------------------------------------------------------------
-------------------------------------------------------------------------
--
-- Organizationally Defined Information Extension - IEEE 802.1
-- Definitions to support the trSet TLV set (Table D-1)
-- for Topology Recognition
--
-------------------------------------------------------------------------
-------------------------------------------------------------------------

lldpXdot1TrMIB OBJECT IDENTIFIER ::= { lldpV2Xdot1MIB 10 }
lldpXdot1TrObjects OBJECT IDENTIFIER ::= { lldpXdot1TrMIB 1 }

-- TR 802.1 MIB Extension groups

lldpXdot1TrConfig OBJECT IDENTIFIER ::= { lldpXdot1TrObjects 1 }
lldpXdot1TrLocalData OBJECT IDENTIFIER ::= { lldpXdot1TrObjects 2 }
lldpXdot1TrRemoteData OBJECT IDENTIFIER ::= { lldpXdot1TrObjects 3 }

-------------------------------------------------------------------------
-- Textual conventions for Topology Recognition
-------------------------------------------------------------------------

LldpXdot1TrDeviceType ::= TEXTUAL-CONVENTION
    STATUS      current
    DESCRIPTION
        "Indicates the type of device for the Topology Recognition
         algorithm.  Used in the Device Type field of the Topology
         Recognition TLV
         0: End-station / Server
         1: Bridge
         2: Router
         255: Unknown"
    SYNTAX  INTEGER {
         trEndStation(0),
         trBridge(1),
         trRouter(2),
         trUnknown(255)
    }

LldpXdot1TrPortOrientation ::= TEXTUAL-CONVENTION
    STATUS      current
    DESCRIPTION
        "Indicates the orientation of the port in the Topology Recognition
         algorithm.  Used in the Port Orientation field of the Topology
         Recognition TLV
         0: uplink
         1: downlink
         2: crosslink
         255: Unknown"
    SYNTAX  INTEGER {
         trPortUplink(0),
         trPortDownlink(1),
         trPortCrosslink(2),
         trPortUnknown(255)
    }

-------------------------------------------------------------------------
-- IEEE 802.1 - Topology Recognition Configuration
-------------------------------------------------------------------------

--
--  lldpXdot1TrConfigTrTable : configure the
--  transmission of the Topology Recognition TLV on a set of ports
--

lldpXdot1TrConfigTrTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF LldpXdot1TrConfigTrEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "A table that controls selection of Topology Recognition
```

```
          TLVs to be transmitted on individual ports."
    ::= { lldpXdot1TrConfig 1 }

lldpXdot1TrConfigTrEntry OBJECT-TYPE
    SYNTAX        LldpXdot1TrConfigTrEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "LLDP configuration information that controls the
        transmission of IEEE 802.1 organizationally defined
        Topology Recognition TLV on LLDP transmission-capable ports.

        This configuration object augments the lldpV2PortConfigEntry of
        the LLDP-MIB, therefore it is only present along with the port
        configuration defined by the associated lldpV2PortConfigEntry
        entry.

        Each active lldpConfigEntry is restored from non-volatile
        storage (along with the corresponding lldpV2PortConfigEntry)
        after a re-initialization of the management system."
    AUGMENTS      { lldpV2PortConfigEntry }
    ::= { lldpXdot1TrConfigTrTable 1 }

LldpXdot1TrConfigTrEntry ::= SEQUENCE {
    lldpXdot1TrConfigTrTxEnable TruthValue
}

lldpXdot1TrConfigTrTxEnable OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "The lldpXdot1TrConfigTrTxEnable, which is
        defined as a truth value and configured by the network
        management, determines whether the IEEE 802.1 organizationally
        defined Topology Recognition TLV transmission is allowed
        on a given LLDP transmission-capable port.

        The value of this object is restored from non-volatile
        storage after a re-initialization of the management system."
    REFERENCE
        "D.2.16"
    DEFVAL         { false }
    ::= { lldpXdot1TrConfigTrEntry 1 }

-- ------------------------------------------------------------------------
-- IEEE 802.1 - Topology Recognition Local System Information
-- ------------------------------------------------------------------------

---
---
--- lldpXdot1TrLocalData: Contains the information for the TR TLV
---
---
lldpXdot1LocTrTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpXdot1LocTrEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This table contains one row per port of Topology Recognition
        information (as a part of the LLDP 802.1 organizational extension)
        on the local system known to this agent."
    ::= { lldpXdot1TrLocalData 1 }

lldpXdot1LocTrEntry OBJECT-TYPE
    SYNTAX      LldpXdot1LocTrEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "Topology Recognition information about a particular port
        component."
    INDEX   { lldpV2LocPortIfIndex }
```

```
    ::= { lldpXdot1LocTrTable 1 }

LldpXdot1LocTrEntry ::= SEQUENCE {
      lldpXdot1LocTrDeviceType       LldpXdot1TrDeviceType,
      lldpXdot1LocTrTopoLevel        Unsigned32,
      lldpXdot1LocTrPortOrientation  LldpXdot1TrPortOrientation
}

lldpXdot1LocTrDeviceType  OBJECT-TYPE
    SYNTAX      LldpXdot1TrDeviceType
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Indicates the type of device sending the Topology Recognition TLV.
        End-stations or servers that are non-relay systems at the edge
        of the topology use the value trEndStation(0).  A layer-2 relay
        system uses the value trBridge(1) and layer-3 relay systems use
        the value trRouter(2)."
    REFERENCE
        "D.2.16.3"
    ::= { lldpXdot1LocTrEntry 1 }

lldpXdot1LocTrTopoLevel OBJECT-TYPE
    SYNTAX      Unsigned32 (0..255)
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "Indicates the system understanding of its current level in
        the topology. The value of 0 indicates the edge of the topology
        and the value 255 indicates the level is currently unknown. Other
        non-zero values between 1 and 254 indicate the minimum number
        of links between the system and the edge of the topology."
    REFERENCE
        "D.2.16.4"
    ::= { lldpXdot1LocTrEntry 2 }

lldpXdot1LocTrPortOrientation  OBJECT-TYPE
    SYNTAX      LldpXdot1TrPortOrientation
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "Indicates whether the port is facing a trUplink(0), trDownlink(1),
        trCrosslink(2), or the orientation is TrUnknown(255). An uplink is a
        port that is facing a system that is deeper in the topology (i.e.,
        has a Topology Level greater than the sending system). A downlink
        is a port that is facing a system closer to the edge of the topology
        (i.e., has a Topology Level less than the sending system). A crosslink
        is a port that is facing a system at the same level of the topology.
        Systems that are end-stations initialize this value to trUplink(0).
        Systems that are not end-stations initialize this value to
        TrUnknown(255)."
    REFERENCE
        "D.2.16.5"
    ::= { lldpXdot1LocTrEntry 3 }

-- ----------------------------------------------------------------------
-- IEEE 802.1 - Topology Recognition Remote System Information
-- ----------------------------------------------------------------------

---
---
--- lldpXdot1TrRemoteData: Contains the received information for the TR TLV
---
---
lldpXdot1RemTrTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpXdot1RemTrEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This table contains one row per port of basic Topology Recognition
        information (as a part of the LLDP 802.1 organizational extension)
        of the remote system."
```

```
    ::= { lldpXdot1TrRemoteData 1 }

lldpXdot1RemTrEntry OBJECT-TYPE
    SYNTAX      LldpXdot1RemTrEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "Basic Topology Recognition information about a particular port
        component."
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress,
              lldpV2RemIndex }
    ::= { lldpXdot1RemTrTable 1 }

LldpXdot1RemTrEntry ::= SEQUENCE {
      lldpXdot1RemTrDeviceType       LldpXdot1TrDeviceType,
      lldpXdot1RemTrTopoLevel        Unsigned32,
      lldpXdot1RemTrPortOrientation  LldpXdot1TrPortOrientation
}

lldpXdot1RemTrDeviceType  OBJECT-TYPE
    SYNTAX      LldpXdot1TrDeviceType
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Indicates the type of device sending the Topology Recognition TLV.
        End-stations or servers that are non-relay systems at the edge
        of the topology use the value trEndStation(0).  A layer-2 relay
        system uses the value trBridge(1) and layer-3 relay systems use
        the value trRouter(2)."
    REFERENCE
        "D.2.16.3"
    ::= { lldpXdot1RemTrEntry 1 }

lldpXdot1RemTrTopoLevel OBJECT-TYPE
    SYNTAX      Unsigned32 (0..255)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Indicates the system understanding of its current level in
        the topology. The value of 0 indicates the edge of the topology
        and the value 255 indicates the level is currently unknown. Other
        non-zero values between 1 and 254 indicate the minimum number
        of links between the system and the edge of the topology."
    REFERENCE
        "D.2.16.4"
    ::= { lldpXdot1RemTrEntry 2 }

lldpXdot1RemTrPortOrientation  OBJECT-TYPE
    SYNTAX      LldpXdot1TrPortOrientation
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Indicates whether the port is facing a trUplink(0), trDownlink(1),
        trCrosslink(2), or the orientation is TrUnknown(255). An uplink is a
        port that is facing a system that is deeper in the topology (i.e.,
        has a Topology Level greater than the sending system). A downlink
        is a port that is facing a system closer to the edge of the topology
        (i.e., has a Topology Level less than the sending system). A crosslink
        is a port that is facing a system at the same level of the topology.
        Systems that are end-stations initialize this value to trUplink(0).
        Systems that are not end-stations initialize this value to
        TrUnknown(255)."
    REFERENCE
        "D.2.16.5"
    ::= { lldpXdot1RemTrEntry 3 }

-- ----------------------------------------------------------------------
-- IEEE 802.1 - Topology Recognition Conformance Information
-- ----------------------------------------------------------------------
```

```
lldpXdot1TrConformance OBJECT IDENTIFIER ::= { lldpV2Xdot1MIB 11 }

lldpXdot1TrCompliances
    OBJECT IDENTIFIER ::= { lldpXdot1TrConformance 1 }
lldpXdot1TrGroups OBJECT IDENTIFIER ::= { lldpXdot1TrConformance 2 }

--
-- Topology Recognition - Compliance Statements
--

lldpXdot1TrCompliance MODULE-COMPLIANCE
    STATUS        current
    DESCRIPTION
         "A compliance statement for SNMP entities that implement
         the IEEE 802.1 organizationally defined Topology
         Recognition group in the LLDP extension MIB.

         This group is mandatory for agents that implement the
         Topology Recognition cnSet TLV set."
    MODULE        -- this module
        MANDATORY-GROUPS  { lldpXdot1TrGroup,
                            ifGeneralInformationGroup }
    ::= { lldpXdot1TrCompliances 1 }


--
-- Topology Recognition - MIB groupings
--

lldpXdot1TrGroup  OBJECT-GROUP
    OBJECTS {
        lldpXdot1TrConfigTrTxEnable,
        lldpXdot1LocTrDeviceType,
        lldpXdot1LocTrTopoLevel,
        lldpXdot1LocTrPortOrientation,
        lldpXdot1RemTrDeviceType,
        lldpXdot1RemTrTopoLevel,
        lldpXdot1RemTrPortOrientation
    }
    STATUS  current
    DESCRIPTION
        "The collection of objects that support the
        Topology Recognition trSet TLV set."
    ::= { lldpXdot1TrGroups 1 }
END
```

Insert D.6 at the end of Annex D as follows:

D.6 IEEE 802.1/LLDP extension YANG

This clause specifies YANG data models that provide objects for managing the operation of IEEE 802.1 Organizationally Specific TLVs. The YANG modules defined here extend the basic YANG module for controlling and monitoring the LLDP agent defined in IEEE Std 802.1AB.

D.6.1 YANG framework

This clause has been developed in a manner consistent with the principles of the Internet Standard Management Framework and according to the YANG guidelines published in IETF RFC 7950 as applicable to IEEE standards.

The YANG framework for the Organizationally Specific TLV YANG follows the framework described in 48.1 and as extended by IEEE Std 802.1AB. Each of the TLV sets shown in Table D-1 has an associated YANG module that augments the base and per-port LLDP YANG defined in IEEE Std 802.1AB. Figure D-17 shows the high-level arrangement of IEEE 802.1 Organizationally Specific TLV YANG in the general YANG framework.

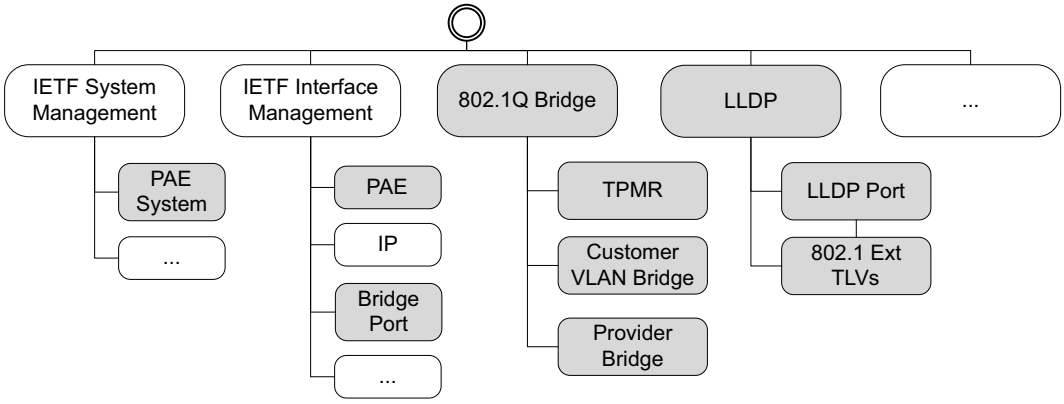


Figure D-17—YANG hierarchy with IEEE 802.1Q Extension TLV YANG

D.6.2 IEEE 802.1 Organizationally Specific TLV YANG data models

The YANG data models are based on the management model outline in D.3. A UML representation of the management model for each TLV set is provided in D.6.2.1 to D.6.2.6.

D.6.2.1 IEEE 802.1/LLDP extension basicSet TLV model

The attributes for the TLVs in the basicSet are obtained from both system wide and per-port managed objects. The model augments both the LLDP base model and the LLDP port model. The UML for the IEEE 802.1/LLDP extension basicSet is derived from the UML specified in IEEE Std 802.1AB and is shown in Figure D-18. The highlighted portions of the UML show how the LLDP models have been augmented.

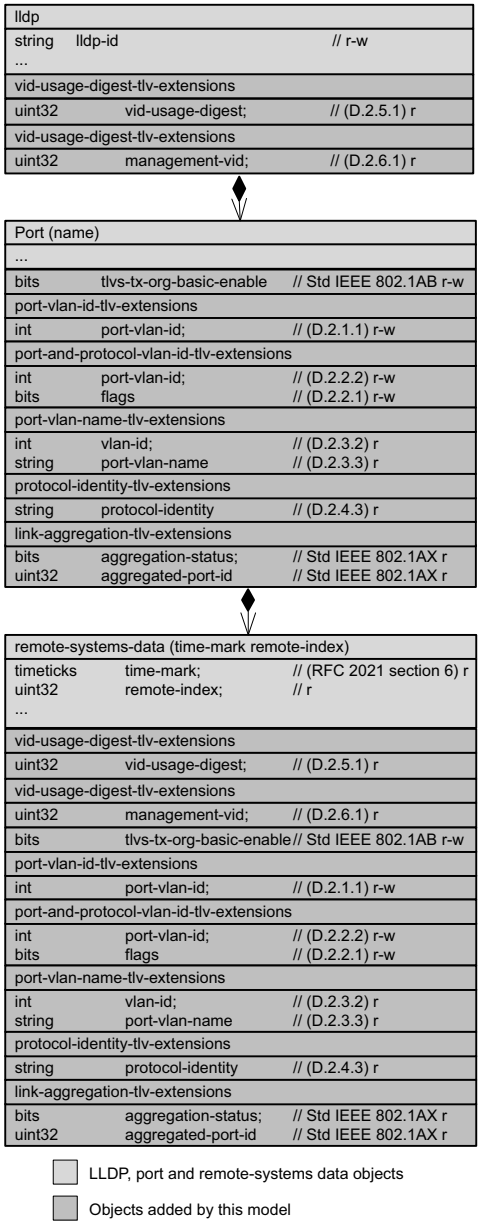


Figure D-18—basicSet TLV model

D.6.2.2 IEEE 802.1/LLDP extension cnSet YANG model

The attributes for the TLV in the cnSet are obtained from per-port managed objects. The model augments the LLDP port model. The UML for the IEEE 802.1/LLDP extension cnSet is derived from the UML specified in IEEE Std 802.1AB and is shown in Figure D-19. The highlighted portions of the UML show how the LLDP model has been augmented.

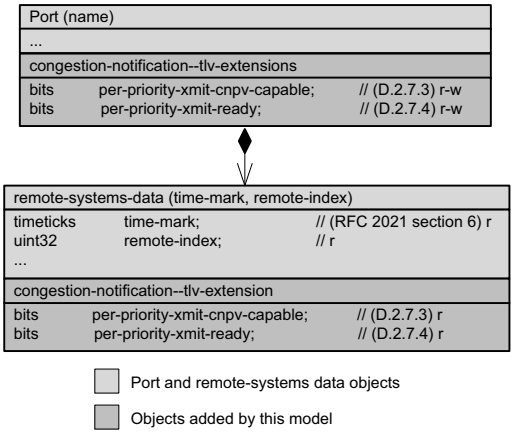


Figure D-19—cnSet TLV model

D.6.2.3 IEEE 802.1/LLDP extension dcbxSet YANG model

The attributes for the TLV in the dcbxSet are obtained from per-port managed objects. The model augments the LLDP port model. The UML for the IEEE 802.1/LLDP extension dcbxSet is derived from the UML specified in IEEE Std 802.1AB and is shown in Figure D-20. The highlighted portions of the UML show how the LLDP model has been augmented.

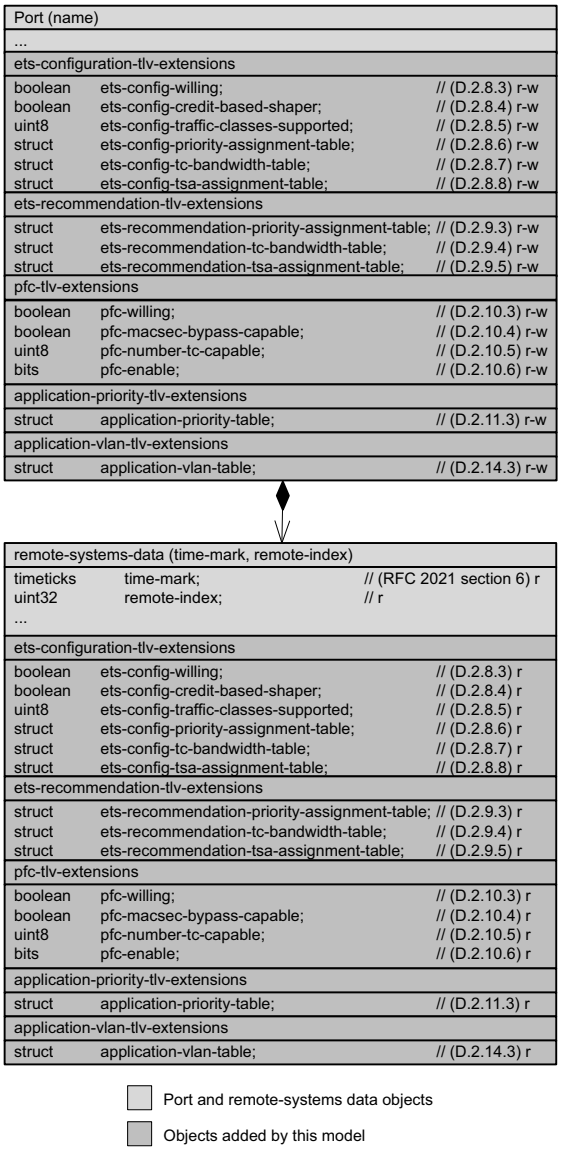


Figure D-20—dcbxSet TLV model

D.6.2.4 IEEE 802.1/LLDP extension evbSet YANG model

The attributes for the TLVs in the evbSet are obtained from per-port managed objects. The model augments the LLDP port model. The UML for the IEEE 802.1/LLDP extension evbSet is derived from the UML specified in IEEE Std 802.1AB and is shown in Figure D-21. The highlighted portions of the UML show how the LLDP model has been augmented.

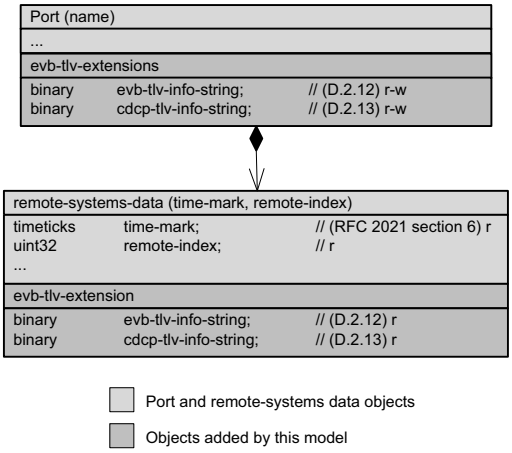


Figure D-21—evbSet TLV model

D.6.2.5 IEEE 802.1/LLDP extension ciSet TLV model

The attributes for the Congestion Isolation TLV in the ciSet are obtained from per-port managed objects and augment the LLDP port. The UML for the IEEE 802.1/LLDP extension ciSet is derived from the UML specified in IEEE Std 802.1AB and is shown in Figure D-22. The highlighted portions of the UML show how the LLDP models have been augmented..

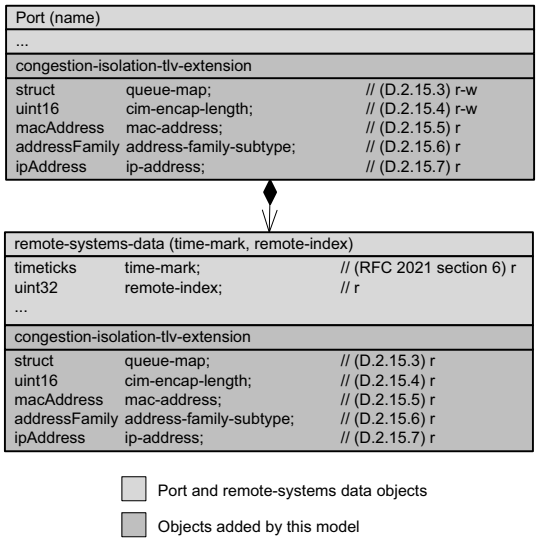


Figure D-22—ciSet TLV model

D.6.2.6 IEEE 802.1/LLDP extension trSet TLV model

The attributes for the Topology Recognition TLV in the trSet are obtained from both system wide and per-port managed objects. The model augments both the LLDP system and the LLDP port. The UML for the IEEE 802.1/LLDP extension trSet is derived from the UML specified in IEEE Std 802.1AB and is shown in Figure D-23. The highlighted portions of the UML show how the LLDP models have been augmented.

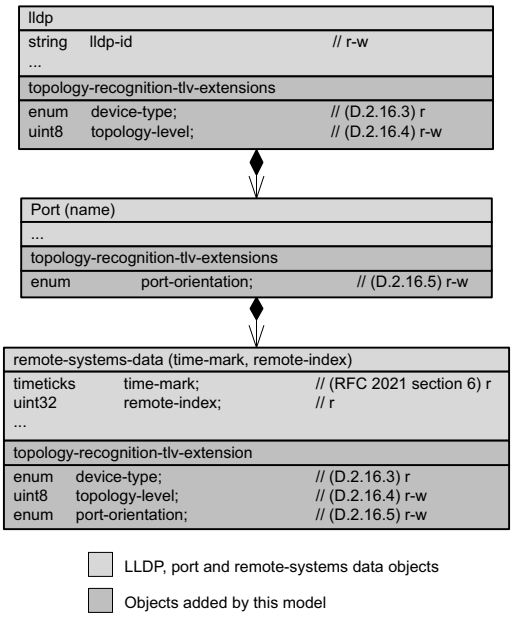


Figure D-23—trSet TLV model

D.6.3 Structure of the IEEE 802.1/LLDP extension YANG models

IEEE 802.1/LLDP extension YANG models are divided into a number of YANG modules, one for each TLV set defined in Table D-1. Each YANG module augments the LLDP base module and/or the LLDP port module with objects needed to generate the IEEE 802.1 Organizationally Specific TLVs. Each YANG module augments the LLDP port module's remote-systems-data to create space to hold the objects received from a peer LLDP agent. A summary of the modules contained in this clause is represented in Table D-16.

Table D-16—Summary of the YANG modules

Module	References	Notes
ieee802-dot1q-lldp-basic-tlv	D.6.6.1	Basic set of IEEE 802.1 Organizationally Specific TLVs.
ieee802-dot1q-lldp-cn-tlv	D.6.6.2	Congestion Notification set of IEEE 802.1 Organizationally Specific TLVs.
ieee802-dot1q-lldp-dcbx-tlv	D.6.6.3	DCBX set of IEEE 802.1 Organizationally Specific TLVs.
ieee802-dot1q-lldp-evb-tlv	D.6.6.4	Edge Virtual Bridging set of IEEE 802.1 Organizationally Specific TLVs.
ieee802-dot1q-lldp-ci-tlv	D.6.6.5	Congestion Isolation set of IEEE 802.1 Organizationally Specific TLVs.
ieee802-dot1q-lldp-tr-tlv	D.6.6.6	Topology Recognition set of IEEE 802.1 Organizationally Specific TLVs.

D.6.4 Security considerations

The general security considerations specified in 48.4 apply to the YANG modules defined in this clause. There are a number of management objects defined in the Organizationally Specific TLV extension 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 [B51]), 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 are possible.

The following subclauses define module specific security considerations for each of the Organizationally Specific TLV sets.

D.6.4.1 Security considerations of the ieee802-dot1q-lldp-basic-tlv YANG module

The following objects in the ieee802-dot1q-lldp-basic-tlv YANG module could be manipulated to interfere with the operation of IEEE 802.1 organizationally specific functionality using LLDP on a port and, for example, be used to cause network instability:

/lldp/vid-usage-digest-tlv-extension/vid-usage-digest

/lldp/management-vid-tlv-extension/management-vid

/lldp/port/tlvs-tx-org-basic-enable

/lldp/port/port-vlan-id-tlv-extension/port-vlan-id

/lldp/port/port-and-protocol-vlan-id-extension/port-vlan-id

/lldp/port/port-and-protocol-vlan-id-extension/flags

/lldp/port/port-vlan-name-tlv-extension/vlan-id

/lldp/port/port-vlan-name-tlv-extension/port-vlan-name

/lldp/port/protocol-identity-tlv-extension/protocol-identity

/lldp/port/link-aggregation-tlv-extension/aggregation-status

/lldp/port/link-aggregation-tlv-extension/aggregated-port-id

D.6.4.2 Security considerations of the ieee802-dot1q-lldp-cn-tlv YANG module

The following objects in the ieee802-dot1q-lldp-cn-tlv YANG module could be manipulated to interfere with the operation of IEEE 802.1 organizationally specific functionality using LLDP on a port and, for example, be used to cause network instability:

/lldp/port/congestion-notification-tlv-extension/per-priority-xmit-cnpv-enable

/lldp/port/congestion-notification-tlv-extension/per-priority-xmit-ready

D.6.4.3 Security considerations of the ieee802-dot1q-lldp-dcbx-tlv YANG module

The following objects in the ieee802-dot1q-lldp-dcbx-tlv YANG module could be manipulated to interfere with the operation of IEEE 802.1 organizationally specific functionality using LLDP on a port and, for example, be used to cause network instability:

/lldp/port/ets-configuration-tlv-extension/ets-config-willing

/lldp/port/ets-configuration-tlv-extension/ets-config-credit-based-shaper

/lldp/port/ets-configuration-tlv-extension/ets-config-traffic-classes-supported

/lldp/port/ets-configuration-tlv-extension/ets-config-priority-assignment-table

/lldp/port/ets-configuration-tlv-extension/ets-config-tc-bandwidth-table

/lldp/port/ets-configuration-tlv-extension/ets-config-tsa-assignment-table

/lldp/port/ets-recommendation-tlv-extension/ets-recommend-priority-assignment-table

/lldp/port/ets-recommendation-tlv-extension/ets-recommend-tc-bandwidth-table

/lldp/port/ets-recommendation-tlv-extension/ets-recommend-tsa-assignment-table

/lldp/port/pfc-tlv-extension/pfc-willing

/lldp/port/pfc-tlv-extension/pfc-macsec-bypass-capable

/lldp/port/pfc-tlv-extension/pfc-number-tc-capable

/lldp/port/pfc-tlv-extension/pfc-enable

/lldp/port/application-priority-tlv-extension/application-priority-table

/lldp/port/application-vlan-tlv-extension/application-vlan-table

D.6.4.4 Security considerations of the ieee802-dot1q-lldp-evb-tlv YANG module

The following objects in the ieee802-dot1q-lldp-evb-tlv YANG module could be manipulated to interfere with the operation of IEEE 802.1 organizationally specific functionality using LLDP on a port and, for example, be used to cause network instability:

/lldp/port/evb-tlv-extension/evb-tlv-info-string

/lldp/port/evb-tlv-extension/cdcp-tlv-info-string

D.6.4.5 Security considerations of the ieee802-dot1q-lldp-ci-tlv YANG module

The following objects in the ieee802-dot1q-lldp-ci-tlv YANG module could be manipulated to interfere with the operation of IEEE 802.1 organizationally specific functionality using LLDP on a port and, for example, be used to cause network instability:

/lldp/port/tlvs-tx-org-ci-enable

/lldp/port/congestion-isolation-tlv-extension/queue-map

/lldp/port/congestion-isolation-tlv-extension/cim-encap-length

/lldp/port/congestion-isolation-tlv-extension/address-family-subtype

/lldp/port/congestion-isolation-tlv-extension/ip-address

D.6.4.6 Security considerations of the ieee802-dot1q-lldp-tr-tlv YANG module

The following objects in the ieee802-dot1q-lldp-tr-tlv YANG module could be manipulated to interfere with the operation of IEEE 802.1 organizationally specific functionality using LLDP on a port and, for example, be used to cause network instability:

/lldp/topology-recognition-tlv-extension/topology-level

/lldp/port/tlvs-tx-org-tr-enable

/lldp/port/topology-recognition-tlv-extension/port-orientation

D.6.5 Definition of the IEEE 802.1/LLDP extension YANG modules

The structure of the IEEE 802.1/LLDP extension YANG modules is described in D.6.3. In the following YANG module definitions, if any discrepancy between the DESCRIPTION text and the corresponding definition in any other part of this standard occurs, the definitions outside this subclause take precedence.

The simplified graphical representation of the data model described in 48.5 is used in the following subclauses to describe the data schema for the IEEE 802.1/LLDP extension YANG modules.

D.6.5.1 Schema for the ieee802-dot1q-lldp-basic-tlv YANG module

```
module: ieee802-dot1q-lldp-basic-tlv
```

```
  augment /lldp:lldp:
    +--rw vid-usage-digest-tlv-extension
    |  +--ro vid-usage-digest?   uint32
    +--rw management-vid-tlv-extension
       +--rw management-vid?   dot1qtypes:vlanid
  augment /lldp:lldp/lldp:port:
    +--rw tlvs-tx-org-basic-enable?              bits
    +--rw port-vlan-id-tlv-extension
    |  +--rw port-vlan-id?   dot1qtypes:vlanid
    +--rw port-and-protocol-vlan-id-extension
    |  +--rw port-vlan-id?   dot1qtypes:vlanid
    |  +--rw flags?          bits
    +--rw port-vlan-name-tlv-extension
    |  +--rw vlan-id?          dot1qtypes:vlanid
    |  +--rw port-vlan-name?   string
    +--rw protocol-identity-tlv-extension
    |  +--rw protocol-identity?   string
    +--rw link-aggregation-tlv-extension
       +--rw aggregation-status?   bits
       +--rw aggregated-port-id?   uint32
  augment /lldp:lldp/lldp:port/lldp:remote-systems-data:
    +--ro port-vlan-id-tlv-extension
    |  +--ro port-vlan-id?   dot1qtypes:vlanid
    +--ro port-and-protocol-vlan-id-extension
    |  +--ro port-vlan-id?   dot1qtypes:vlanid
    |  +--ro flags?          bits
    +--ro port-vlan-name-tlv-extension
    |  +--ro vlan-id?          dot1qtypes:vlanid
    |  +--ro port-vlan-name?   string
    +--ro protocol-identity-tlv-extension
    |  +--ro protocol-identity?   string
    +--ro link-aggregation-tlv-extension
    |  +--ro aggregation-status?   bits
    |  +--ro aggregated-port-id?   uint32
    +--ro vid-usage-digest-tlv-extension
    |  +--ro vid-usage-digest?   uint32
    +--ro management-vid-tlv-extension
       +--ro management-vid?   dot1qtypes:vlanid
```

D.6.5.2 Schema for the ieee802-dot1q-lldp-cn-tlv YANG module

```
module: ieee802-dot1q-lldp-cn-tlv

  augment /lldp:lldp/lldp:port:
    +--rw tlvs-tx-org-congestion-notification-enable?   boolean
    +--rw congestion-notification-tlv-extension
       +--rw per-priority-xmit-cnpv-capable?
       |       congestion-notification-bit-vector
       +--rw per-priority-xmit-ready?
               congestion-notification-bit-vector
  augment /lldp:lldp/lldp:port/lldp:remote-systems-data:
    +--ro congestion-notification-tlv-extension
       +--ro per-priority-xmit-cnpv-capable?
       |       congestion-notification-bit-vector
       +--ro per-priority-xmit-ready?
               congestion-notification-bit-vector
```

D.6.5.3 Schema for the ieee802-dot1q-lldp-dcbx-tlv YANG module

```
module: ieee802-dot1q-lldp-dcbx-tlv

  augment /lldp:lldp/lldp:port:
    +--rw tlvs-tx-org-dcbx-enable?              bits
    +--rw ets-configuration-tlv-extension
    |  +--rw willing?                    boolean
    |  +--rw credit-based-shaper?        boolean
    |  +--rw traffic-classes-supported?
    |  |       dot1q-types:num-traffic-class-type
    |  +--rw priority-assignment-table* [priority]
```

```
  |  |  +--rw priority
  |  |  |       dot1q-types:priority-type
  |  |  +--rw priority-traffic-class?
  |  |  |       dot1q-types:traffic-class-type
  |  |  +--rw transmission-selection-algorithm?   identityref
  |  +--rw tc-bandwidth-table* [traffic-class]
  |  |  +--rw traffic-class           dot1q-types:traffic-class-type
  |  |  +--rw percentage-bandwidth?   uint8
  |  +--rw tsa-assignment-table* [tsa-traffic-class]
  |     +--rw tsa-traffic-class
  |     |       dot1q-types:traffic-class-type
  |     +--rw transmission-selection-algorithm?   identityref
  +--rw ets-recommendation-tlv-extension
  |  +--rw priority-assignment-table* [priority]
  |  |  +--rw priority                  dot1q-types:priority-type
  |  |  +--rw priority-traffic-class?   dot1q-types:traffic-class-type
  |  +--rw tc-bandwidth-table* [traffic-class]
  |  |  +--rw traffic-class           dot1q-types:traffic-class-type
  |  |  +--rw percentage-bandwidth?   uint8
  |  +--rw tsa-assignment-table* [tsa-traffic-class]
  |     +--rw tsa-traffic-class
  |     |       dot1q-types:traffic-class-type
  |     +--rw transmission-selection-algorithm?   identityref
  +--rw pfc-tlv-extension
  |  +--rw willing?                boolean
  |  +--rw macsec-bypass-capable?  boolean
  |  +--rw number-tc-capable?      dot1q-types:num-traffic-class-type
  |  +--rw enable?                 bits
  +--rw application-priority-tlv-extension
  |  +--rw application-priority-table* [application-priority]
  |     +--rw application-priority
  |     |       dot1q-types:priority-type
  |     +--rw application-priority-selector?   identityref
  |     +--rw application-priority-protocol?   uint16
  +--rw application-vlan-tlv-extension
     +--rw application-vlan-table* [application-vlan]
        +--rw application-vlan            dot1q-types:vlanid
        +--rw application-vlan-selector?  identityref
        +--rw application-vlan-protocol?  uint16
augment /lldp:lldp/lldp:port/lldp:remote-systems-data:
  +--ro ets-configuration-tlv-extension
  |  +--ro willing?                    boolean
  |  +--ro credit-based-shaper?        boolean
  |  +--ro traffic-classes-supported?
  |  |       dot1q-types:num-traffic-class-type
  |  +--ro priority-assignment-table* [priority]
  |  |  +--ro priority
  |  |  |       dot1q-types:priority-type
  |  |  +--ro priority-traffic-class?
  |  |  |       dot1q-types:traffic-class-type
  |  |  +--ro transmission-selection-algorithm?   identityref
  |  +--ro tc-bandwidth-table* [traffic-class]
  |  |  +--ro traffic-class           dot1q-types:traffic-class-type
  |  |  +--ro percentage-bandwidth?   uint8
  |  +--ro tsa-assignment-table* [tsa-traffic-class]
  |     +--ro tsa-traffic-class
  |     |       dot1q-types:traffic-class-type
  |     +--ro transmission-selection-algorithm?   identityref
  +--ro ets-recommendation-tlv-extension
  |  +--ro priority-assignment-table* [priority]
  |  |  +--ro priority                  dot1q-types:priority-type
  |  |  +--ro priority-traffic-class?   dot1q-types:traffic-class-type
  |  +--ro tc-bandwidth-table* [traffic-class]
  |  |  +--ro traffic-class           dot1q-types:traffic-class-type
  |  |  +--ro percentage-bandwidth?   uint8
  |  +--ro tsa-assignment-table* [tsa-traffic-class]
  |     +--ro tsa-traffic-class
  |     |       dot1q-types:traffic-class-type
  |     +--ro transmission-selection-algorithm?   identityref
  +--ro pfc-tlv-extension
  |  +--ro willing?                boolean
  |  +--ro macsec-bypass-capable?  boolean
```

```
   |  +--ro number-tc-capable?       dot1q-types:num-traffic-class-type
   |  +--ro enable?                  bits
   +--ro application-priority-tlv-extension
   |  +--ro application-priority-table* [application-priority]
   |     +--ro application-priority
   |     |       dot1q-types:priority-type
   |     +--ro application-priority-selector?   identityref
   |     +--ro application-priority-protocol?   uint16
   +--ro application-vlan-tlv-extension
      +--ro application-vlan-table* [application-vlan]
         +--ro application-vlan             dot1q-types:vlanid
         +--ro application-vlan-selector?   identityref
         +--ro application-vlan-protocol?   uint16
```

D.6.5.4 Schema for the ieee802-dot1q-lldp-evb-tlv YANG module

```
module: ieee802-dot1q-lldp-evb-tlv

  augment /lldp:lldp/lldp:port:
    +--rw tlvs-tx-org-evb-enable?   bits
    +--rw evb-tlv-extension
    |  +--ro evb-tlv-info-string?   binary
    +--rw cdcp-tlv-extension
       +--ro cdcp-tlv-info-string?   binary
  augment /lldp:lldp/lldp:port/lldp:remote-systems-data:
    +--ro evb-tlv-extension
    |  +--ro evb-tlv-info-string?   binary
    +--ro cdcp-tlv-extension
       +--ro cdcp-tlv-info-string?   binary
```

D.6.5.5 Schema for the ieee802-dot1q-lldp-ci-tlv YANG module

```
module: ieee802-dot1q-lldp-ci-tlv

  augment /lldp:lldp/lldp:port:
    +--rw tlvs-tx-org-ci-enable?               bits
    +--rw congestion-isolation-tlv-extension
       +--rw queue-map* [priority]
       |  +--rw priority        dot1q-types:priority-type
       |  +--rw queue-config?   dot1q-ci:abs-traffic-class-plus-one-type
       +--rw cim-encap-length?   uint16
       +--ro mac-address?        ieee:mac-address
       +--ro udp-port-number?    inet:port-number
       +--ro ip-address?         inet:ip-address
  augment /lldp:lldp/lldp:port/lldp:remote-systems-data:
    +--ro congestion-isolation-tlv-extension
       +--ro queue-map* [priority]
       |  +--ro priority        dot1q-types:priority-type
       |  +--ro queue-config?   dot1q-ci:abs-traffic-class-plus-one-type
       +--ro cim-encap-length?   uint16
       +--ro mac-address?        ieee:mac-address
       +--ro udp-port-number?    inet:port-number
       +--ro ip-address?         inet:ip-address
```

D.6.5.6 Schema for the ieee802-dot1q-lldp-tr-tlv YANG module

```
module: ieee802-dot1q-lldp-tr-tlv

  augment /lldp:lldp:
    +--rw topology-recognition-tlv-extension
       +--ro device-type?      enumeration
       +--rw topology-level?   uint8
  augment /lldp:lldp/lldp:port:
    +--rw tlvs-tx-org-tr-enable?               bits
    +--rw topology-recognition-tlv-extension
       +--rw port-orientation?   enumeration
  augment /lldp:lldp/lldp:port/lldp:remote-systems-data:
    +--ro congestion-isolation-tlv-extension
       +--ro device-type?        enumeration
```

```
      +--ro topology-level?     uint8
      +--ro port-orientation?   enumeration
```

D.6.6 IEEE 802.1/LLDP extension YANG modules

D.6.6.1 The ieee802-dot1q-lldp-basic-tlv YANG module

```
module ieee802-dot1q-lldp-basic-tlv {
  yang-version "1.1";
  namespace urn:ieee:std:802.1Q:yang:ieee802-dot1q-lldp-basic-tlv;
  prefix lldp-basic-tlv;
  import ieee802-dot1ab-lldp {
    prefix lldp;
  }
  import ieee802-dot1q-types {
    prefix dot1qtypes;
  }
  organization
    "Institute of Electrical and Electronics Engineers";
  contact
    "WG-URL: http://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
    "IEEE Std 802.1Q extension TLVs for LLDP

    References in this YANG module to IEEE Std 802.1Q are to IEEE Std
    802.1Q-2022 as amended by IEEE Std 802.1Qcz-2023.

    Copyright (C) IEEE (2023).

    This version of this YANG module is part of IEEE Std 802.1Q; see
    the standard itself for full legal notices.";
  revision 2023-07-03 {
    description
      "LLDP extension TLVs for the basicSet. Published as part of IEEE
      Std 802.1Qcz-2023.";
    reference
      "Annex D of IEEE Std 802.1Q";
  }
  grouping port-vlan-id-tlv {
    description
      "Port VLAN ID TLV";
    reference
      "D.2.1 of IEEE Std 802.1Q";
    leaf port-vlan-id {
      type dot1qtypes:vlanid;
      description
        "Advertise port VLAN Identifier, Send 0 if unknown or unsupported";
      reference
        "D.2.1 of IEEE Std 802.1Q";
    }
  }
  grouping port-and-protocol-vlan-id-tlv {
    description
      "Port and Protocol VLAN ID TLV";
    reference
      "D.2.2 of IEEE Std 802.1Q";
    uses port-vlan-id-tlv {
      reference
        "D.2.2 of IEEE Std 802.1Q";
    }
```

```
    leaf flags {
      type bits {
        bit port-and-protocol-vlan-supported {
          position 1;
          description
            "1 = supported, 0 = not supported";
        }
        bit port-and-protocol-vlan-enabled {
          position 2;
          description
            "1 = enabled, 0 = not enabled";
        }
      }
      description
        "Port and Protocol VLAN capability and status. Bit positions 0
        and 3-7 are reserved for future standardization";
      reference
        "D.2.2.1 of IEEE Std 802.1Q";
    }
  }
  grouping port-vlan-name-tlv {
    description
      "Port VLAN NAME TLV";
    reference
      "D.2.3 of IEEE Std 802.1Q";
    leaf vlan-id {
      type dot1qtypes:vlanid;
      description
        "The VLAN ID associated with the VLAN Name";
      reference
        "D.2.3.2 of IEEE Std 802.1Q";
    }
    leaf port-vlan-name {
      type string {
        length "0..32";
      }
      description
        "Advertise port VLAN Name, Send 0 length if unknown or
        unsupported";
      reference
        "D.2.3.3 of IEEE Std 802.1Q";
    }
  }
  grouping protocol-identity-tlv {
    description
      "Protocol Identity TLV";
    reference
      "D.2.4 of IEEE Std 802.1Q";
    leaf protocol-identity {
      type string {
        length "1..255";
      }
      description
        "Advertise ProtocolIdentity";
      reference
        "D.2.4.3 of IEEE Std 802.1Q";
    }
  }
  grouping vid-usage-digest-tlv {
    description
      "VID Usage Digest TLV";
    reference
      "D.2.5 of IEEE Std 802.1Q";
    leaf vid-usage-digest {
      type uint32;
      config false;
      description
        "Advertise VID Usage Digest";
      reference
        "D.2.5.1 of IEEE Std 802.1Q";
    }
  }
```

```
grouping management-vid-tlv {
  description
    "Management VID TLV";
  reference
    "D.2.6 of IEEE Std 802.1Q";
  leaf management-vid {
    type dot1qtypes:vlanid;
    description
      "Advertise Management VID";
    reference
      "D.2.6.1 of IEEE Std 802.1Q";
  }
}
grouping link-aggregation-tlv {
  description
    "Link Aggregation TLV";
  reference
    "F.2 of IEEE Std 802.1AX-2020";
  leaf aggregation-status {
    type bits {
      bit aggregation-capability {
        position 0;
        description
          "1 = supported, 0 = not supported";
      }
      bit aggregation-status {
        position 1;
        description
          "1 = currently aggregated, 0 = not currently aggregated";
      }
      bit port-typeLS {
        position 2;
        description
          "Least Significant Bit of 2 bit port type value";
      }
      bit port-typeMS {
        position 3;
        description
          "Most Significant Bit of 2 bit port type value";
      }
    }
    description
      "Link Aggregation capability and status. Bit positions 4-7 are
      reserved for future standardization";
    reference
      "F.2.1 of IEEE Std 802.1AX-2020";
  }
  leaf aggregated-port-id {
    type uint32;
    description
      "Advertise aggregated port identifier";
    reference
      "F.2.2 of IEEE Std 802.1AX-2020";
  }
}
augment "/lldp:lldp" {
  description
    "Augments lldp with information needed for system level extension
    TLVs";
  container vid-usage-digest-tlv-extension {
    description
      "The VID Usage Digest TLV";
    uses vid-usage-digest-tlv;
  }
  container management-vid-tlv-extension {
    description
      "The Management VID TLV";
    uses management-vid-tlv;
  }
}
augment "/lldp:lldp/lldp:port" {
  description
```

```
    "Augments port with basic extension TLVs";
  leaf tlvs-tx-org-basic-enable {
    type bits {
      bit port-vlan-id {
        position 0;
        description
          "D.2.1 of IEEE Std 802.1Q";
      }
      bit port-protocol-vlan-id {
        position 1;
        description
          "D.2.2 of IEEE Std 802.1Q";
      }
      bit vlan-name {
        position 2;
        description
          "D.2.3 of IEEE Std 802.1Q";
      }
      bit protocol-identity {
        position 3;
        description
          "D.2.4 of IEEE Std 802.1Q";
      }
      bit vid-user-digest {
        position 4;
        description
          "D.2.5 of IEEE Std 802.1Q";
      }
      bit management-vid {
        position 5;
        description
          "D.2.6 of IEEE Std 802.1Q";
      }
      bit link-aggregation {
        position 6;
        description
          "Annex F of IEEE Std 802.1AX-2020";
      }
    }
    description
      "Bitmap that includes the basicSet of TLVs from Table D-1 of
      IEEE Std 802.1Q";
    reference
      "D.2 of IEEE Std 802.1Q";
  }
  container port-vlan-id-tlv-extension {
    description
      "The Port VLAN ID TLV";
    uses port-vlan-id-tlv;
  }
  container port-and-protocol-vlan-id-extension {
    description
      "The Port and Protocol VLAN ID TLV";
    uses port-and-protocol-vlan-id-tlv;
  }
  container port-vlan-name-tlv-extension {
    description
      "The Port VLAN Name TLV";
    uses port-vlan-name-tlv;
  }
  container protocol-identity-tlv-extension {
    description
      "The Protocol Identity TLV";
    uses protocol-identity-tlv;
  }
  container link-aggregation-tlv-extension {
    description
      "The Link Aggregation TLV";
    uses link-aggregation-tlv;
  }
}
augment "/lldp:lldp/lldp:port/lldp:remote-systems-data" {
```

```
    description
      "Augments port remote-systems-data with received basic extension
      TLVs";
    container port-vlan-id-tlv-extension {
      description
        "Holds a received Port VLAN ID TLV";
      uses port-vlan-id-tlv;
    }
    container port-and-protocol-vlan-id-extension {
      description
        "Holds a received Port and Protocol VLAN ID TLV";
      uses port-and-protocol-vlan-id-tlv;
    }
    container port-vlan-name-tlv-extension {
      description
        "Holds a received VLAN Name TLV";
      uses port-vlan-name-tlv;
    }
    container protocol-identity-tlv-extension {
      description
        "Holds a received Protocol Identity TLV";
      uses protocol-identity-tlv;
    }
    container link-aggregation-tlv-extension {
      description
        "Holds a received Link Aggregation TLV";
      uses link-aggregation-tlv;
    }
    container vid-usage-digest-tlv-extension {
      description
        "Holds a received VID Usage TLV";
      uses vid-usage-digest-tlv;
    }
    container management-vid-tlv-extension {
      description
        "Holds a received Management VID TLV";
      uses management-vid-tlv;
    }
  }
}
```

D.6.6.2 The ieee802-dot1q-lldp-cn-tlv YANG module

```
module ieee802-dot1q-lldp-cn-tlv {
  yang-version "1.1";
  namespace urn:ieee:std:802.1Q:yang:ieee802-dot1q-lldp-cn-tlv;
  prefix lldp-cn-tlv;
  import ieee802-dot1ab-lldp {
    prefix lldp;
  }
  organization
    "Institute of Electrical and Electronics Engineers";
  contact
    "WG-URL: http://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
    "IEEE Std 802.1Q extension TLVs for LLDP

    References in this YANG module to IEEE Std 802.1Q are to IEEE Std
    802.1Q-2022 as amended by IEEE Std 802.1Qcz-2023.

    Copyright (C) IEEE (2023).
```

```
  This version of this YANG module is part of IEEE Std 802.1Q; see
  the standard itself for full legal notices.";
revision 2023-07-03 {
  description
    "LLDP extension tlv for congestion notification.";
  reference
    "Annex D of IEEE Std 802.1Q";
}
grouping congestion-notification-tlv {
  description
    "Congestion Notification TLV";
  reference
    "D.2.7 of IEEE Std 802.1Q";
  typedef congestion-notification-bit-vector {
    type bits {
      bit priority0 {
        position 0;
        description
          "status for priority0, 0 is FALSE, 1 is TRUE";
      }
      bit priority1 {
        position 1;
        description
          "status for priority1, 0 is FALSE, 1 is TRUE";
      }
      bit priority2 {
        position 2;
        description
          "status for priority2, 0 is FALSE, 1 is TRUE";
      }
      bit priority3 {
        position 3;
        description
          "status for priority3, 0 is FALSE, 1 is TRUE";
      }
      bit priority4 {
        position 4;
        description
          "status for priority4, 0 is FALSE, 1 is TRUE";
      }
      bit priority5 {
        position 5;
        description
          "status for priority5, 0 is FALSE, 1 is TRUE";
      }
      bit priority6 {
        position 6;
        description
          "status for priority6, 0 is FALSE, 1 is TRUE";
      }
      bit priority7 {
        position 7;
        description
          "status for priority7, 0 is FALSE, 1 is TRUE";
      }
    }
    description
      "Describes a bit vector used in Congestion Notification Objects";
    reference
      "32.4.7, 32.4.8 of IEEE Std 802.1Q";
  }
  leaf per-priority-xmit-cnpv-capable {
    type congestion-notification-bit-vector;
    description
      "Indicates if a priority on this Port is operating as a CNPV";
    reference
      "D.2.7.3, 32.4.7 of IEEE Std 802.1Q";
  }
  leaf per-priority-xmit-ready {
    type congestion-notification-bit-vector;
    description
      "Indicates if the priority remap defenses for this Port and CNPV
```

```
        have been disabled";
      reference
        "D.2.7.4, 32.4.8 of IEEE Std 802.1Q";
    }
  }
  augment "/lldp:lldp/lldp:port" {
    description
      "Augments port with the congestion notification extension tlv";
    leaf tlvs-tx-org-congestion-notification-enable {
      type boolean;
      description
        "Leaf that indicates if congestion notification tlv is enabled
        from Table D-1 of IEEE Std 802.1Q";
      reference
        "D.2 of IEEE Std 802.1Q";
    }
    container congestion-notification-tlv-extension {
      description
        "The Congestion Notification TLV";
      uses congestion-notification-tlv;
    }
  }
  augment "/lldp:lldp/lldp:port/lldp:remote-systems-data" {
    description
      "Augments port remote-systems-data with received cn extension TLVs";
    container congestion-notification-tlv-extension {
      description
        "Holds a received Congestion Notification TLV";
      uses congestion-notification-tlv;
    }
  }
}
```

D.6.6.3 The ieee802-dot1q-lldp-dcbx-tlv YANG module

```
module ieee802-dot1q-lldp-dcbx-tlv {
  yang-version "1.1";
  namespace urn:ieee:std:802.1Q:yang:ieee802-dot1q-lldp-dcbx-tlv;
  prefix lldp-dcbx-tlv;
  import ieee802-dot1q-types {
    prefix dot1q-types;
  }
  import ieee802-dot1ab-lldp {
    prefix lldp;
  }
  organization
    "Institute of Electrical and Electronics Engineers";
  contact
    "WG-URL: http://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
    "IEEE Std 802.1Q extension TLVs for LLDP

    References in this YANG module to IEEE Std 802.1Q are to IEEE Std
    802.1Q-2022 as amended by IEEE Std 802.1Qcz-2023.

    Copyright (C) IEEE (2023).

    This version of this YANG module is part of IEEE Std 802.1Q; see
    the standard itself for full legal notices.";
  revision 2023-07-03 {
    description
      "LLDP extension TLVs for DCBX. Published as part of IEEE Std
```

```
    802.1Qcz-2023.";
  reference
    "Annex D of IEEE Std 802.1Q";
}
identity application-priority-selector {
  description
    "Specify the application priority selection of IEEE Std 802.1Q
    D.2.11 and Table D-8";
}
identity default {
  base application-priority-selector;
  description
    "Indicates the default application selection of the Application
    Priority Table field of the Application Priority TLV specified in
    D.2.11 of IEEE Std 802.1Q. Signaled as value 1.";
}
identity pri-tcp-sctp {
  base application-priority-selector;
  description
    "Indicates TCP or SCTP application selection of the Application
    Priority Table field of the Application Priority TLV specified in
    D.2.11 of IEEE Std 802.1Q. Signaled as value 2.";
}
identity pri-udp-dccp {
  base application-priority-selector;
  description
    "Indicates UDP or DCCP application selection of the Application
    Priority Table field of the Application Priority TLV specified in
    D.2.11 of IEEE Std 802.1Q. Signaled as value 3.";
}
identity pri-tcp-sctp-udp-dccp {
  base application-priority-selector;
  description
    "Indicates TCP, SCTP, UDP or DCCP application selection of the
    Application Priority Table field of the Application Priority TLV
    specified in D.2.11 of IEEE Std 802.1Q. Signaled as value 4.";
}
identity pri-dscp {
  base application-priority-selector;
  description
    "Indicates DSCP application selection of the Application Priority
    Table field of the Application Priority TLV specified in D.2.11 of
    IEEE Std 802.1Q. Signaled as value 5.";
}
identity application-vlan-selector {
  description
    "Specify the application VLAN selection of D.2.14, Table D-12, and
    Table D-13 of IEEE Std 802.1Q";
}
identity vlan-pvid-ethertype {
  base application-vlan-selector;
  description
    "Indicates PVID or EtherType selection of the Application VLAN
    Table field of the Application VLAN TLV specified in D.2.14 of
    IEEE Std 802.1Q. Signaled as value 1.";
}
identity vlan-tcp-sctp {
  base application-vlan-selector;
  description
    "Indicates TCP or SCTP application selection of the Application
    VLAN Table field of the Application VLAN TLV specified in D.2.14 of
    IEEE Std 802.1Q. Signaled as value 2.";
}
identity vlan-udp-dccp {
  base application-vlan-selector;
  description
    "Indicates UDP or DCCP application selection of the Application
    VLAN Table field of the Application VLAN TLV specified in D.2.14 of
    IEEE Std 802.1Q. Signaled as value 3.";
}
identity vlan-tcp-sctp-udp-dccp {
  base application-vlan-selector;
```

```
  description
    "Indicates TCP, SCTP, UDP or DCCP application selection of the
    Application VLAN Table field of the Application VLAN TLV specified
    in D.2.14 of IEEE Std 802.1Q. Signaled as value 4.";
}
identity vlan-dscp {
  base application-vlan-selector;
  description
    "Indicates DSCP application selection of the Application VLAN Table
    field of the Application VLAN TLV specified in D.2.14 of IEEE Std
    802.1Q. Signaled as value 5.";
}
grouping ets-configuration-tlv {
  description
    "The Enhanced Transmission Selection configuration TLV";
  reference
    "D.2.8 of IEEE Std 802.1Q";
  leaf willing {
    type boolean;
    description
      "True indicates willing to accept configurations from remote
      station";
    reference
      "D.2.8.3 of IEEE Std 802.1Q";
  }
  leaf credit-based-shaper {
    type boolean;
    description
      "True indicates station supports the Credit-based Shaper
      transmission selection algorithm";
    reference
      "D.2.8.4 of IEEE Std 802.1Q";
  }
  leaf traffic-classes-supported {
    type dot1q-types:num-traffic-class-type;
    description
      "Indicates number of traffic classes supported. The value of 8 is
      encoded as 0 in the TLV since 3-bits are used to specify the
      number";
    reference
      "D.2.8.5 of IEEE Std 802.1Q";
  }
  list priority-assignment-table {
    key "priority";
    description
      "Maps a priority to a traffic class";
    leaf priority {
      type dot1q-types:priority-type;
      description
        "Indicates priority";
      reference
        "D.2.8.6 of IEEE Std 802.1Q";
    }
    leaf priority-traffic-class {
      type dot1q-types:traffic-class-type;
      description
        "Indicates mapped traffic class for priority";
      reference
        "D.2.8.6 of IEEE Std 802.1Q";
    }
    leaf transmission-selection-algorithm {
      type identityref {
        base dot1q-types:transmission-selection-algorithm;
      }
      description
        "Transmission selection algorithm";
      reference
        "8.6.8 and Table 8-6 of IEEE Std 802.1Q";
    }
  }
  list tc-bandwidth-table {
    key "traffic-class";
```

```
    description
      "Indicates the current bandwidth percentage for each traffic
      class";
    leaf traffic-class {
      type dot1q-types:traffic-class-type;
      description
        "Indicates traffic class";
      reference
        "D.2.8.7 of IEEE Std 802.1Q";
    }
    leaf percentage-bandwidth {
      type uint8 {
        range "0..100";
      }
      description
        "Percentage configured for the traffic class";
      reference
        "D.2.8.7 of IEEE Std 802.1Q";
    }
  }
  list tsa-assignment-table {
    key "tsa-traffic-class";
    description
      "Indicates the transmission selection algorithm used for a
      traffic class";
    leaf tsa-traffic-class {
      type dot1q-types:traffic-class-type;
      description
        "Indicates traffic class";
      reference
        "D.2.8.8 of IEEE Std 802.1Q";
    }
    leaf transmission-selection-algorithm {
      type identityref {
        base dot1q-types:transmission-selection-algorithm;
      }
      description
        "Transmission selection algorithm";
      reference
        "8.6.8 and Table 8-6 of IEEE Std 802.1Q";
    }
  }
}
grouping ets-recommendation-tlv {
  description
    "Recommendation of Enhanced Transmission Selection configuration
    TLV";
  reference
    "D.2.9 of IEEE Std 802.1Q";
  list priority-assignment-table {
    key "priority";
    description
      "Maps a priority to a traffic class";
    leaf priority {
      type dot1q-types:priority-type;
      description
        "Indicates priority";
      reference
        "D.2.9.3 of IEEE Std 802.1Q";
    }
    leaf priority-traffic-class {
      type dot1q-types:traffic-class-type;
      description
        "Indicates mapped traffic class for priority";
      reference
        "D.2.9.3 of IEEE Std 802.1Q";
    }
  }
  list tc-bandwidth-table {
    key "traffic-class";
    description
      "Indicates the current bandwidth percentage for each traffic
```

```
      class";
    leaf traffic-class {
      type dot1q-types:traffic-class-type;
      description
        "Indicates traffic class";
      reference
        "D.2.9.4 of IEEE Std 802.1Q";
    }
    leaf percentage-bandwidth {
      type uint8 {
        range "0..100";
      }
      description
        "Percentage configured for the traffic class";
      reference
        "D.2.9.4 of IEEE Std 802.1Q";
    }
  }
  list tsa-assignment-table {
    key "tsa-traffic-class";
    description
      "Indicates the transmission selection algorithm used for a
      traffic class";
    leaf tsa-traffic-class {
      type dot1q-types:traffic-class-type;
      description
        "Indicates traffic class";
      reference
        "D.2.9.5 of IEEE Std 802.1Q";
    }
    leaf transmission-selection-algorithm {
      type identityref {
        base dot1q-types:transmission-selection-algorithm;
      }
      description
        "Transmission selection algorithm";
      reference
        "8.6.8 and Table 8-6 of IEEE Std 802.Q";
    }
  }
}
grouping pfc-tlv {
  description
    "The Priority-based Flow Control configuration TLV";
  reference
    "D.2.10 of IEEE Std 802.1Q";
  leaf willing {
    type boolean;
    description
      "True indicates willing to accept configurations from remote
      station";
    reference
      "D.2.10.3 of IEEE Std 802.1Q";
  }
  leaf macsec-bypass-capable {
    type boolean;
    description
      "True indicates sending station is not capable of bypassing
      MACsec";
    reference
      "D.2.10.4 of IEEE Std 802.1Q";
  }
  leaf number-tc-capable {
    type dot1q-types:num-traffic-class-type;
    description
      "Indicates how many traffic classes may simultaneously support
      PFC.";
    reference
      "D.2.10.5 of IEEE Std 802.1Q";
  }
  leaf enable {
    type bits {
```

```
      bit p0 {
        position 0;
        description
          "1 indicates PFC is enabled on the priority";
      }
      bit p1 {
        position 1;
        description
          "1 indicates PFC is enabled on the priority";
      }
      bit p2 {
        position 2;
        description
          "1 indicates PFC is enabled on the priority";
      }
      bit p3 {
        position 3;
        description
          "1 indicates PFC is enabled on the priority";
      }
      bit p4 {
        position 4;
        description
          "1 indicates PFC is enabled on the priority";
      }
      bit p5 {
        position 5;
        description
          "1 indicates PFC is enabled on the priority";
      }
      bit p6 {
        position 6;
        description
          "1 indicates PFC is enabled on the priority";
      }
      bit p7 {
        position 7;
        description
          "1 indicates PFC is enabled on the priority";
      }
    }
    description
      "PFC enabled per priority";
    reference
      "D.2.10.6 of IEEE Std 802.1Q";
  }
}
grouping application-priority-tlv {
  description
    "The application priority table TLV";
  reference
    "D.2.11 of IEEE Std 802.1Q";
  list application-priority-table {
    key "application-priority";
    description
      "Specifies a 3-bit priority for a Protocol ID";
    leaf application-priority {
      type dot1q-types:priority-type;
      description
        "Priority for which the Protocol ID is being used";
      reference
        "D.2.11.3 of IEEE Std 802.1Q";
    }
    leaf application-priority-selector {
      type identityref {
        base application-priority-selector;
      }
      description
        "Selector to determine what the Protocol ID means.";
      reference
        "D.2.11.3 of IEEE Std 802.1Q";
    }
```

```
    leaf application-priority-protocol {
      type uint16 {
        range "0..65535";
      }
      description
        "Protocol ID of the type indicated by the selector";
      reference
        "D.2.11.3 of IEEE Std 802.1Q";
    }
  }
}
grouping application-vlan-tlv {
  description
    "The Application VLAN table TLV";
  reference
    "D.2.14 of IEEE Std 802.1Q";
  list application-vlan-table {
    key "application-vlan";
    description
      "Specifies a VLAN ID priority for a Protocol ID";
    leaf application-vlan {
      type dot1q-types:vlanid;
      description
        "Vlan for which the Protocol ID is being used";
      reference
        "D.2.14.3 of IEEE Std 802.1Q";
    }
    leaf application-vlan-selector {
      type identityref {
        base application-vlan-selector;
      }
      description
        "Selector to determine what the Protocol ID means.";
      reference
        "D.2.14.3 of IEEE Std 802.1Q";
    }
    leaf application-vlan-protocol {
      type uint16 {
        range "0..65535";
      }
      description
        "Protocol ID of the type indicated by the selector";
      reference
        "D.2.14.3 of IEEE Std 802.1Q";
    }
  }
}
augment "/lldp:lldp/lldp:port" {
  description
    "Augments port with the dcbx extension tlv";
  leaf tlvs-tx-org-dcbx-enable {
    type bits {
      bit ets-configuration {
        position 0;
        description
          "D.2.8 of IEEE Std 802.1Q";
      }
      bit ets-recommendation {
        position 1;
        description
          "D.2.9 of IEEE Std 802.1Q";
      }
      bit pfc {
        position 2;
        description
          "D.2.10 of IEEE Std 802.1Q";
      }
      bit application-priority {
        position 3;
        description
          "D.2.11 of IEEE Std 802.1Q";
      }
```

```
        bit application-vlan {
          position 4;
          description
            "D.2.14 of IEEE Std 802.1Q";
        }
      }
      description
        "Bitmap including the dcbxSet of TLVs from Table D-1 of IEEE Std
        802.1Q";
      reference
        "D.1 of IEEE Std 802.1Q";
    }
    container ets-configuration-tlv-extension {
      description
        "The ETS Configuration TLV";
      uses ets-configuration-tlv;
    }
    container ets-recommendation-tlv-extension {
      description
        "The ETS Recommendation TLV";
      uses ets-recommendation-tlv;
    }
    container pfc-tlv-extension {
      description
        "The Priority-based Flow Control Configuration TLV";
      uses pfc-tlv;
    }
    container application-priority-tlv-extension {
      description
        "The Application Priority TLV";
      uses application-priority-tlv;
    }
    container application-vlan-tlv-extension {
      description
        "The Application VLAN TLV";
      uses application-vlan-tlv;
    }
  }
  augment "/lldp:lldp/lldp:port/lldp:remote-systems-data" {
    description
      "Augments port remote-systems-data with received dcbx extension
      TLVs";
    container ets-configuration-tlv-extension {
      description
        "Holds a received ETS Configuration TLV";
      uses ets-configuration-tlv;
    }
    container ets-recommendation-tlv-extension {
      description
        "Holds a received ETS Recommendation TLV";
      uses ets-recommendation-tlv;
    }
    container pfc-tlv-extension {
      description
        "Holds a received Proirity-based Flow Control Configuration TLV";
      uses pfc-tlv;
    }
    container application-priority-tlv-extension {
      description
        "Holds a received Application Priority TLV";
      uses application-priority-tlv;
    }
    container application-vlan-tlv-extension {
      description
        "Holds a received Application VLAN TLV";
      uses application-vlan-tlv;
    }
  }
}
```

D.6.6.4 The ieee802-dot1q-lldp-evb-tlv YANG module

```
module ieee802-dot1q-lldp-evb-tlv {
  yang-version "1.1";
  namespace urn:ieee:std:802.1Q:yang:ieee802-dot1q-lldp-evb-tlv;
  prefix lldp-evb-tlv;
  import ieee802-dot1ab-lldp {
    prefix lldp;
  }
  organization
    "Institute of Electrical and Electronics Engineers";
  contact
    "WG-URL: http://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
    "IEEE Std 802.1Q extension TLVs for LLDP

    References in this YANG module to IEEE Std 802.1Q are to IEEE Std
    802.1Q-2022 as amended by IEEE Std 802.1Qcz-2023.

    Copyright (C) IEEE (2023).

    This version of this YANG module is part of IEEE Std 802.1Q; see the
    standard itself for full legal notices.";
  revision 2023-07-03 {
    description
      "LLDP extension tlv for EVB. Published as part of IEEE Std
      802.1Qcz-2023.";
    reference
      "Annex D of IEEE Std 802.1Q";
  }
  grouping evb-tlv {
    description
      "Edge Virtual Bridging (EVB) TLV";
    reference
      "D.2.12 of IEEE Std 802.1Q";
    leaf evb-tlv-info-string {
      type binary {
        length "0..9";
      }
      config false;
      description
        "Opaque string containing EVB TLV information string. As the
        elements within the string are not individually manipulated by
        management (they are of concern only to the state machines), the
        sub-structure of the string is not visible as separate objects
        within the local database.";
      reference
        "D.2.12 of IEEE Std 802.1Q";
    }
  }
  grouping cdcp-tlv {
    description
      "Channel Discovery and Configuration TLV";
    reference
      "D.2.13 of IEEE Std 802.1Q";
    leaf cdcp-tlv-info-string {
      type binary {
        length "0..511";
      }
      config false;
      description
        "Opaque string containing CDCP TLV information. Up to 167
        S-channel numbers are supported. As the elements within the
```

```
        string are not individually manipulated by management (they are
        of concern only to the state machines), the sub-structure of the
        string is not visible as separate objects within the local
        database.";
      reference
        "D.2.13 and D.2.13.8 of IEEE Std 802.1Q";
    }
  }
  augment "/lldp:lldp/lldp:port" {
    description
      "Augments port with the EVB TLV";
    leaf tlvs-tx-org-evb-enable {
      type bits {
        bit evb {
          position 0;
          description
            "D.2.12 of IEEE Std 802.1Q";
        }
        bit cdcp {
          position 1;
          description
            "D.2.13 of IEEE Std 802.1Q";
        }
      }
      description
        "Bitmap that includes the evbSet of TLVs from Table D-1 of
        IEEE Std 802.1Q";
      reference
        "D.1 of IEEE Std 802.1Q";
    }
    container evb-tlv-extension {
      description
        "The EVB TLV";
      uses evb-tlv;
    }
    container cdcp-tlv-extension {
      description
        "The CDCP TLV";
      uses cdcp-tlv;
    }
  }
  augment "/lldp:lldp/lldp:port/lldp:remote-systems-data" {
    description
      "Augments port remote-systems-data with received EVB TLVs";
    container evb-tlv-extension {
      description
        "Holds a received EVB TLV";
      uses evb-tlv;
    }
    container cdcp-tlv-extension {
      description
        "Holds a received CDCP TLV";
      uses cdcp-tlv;
    }
  }
}
```

D.6.6.5 The ieee802-dot1q-lldp-ci-tlv YANG module

```
module ieee802-dot1q-lldp-ci-tlv {
  yang-version "1.1";
  namespace urn:ieee:std:802.1Q:yang:ieee802-dot1q-lldp-ci-tlv;
  prefix lldp-ci-tlv;
  import ieee802-dot1ab-lldp {
    prefix lldp;
  }
  import ieee802-dot1q-congestion-isolation {
    prefix dot1q-ci;
  }
  import ietf-inet-types {
    prefix inet;
```

```
}
import ieee802-types {
  prefix ieee;
}
import ieee802-dot1q-types {
  prefix dot1q-types;
}
organization
  "Institute of Electrical and Electronics Engineers";
contact
  "WG-URL: http://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
  "IEEE Std 802.1Q extension TLVs for LLDP from the Congestion
  Isolation set (ciSet).

  References in this YANG module to IEEE Std 802.1Q are to IEEE Std
  802.1Q-2022 as amended by IEEE Std 802.1Qcz-2023.

  Copyright (C) IEEE (2023).

  This version of this YANG module is part of IEEE Std 802.1Q; see the
  standard itself for full legal notices.";
revision 2023-07-03 {
  description
    "LLDP extension TLVs for the ciSet. Published as part of IEEE Std
    802.1Qcz-2023.";
  reference
    "Annex D of IEEE Std 802.1Q";
}
grouping congestion-isolation-tlv {
  description
    "Congestion Isolation TLV";
  reference
    "D.2.15 of IEEE Std 802.1Q";
  list queue-map {
    key "priority";
    description
      "Eight integer octets, one entry for each traffic class indexed
      by priority. Each octet specifies a value that can be translated
      to the numeric value of the traffic class to be used as either
      the congesting traffic class or the monitored traffic class for
      the traffic class specified by the index. The octets range in
      value from -8 to 8. A value of 0 in the list specifies that the
      traffic class is not participating in congestion isolation. A
      positive number specifies a traffic class for a monitored queue
      that is one less than the value (e.g., a value of 5 represents
      traffic class 4). A negative number specifies a traffic class for
      a congesting queue that is one less than the absolute value
      (e.g., a value of -4 represents traffic class 3).";
    reference
      "D.2.15.3 of IEEE Std 802.1Q";
    leaf priority {
      type dot1q-types:priority-type;
      description
        "There are eight values of Priority that map to an absolute
        value that is a traffic class plus one, or the value 0 which
        indicates the traffic class is not used by congestion
        isolation.";
      reference
        "D.2.15.3 of IEEE Std 802.1Q";
    }
    leaf queue-config {
      type dot1q-ci:abs-traffic-class-plus-one-type;
```

```
      description
        "A value that can be translated to represent a traffic class or
        an indication of non-use. A value of 0 specifies that the
        traffic class is not participating in congestion isolation. A
        positive number specifies a traffic class for a monitored
        queue, and a negative number specifies a traffic class for a
        congesting queue.";
      reference
        "D.2.15.3 of IEEE Std 802.1Q";
    }
  }
  leaf cim-encap-length {
    type uint16;
    description
      "The minimum number of octets to include in the Encapsulated MSDU
      field of each CIM generated. The default value is 48.";
    reference
      "D.2.15.4 of IEEE Std 802.1Q";
  }
  leaf mac-address {
    type ieee:mac-address;
    config false;
    description
      "The MAC address to be used as the destination MAC address of a
      CIM sent by the peer to reach this station.";
    reference
      "D.2.15.5 of IEEE Std 802.1Q";
  }
  leaf udp-port-number {
    type inet:port-number;
    config false;
    description
      "The UDP port number to be used as the destination port number of
      a layer-3 CIM sent by the peer to reach this station.";
    reference
      "D.2.15.6 of IEEE Std 802.1Q";
  }
  leaf ip-address {
    type inet:ip-address;
    config false;
    description
      "This leaf holds the IP address that will be used to populate
      both the address family and IP address fields of the TLV. The IP
      address field in the TLV is an octet string to be encoded in
      network octet order with length of 0, 4, or 16 octets dependent
      upon the address family. If this leaf is an IPv4 address, the
      address family field is 1 and the IP address field is 4 octets
      representing the IPv4 address (e.g., IPv4 address 192.0.2.10
      would be encoded as C0-00-02-0A). If this leaf is an IPv6
      address, the address family field is 2 and the IP address field
      is 16 octets representing the IPv6 address. No address shall be
      provided for any other address families.";
    reference
      "D.2.15.7 and D.2.15.8 of IEEE Std 802.1Q";
  }
}
augment "/lldp:lldp/lldp:port" {
  description
    "Augments port with Congestion Isolation extension TLVs";
  leaf tlvs-tx-org-ci-enable {
    type bits {
      bit congestion-isolation {
        position 0;
        description
          "Enables transmission of the Congestion Isolation TLV in the
          ciSet";
      }
    }
    description
      "Bitmap that includes the ciSet of TLVs from Table D-1 of
      IEEE Std 802.1Q";
    reference
```

```
        "D.2 of IEEE Std 802.1Q";
    }
    container congestion-isolation-tlv-extension {
      description
        "The Congestion Isolation TLV";
      uses congestion-isolation-tlv;
    }
  }
  augment "/lldp:lldp/lldp:port/lldp:remote-systems-data" {
    description
      "Augments port remote-systems-data with received Congestion
      Isolation extension TLVs";
    container congestion-isolation-tlv-extension {
      description
        "Holds a received Congestion Isolation TLV";
      uses congestion-isolation-tlv;
    }
  }
}
```

D.6.6.6 The ieee802-dot1q-lldp-tr-tlv YANG module

```
module ieee802-dot1q-lldp-tr-tlv {
  yang-version "1.1";
  namespace urn:ieee:std:802.1Q:yang:ieee802-dot1q-lldp-tr-tlv;
  prefix lldp-tr-tlv;
  import ieee802-dot1ab-lldp {
    prefix lldp;
  }
  organization
    "Institute of Electrical and Electronics Engineers";
  contact
    "WG-URL: http://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
    "IEEE Std 802.1Q extension TLVs for LLDP from the Topology
    Recognition set (trSet)

    References in this YANG module to IEEE Std 802.1Q are to IEEE Std
    802.1Q-2022 as amended by IEEE Std 802.1Qcz-2023.

    Copyright (C) IEEE (2023).

    This version of this YANG module is part of IEEE Std 802.1Q; see the
    standard itself for full legal notices.";
  revision 2023-07-03 {
    description
      "LLDP extension TLVs for the trSet. Published as part of IEEE Std
      802.1Qcz-2023.";
    reference
      "Annex D of IEEE Std 802.1Q";
  }
  grouping topology-recognition-tlv-lldp {
    description
      "System level components of Topology Recognition TLV";
    reference
      "D.2.16 of IEEE Std 802.1Q";
    leaf device-type {
      type enumeration {
        enum end-station {
          value 0;
          description
            "Indicates that the device is a non-relay end-station or
```

```
          server.";
        }
        enum bridge {
          value 1;
          description
            "Indicates that the device is a layer-2 bridge.";
        }
        enum router {
          value 2;
          description
            "Indicates that the device is a layer-3 router.";
        }
        enum unknown {
          value 255;
          description
            "Indicates that the device type is unknown.";
        }
      }
      config false;
      description
        "Identifies the type of system performing Topology Recognition";
      reference
        "D.2.16.3 of IEEE Std 802.1Q";
    }
    leaf topology-level {
      type uint8;
      description
        "A single octet unsigned integer that indicates the system's
        understanding of its current level in the topology. The value of
        0 indicates the edge of the topology and the value 255 indicates
        the level is currently unknown. Other non-zero values indicate
        the minimum number of links between the system and the edge of
        the topology. Initially systems may not know their position in
        the topology and will use the value of unknown by default. As
        systems discover the device type and topology level of their
        peers the topology level of the sending system may change.";
      reference
        "D.2.16.4 of IEEE Std 802.1Q";
    }
  }
  grouping topology-recognition-tlv-port {
    description
      "Port level components of Topology Recognition TLV";
    reference
      "D.2.16 of IEEE Std 802.1Q";
    leaf port-orientation {
      type enumeration {
        enum uplink {
          value 0;
          description
            "Indicates that the port is facing a system deeper in the
            topology.";
        }
        enum downlink {
          value 1;
          description
            "Indicates that the port is facing a system closer to the
            edge of the topology.";
        }
        enum crosslink {
          value 2;
          description
            "Indicates that the port is facing a system at the same level
            in the topology.";
        }
        enum unknown {
          value 255;
          description
            "Indicates that the port orientation is unknown.";
        }
      }
      description
```

```
        "Indicates whether the port is facing an uplink, downlink,
        crosslink or the orientation is currently unknown. Initially
        systems may not know the port orientation and will use the value
        of unknown by default. As systems discover the device type and
        topology level of their peers the port orientation of the sending
        system may change.";
      reference
        "D.2.16.5 of IEEE Std 802.1Q";
    }
  }
  augment "/lldp:lldp" {
    description
      "Augments lldp with information at the system level needed to
      construct Topology Recognition TLVs";
    reference
      "D.2.16 of IEEE Std 802.1Q";
    container topology-recognition-tlv-extension {
      description
        "The system level components of the Topology Recognition TLV";
      uses topology-recognition-tlv-lldp;
    }
  }
  augment "/lldp:lldp/lldp:port" {
    when
      "lldp:name";
    description
      "Augments port with Topology Recognition extension TLVs";
    leaf tlvs-tx-org-tr-enable {
      type bits {
        bit topology-recognition {
          position 0;
          description
            "Enables transmission of the Topology Recognition TLV in the
            trSet";
        }
      }
      description
        "Bitmap that includes the trSet of TLVs from Table D-1 of
        IEEE Std 802.1Q";
      reference
        "D.2 of IEEE Std 802.1Q";
    }
    container topology-recognition-tlv-extension {
      description
        "The port level components of the Topology Recognition TLV";
      uses topology-recognition-tlv-port;
    }
  }
  augment "/lldp:lldp/lldp:port/lldp:remote-systems-data" {
    description
      "Augments port remote-systems-data with received Topology
      Recognition extension TLVs";
    container congestion-isolation-tlv-extension {
      description
        "Holds a received Topology Recognition TLV";
      uses topology-recognition-tlv-lldp;
      uses topology-recognition-tlv-port;
    }
  }
}
```

Insert new Annex W after Annex V as follows and re-number the existing Annex W as Annex X:

Annex W

(informative)

Maintaining frame order with Congestion Isolation

The process of congestion isolation involves identifying the frames of a congesting flow and subsequently modifying the egress traffic class of those frames based on the level of congestion in the monitored and congesting queues. During this process, it is possible that frames for the same flow can exist in multiple queues at the same time, resulting in the possibility of an out-of-order frame delivery. As an illustration, consider the following example depicted in Figure W-1.

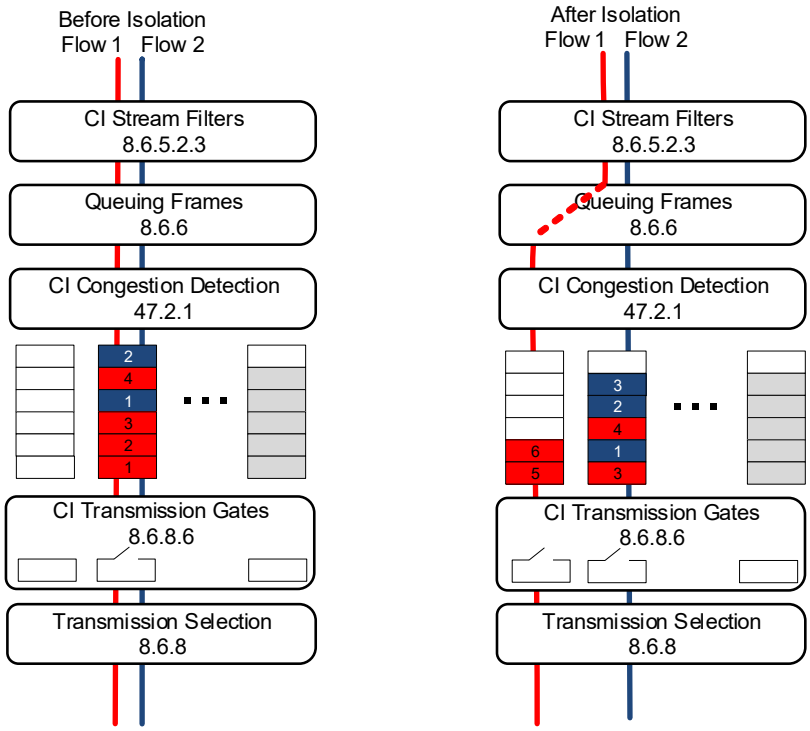


Figure W-1—Isolation out-of-order frame example

In the example in Figure W-1, the frames of two flows, red and blue, are intermixed while traversing a common monitored queue. As the monitored queue fills, the red flow is determined to be a congesting flow and subsequent frames of that flow will be reclassified and queued in the congesting queue. Previously received frames for that flow, numbered 1 through 4, may reside in the monitored queue. Since the congesting queue is empty, the subsequent frames, numbered 5 and 6, are placed at the head of the congesting queue. Depending upon the traffic selection algorithm, it may be possible for frames 5 and 6 to be selected for transmission before some of frames 1 through 4.

The priority of the congesting queue is lower than the priority of the monitored queue. The strict priority transmission selection algorithm (8.6.8.1) will ensure that no out-of-order frame delivery occurs, however there is a risk of starvation for congesting flows and alternative traffic selection algorithms may be desired. The enhanced transmission selection algorithm (8.6.8.3) or other vendor specific algorithms may not ensure no out-of-order delivery without special consideration.

While the strict priority transmission selection algorithm can ensure in-order delivery when congesting flows are isolated to the congesting queue, it does not ensure in-order delivery when those flows are returned to non-congesting status except in the case where both the congesting and monitored queues themselves become empty. Implementations may want to free resources and reduce flow completion time by returning flows to non-congesting status as soon as possible. This, however, may create another situation where frames from the same flow exist in both the congesting and monitored queue at the same time. Figure W-2 shows an example of possible out-of-order frame delivery when de-isolating a flow (i.e., returning the flow to non-congesting status).

In the example in Figure W-2, a red flow has been isolated to the congesting queue and the blue flow is traversing the monitored queue. Since the queue occupancy is low in both queues, the implementation may decide to de-isolate the red flow. Subsequent frames 7 and 8 will now be placed in the monitored queue resulting in frames from the red flow existing in both queues at the same time. The monitored queue is scheduled at a higher priority or with a greater frequency than the congesting queue and it may become possible for frames 7 and 8 to exit the system ahead of frames 5 and 6. Waiting for the congesting queue to completely empty before de-isolating any congesting flows can ensure in-order delivery during de-isolation, but it may leave flows in a congesting state longer than necessary and makes the transition of one congesting flow dependent upon all other congesting flows.

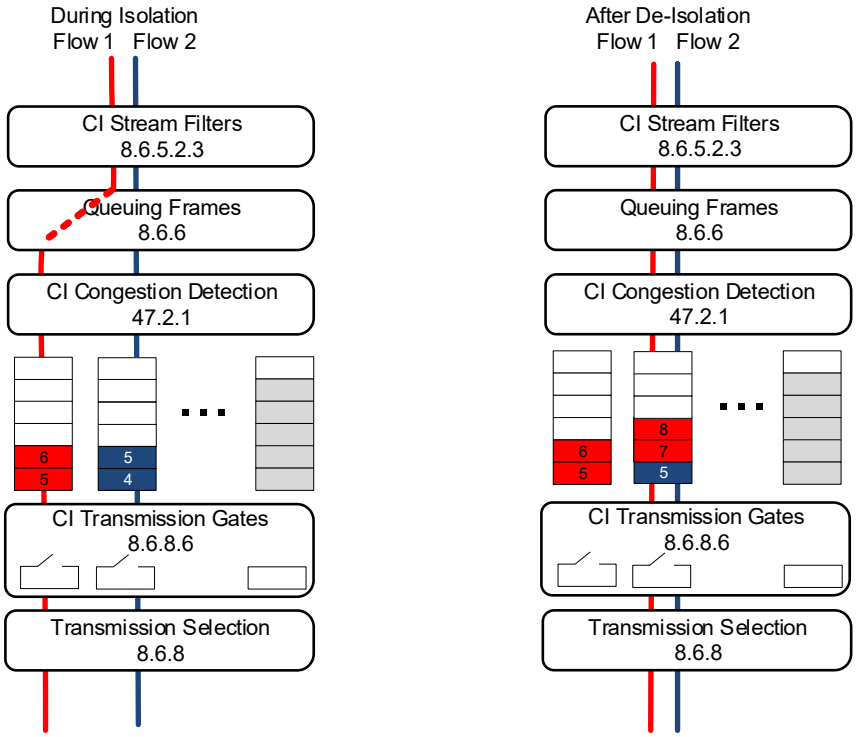


Figure W-2—De-isolation out-of-order frame example

Congestion isolation defines a transmission gate (8.6.8.6) for the monitored and congesting queues that make those queues available to the transmission selection algorithm. When the transmission selection algorithm is strict priority, the transmission gate is permanently *open*. The transmission gate is controlled by the cipGateControl variable for other transmission selection algorithms that can not ensure in-order delivery at all times. The management of cipGateControl is implementation dependent, but must be asserted in a way to ensure the externally visible behavior of the Bridge supporting congestion isolation is to maintain frame order.

The following informative description provides example mechanisms to preserve frame order when isolating and de-isolating flows.

W.1 Queue markers for order preservation

The mechanism below provides control of the cipGateControl variable for a congesting queue in order to preserve the order of frames for a contested flow. It involves a queue position marker and marker counter for both the monitored and congesting queues. The mechanism is described using the example shown in Figure W-3.

The example in Figure W-3 shows the state of the position markers and marker counters during four different phases of congestion isolation operation; before a flow is isolated, position marking during the isolation of a flow, the closing of the congesting queue transmission gate, and the opening of the congesting queue transmission gate. When a queue transmission gate is open, that queue is available to the traffic selection algorithm. When it is closed, the queue is not available to the traffic selection algorithm.

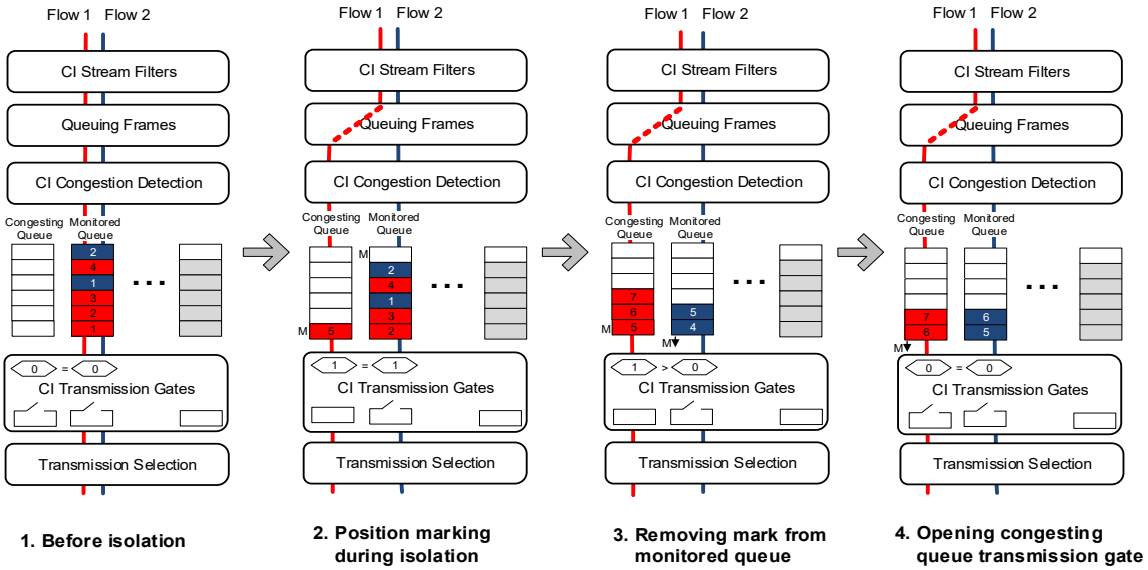


Figure W-3—Using queue markers and counters to preserve order when isolating

In the example, the frames of two flows are intermixed in the monitored queue as they traverse the Bridge. Since no flows have been isolated yet, the position marker counters of both the congesting queue and the monitored queue are set to 0. Once a flow has been isolated and subsequent frames of that flow are placed in the congesting queue, a marker is placed in both the congesting queue and the monitored queue. The marker counter is incremented for both queues once the position is marked. The congesting queue is empty at the time the first flow is isolated, so the marker will be at the head of the queue. When a marker is at the head of the congesting queue and the marker counters are equal, the cipGateControl variable for the congesting queue is set to closed. The monitored queue continues to drain and eventually the position marker will reach

the head of the monitored queue. The marker counter for the monitored queue will be decremented when the frame associated with the position marker is scheduled for transmission and exits the queue. When the value of the congesting queue marker counter is greater than the monitored queue position counter, it is possible to set the cipGateControl variable to open and begin to schedule the congesting queue. Whenever a frame that aligns with a position marker is scheduled for transmission, the associated marker counter is decremented.

A variation of the mechanism above can be used to ensure in-order delivery when de-isolating a flow (i.e., returning a flow to non-congesting status). A separate set of counters and markers can be used to identify the positions in the queues when a congesting flow is allowed to begin to use the monitored queue again.

The example in Figure W-4 shows the state of a separate set of position markers and marker counters during four different phases of the congestion de-isolation process; during isolation, during initial de-isolation, closing the monitored queue, and opening the monitored queue once order has been ensured. In the example, the red flow is currently isolated to the congesting queue and the blue flow is traversing the monitored queue. Since there are no flow ordering issues the counters are initialized to 0. When the implementation decides to de-isolate the red flow, it places a marker after the last frame of the red flow in the congesting queue and with the next frame of the congesting flow in the monitored queue. The counters are incremented each time a marker is placed in the queue. The queue scheduling continues when the counters are equal and no markers are at the head of the monitored queue. Once the marker of the monitored queue reaches the head of the queue, the transmission gate for the monitored queue is closed by setting the cipGateControl variable to *closed*. The lower priority congesting queue is scheduled, allowing the previously isolated frames to be transmitted. Once the marker in the congesting queue is removed and the counter is decremented, the monitored queue gate is opened by setting cipGateControl to *open* and the normal scheduling continues.

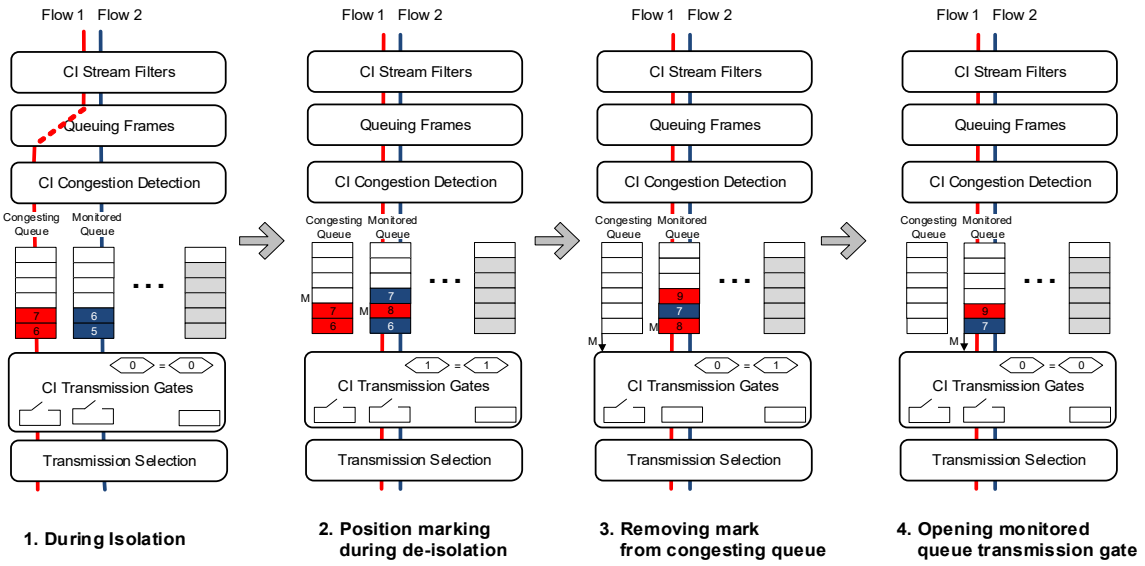


Figure W-4—Using queue markers and counters to preserve order when de-isolating

The marker and counter mechanism described in these examples is fairly simple, but care must be taken when combining the mechanisms for isolation and de-isolation to ensure no deadlocks exist. Implementation details depend on queue and memory architectures and are beyond the scope of this standard.

W.2 Congestion Isolation queuing and Priority-based Flow Control

Priority-based Flow Control (PFC) (Clause 36) is used to create a lossless network on the traffic classes for which it is enabled. PFC, as defined by this standard, is intentionally ambiguous about when the PFC Initiator entity (36.2.1) generates M_CONTROL PFC requests using the M_CONTROL.request primitive. This allows implementation flexibility, as there are many possible buffering and queuing approaches used in practice. Some Bridges may be input buffered, others may be primarily output buffered with small ingress buffers, some may have shared memory and others may use combinations of different memory architectures. In each implementation, the events that cause the PFC Initiator entity to generate an M_CONTROL PFC request may be different. In all cases, however, the purpose of PFC is to avoid dropping frames, not only within a single Bridge but across the entire network. The PFC Initiator is expected to generate an M_CONTROL PFC request when internally Bridge buffering is not able to absorb the reception of additional frames. The M_CONTROL PFC request is expected to eliminate the chance of frame loss.

PFC is known to cause congestion spreading and has recommended use within the data center because of its limited extent (36.1.1). One of the key objectives for congestion isolation is to reduce the frequency of PFC requests and avoid head-of-line blocking in lossless data center networks. By reducing the frequency of PFC requests the impact of congestion spreading can be reduced. Congestion isolation does this by isolating congesting flows to a separate congesting queue, reducing the need to invoke PFC requests caused by congesting flows. During the isolation process, however, it is possible for frames of the same flow to be in multiple queues at the same time, both within the local system and the upstream peer. This scenario can require special consideration for the design of the PFC Initiator.

Consider the Bridge architecture shown in Figure W-5. In the figure, the 4-port Bridge has small ingress buffers, shown on port 1, designed to absorb received frames while forwarding decisions are made. There are two priorities represented in the figure. In this example, priority 3 is the congesting queue and priority 4 is the monitored queue. In the example, frames are being forwarded from port 1 to the egress buffers of port 3. The shaded buffers are assumed to be occupied.

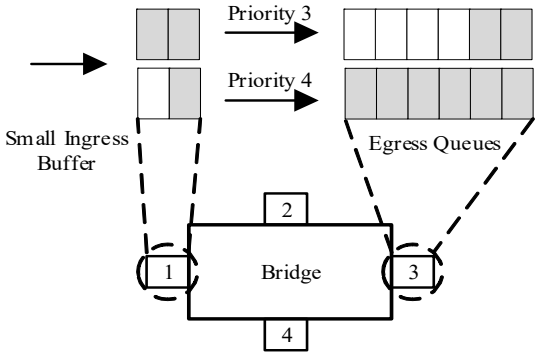


Figure W-5—Example Bridge buffering supporting PFC and CI

When congestion isolation occurs, as seen in Figure W-6, frames received by the downstream Bridge will begin to be placed in the congesting queue (priority 3). A CIM is sent upstream to inform the peer to isolate the same flow. The upstream peer has several frames queued in the monitored queue and will continue transmission while the CIM is in flight.

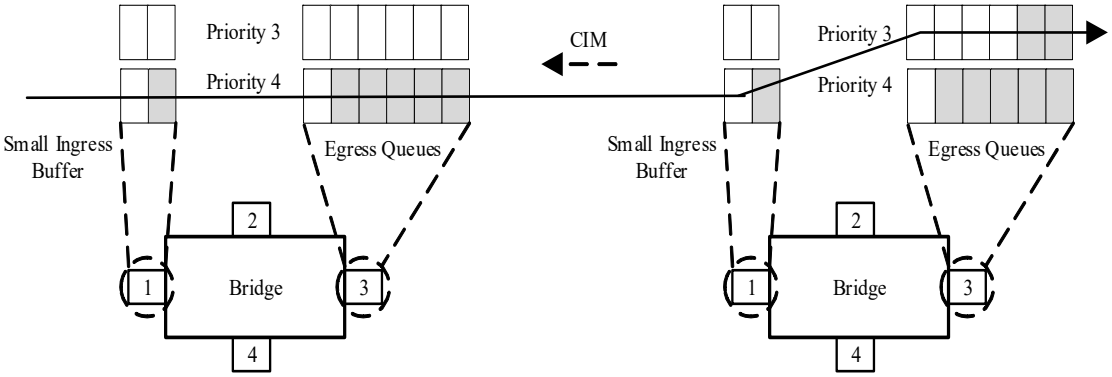


Figure W-6—Example CI initiation by downstream peer

During the isolation process, as seen in Figure W-7, frames will continue to drain from the monitored queue of the upstream peer and will begin to accumulate in the congesting queue. Since the monitored queue has higher priority than the congesting queue, and to avoid delivering out-of-order frames, the scheduling of the congesting queue in the upstream peer is blocked. Frames from the congesting flow accumulate in the congesting queue of the downstream Bridge while previous frames begin to drain from the monitored queue. When multiple flows are sharing the monitored queue the number of frames accumulating in the congesting queue can increase. Since frames for the congesting flow are still in the monitored queue upstream, they will egress the upstream peer at priority 4.

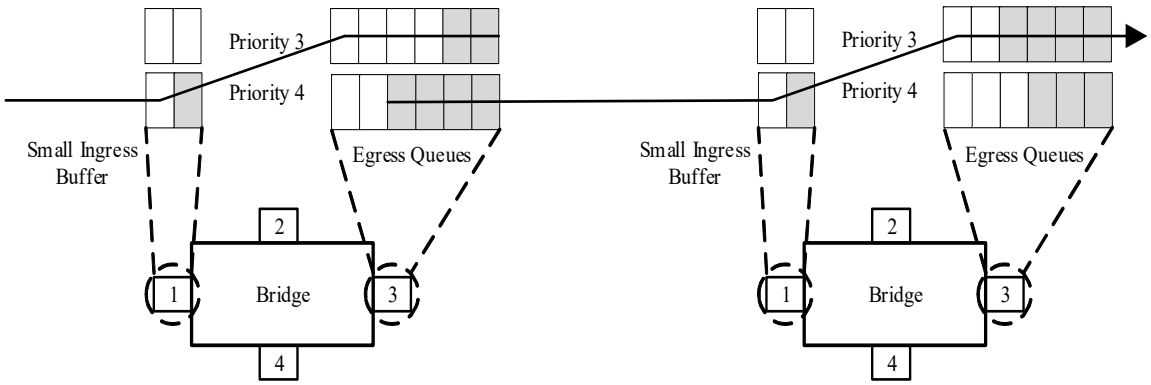


Figure W-7—Example CI in process

If the congesting queue is not allowed to drain at a rate faster than it is being filled, the congesting queue can become exhausted, as seen in Figure W-8. Since the congesting queue is at priority 3, the natural response to an exhausted queue in a lossless environment would be to issue a PFC request on priority 3. However, in the example, there are still frames for the congesting flow egressing the upstream peer at priority 4. A pause on priority 3 will have no effect. Additional frames received at priority 4 on the downstream Bridge may be dropped unless a PFC request is issued at priority 4.

.

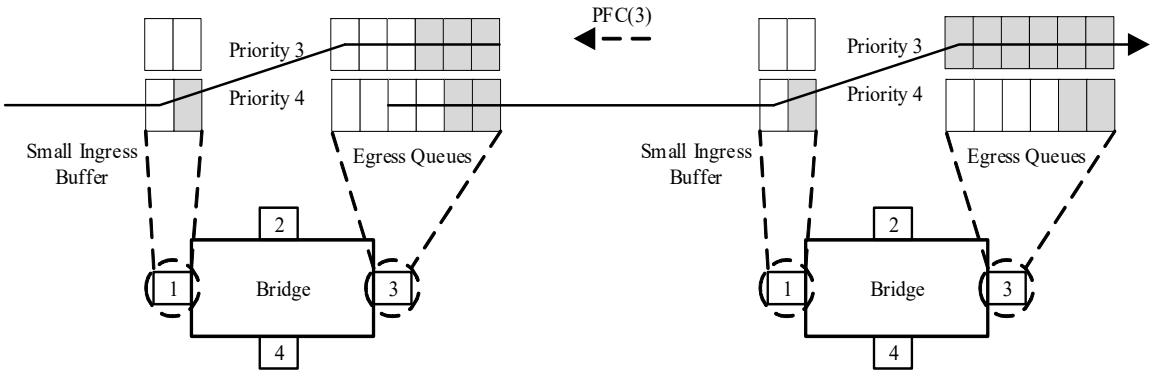


Figure W-8—Example PFC request for congesting queue

The problem with the example in Figure W-8 is that the PFC Initiator is considering the occupancy of the egress queue as the stimulus for issuing the PFC without considering the frame's priority at ingress. The PFC design in this example is not taking into account that a frame's priority may be changed by congestion isolation after reception.

One solution to the problem is for the Bridge to hold the frame at ingress until there is space at egress to queue it. The PFC Initiator can be solely based on the occupancy of the ingress buffers in this case. A PFC request would only be issued for the priority of received frames that have no space in their ultimate egress queue. Obviously it is critical that the downstream Bridge can determine the traffic class used by the upstream peer to transmit the frame.

Figure W-9 shows the scenario where the PFC request is issued on priority 4 to prevent frame loss within the downstream Bridge even though those frames will egress the downstream Bridge at priority 3. This scenario avoids internal packet loss, but has the unfortunate consequence of blocking the monitored queue and potentially creating head-of-line blocking for other non-isolated flows. While this unfortunate scenario only exists in a lossless environment, it defeats the purpose of congestion isolation. The scenario does not create an erroneous situation and is expected to be rare.

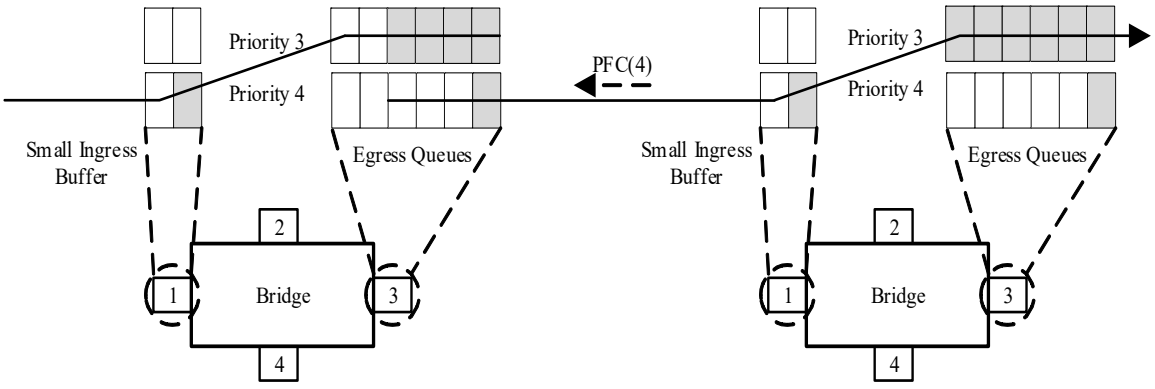


Figure W-9—Example PFC request to avoid packet loss with CI enabled

Annex X

(informative)

Bibliography

Change Annex X (re-numbered from Annex W by the insertion of new Annex W above) as follows, updating cross-references as necessary:

Bibliographical references are resources that provide additional or helpful material but do not need to be understood or used to implement this standard. Reference to these resources is made for informational use only.

[B1] Alizadeh, M., B. Atikoglu, A. Kabbani, A. Lakshmikantha, R. Pan, B. Prabhakar, and M. Seaman, "Data Center Transport Mechanisms: Congestion Control Theory and IEEE Standardization," *Proceedings of the 46th Annual Allerton Conference on Communication, Control and Computing*, Urbana-Champaign, Sept. 2008.

[B2] Asynchronous Transfer Mode (ATM): A collection of equipment and standards used for telecommunications and data transfer, https://www.itu.int/ITU-T/ and https://www.broadband-forum.org.

[B3] Calculating the Delay Added by Qav Stream Queue, https://www.ieee802.org/1/files/public/docs2009/av-fuller-queue-delay-calculation-0809-v02.pdf.

[B4] Duato, J., "A Necessary and Sufficient Condition for Deadlock-Free Routing in Cut-Through and Store-and-Forward Networks," *IEEE Transactions on Parallel and Distributed Systems*," vol. 7, no. 8, pp. 841–854, Aug. 1996. doi:10.1109/71.532115.

[B5] Hu, S., Y. Zhu, P. Cheng, C. Guo, K. Tan, J. Padhye, and K. Chen "Tagger: Practical PFC Deadlock Prevention in Data Center Networks," *Proceedings of the 13th International Conference on emerging Networking EXperiments and Technologies (CoNEXT '17)*, ACM, New York, NY, USA, pp. 451–463. doi:10.1145/3143361.3143382.

[B6] IEC 62439-3:2016, Industrial communications networks—High availability automation networks—Part 3: Parallel Redundancy Protocol (PRP) and High-availability Seamless Redundancy (HSR).[19]

[B7] IEEE Std 802®™-2014, IEEE Standard for Local and Metropolitan Area Networks—Overview and Architecture.[20, 21]

[B8] IEEE Std 802.1AB™-2005, IEEE Standard for Local and metropolitan area networks—Station and Media Access Control Connectivity Discovery.

[B9] IEEE Std 802.1AB™-2009, IEEE Standard for Local and metropolitan area networks—Station and Media Access Control Connectivity Discovery.

[B10] IEEE Std 802.1AC™-2016, IEEE Standard for Local and metropolitan area networks—Media Access Control (MAC) Service Definition.

[B11] IEEE Std 802.1BA™, IEEE Standard for Local and Metropolitan Area Networks—Audio Video Bridging (AVB) Systems.

[19] IEC publications are available from the International Electrotechnical Commission (https://www.iec.ch) and the American National Standards Institute (https://www.ansi.org/).

[20] The IEEE standards or products referred to in Annex X are trademarks owned by The Institute of Electrical and Electronics Engineers, Incorporated.

[21] IEEE publications are available from The Institute of Electrical and Electronics Engineers (https://standards.ieee.org/).

[B12] IEEE Std 802.1D™, 1993 Edition [ISO/IEC 10038:1993], IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local area networks—Media Access Control (MAC) bridges.

[B13] IEEE Std 802.1D™, 1998 Edition [ISO/IEC 15802-3:1998], IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Common specifications—Part 3: Media Access Control (MAC) Bridges.

[B14] IEEE Std 802.1D™-2004, IEEE Standard for Local and metropolitan area networks—Media Access Control (MAC) Bridges.

[B15] IEEE Std 802.3™-2018, IEEE Standard for Ethernet.

[B16] IEEE Std 802.11™-2016, IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements—Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications.

[B17] IEEE Std 1588-2019, IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurements and Control Systems.

[B18] IEEE Std 1722™, IEEE Standard for a Transport Protocol for Time-Sensitive Applications in Bridged Local Area Networks.

NOTE—See also IEC 61883-6:2005, Consumer audio/video equipment—Digital Interface—Part 6: Audio and music data transmission protocol and IEC 61883-4:2004, Consumer audio/video equipment—Digital Interface—Part 4: MPEG2-TS data transmission.

[B17] ~~IETF RFC 768 (STD0006), User Datagram Protocol, August 1980.~~

[B18] ~~IETF RFC 791, Internet Protocol DARPA Internet Program Protocol Specification, September 1981.~~

[B19] IETF RFC 793 (STD0007), Transmission Control Protocol, September 1981.[22]

[B20] IETF RFC 1321, The MD5 Message-Digest Algorithm, April 1992.

[B21] IETF RFC 1633, Integrated Services in the Internet Architecture: an Overview, June 1994.

[B22] IETF RFC 2210, The Use of RSVP with IETF Integrated Services, September 1997.

[B23] IETF RFC 2211, Specification of the Controlled-Load Network Element Service, September 1997.

[B24] IETF RFC 2212, Specification of Guaranteed Quality of Service, September 1997.

[B25] IETF RFC 2215, General Characterization Parameters for Integrated Service Network Elements, September 1997.

[B26] IETF RFC 2475, An Architecture for Differentiated Services, December 1998.

[B27] IETF RFC 2597, Assured Forwarding PHB Group, June 1999.

[B28] IETF RFC 2814, SBM (Subnet Bandwidth Manager): A Protocol for RSVP-based Admission Control over IEEE 802-style Networks, May 2000.

[B29] IETF RFC 2815, Integrated Service Mappings on IEEE 802 Networks, May 2000.

[22] IETF RFCs are available from the Internet Engineering Task Force (https://www.ietf.org/).

[B30] IETF RFC 2816, A Framework for Integrated Services Over Shared and Switched IEEE 802 LAN Technologies, May 2000.

[B31] IETF RFC 3031, Multiprotocol Label Switching Architecture, January 2001.

[B32] IETF RFC 3246, An Expedited Forwarding PHB (Per-Hop Behavior), March 2002.

[B33] IETF RFC 3270, Multi-Protocol Label Switching (MPLS) Support of Differentiated Services, May 2002.

[B34] IETF RFC 4655, A Path Computation Element (PCE)-Based Architecture, August 2006.

[B35] IETF RFC 4663, Transferring MIB Work from IETF Bridge MIB WG to IEEE 802.1 WG, September 2006.

[B36] IETF RFC 4960, Stream Control Transmission Protocol, September 2007.

[B37] IETF RFC 5306, Restart Signaling for IS-IS, October 2008.

[B38] IETF RFC 6087, Guidelines for Authors and Reviewers of YANG Data Model Documents, January 2011.

[B39] IETF RFC 6241, Network Configuration Protocol (NETCONF), June 2011.

[B40] IETF RFC 6242, Using the NETCONF Protocol over Secure Shell (SSH), June 2011.

[B41] IETF RFC 6536, Network Configuration Protocol (NETCONF) Access Control Model, March 2012.

[B42] IETF RFC 6762, Multicast DNS, February 2013.

[B43] IETF RFC 7223, A YANG Data Model for Interface Management, May 2014.

[B44] IETF RFC 7319, IANA Considerations for Connectivity Fault Management (CFM) Code Points, July 2014.

[B45] IETF RFC 7567, IETF Recommendations Regarding Active Queue Management, July 2015.

[B46] IETF RFC 8014, An Architecture for Data-Center Network Virtualization over Layer 3 (NVO3), December 2016.

[B47] IETF RFC 8040, RESTCONF Protocol, January 2017.

[B46] ~~IETF RFC 8200 (STD0086), Internet Protocol, Version 6 (IPv6) Specification, July 2017.~~

[B48] ITU-T Recommendation G.806, Characteristics of transport equipment—Description methodology and generic functionality.[23]

[B49] ITU-T Recommendation G.8031/Y.1342, Ethernet linear protection switching.

[B50] ITU-T Recommendation I.610 (02/1999), B-ISDN operation and maintenance principles and functions.

[B51] ITU-T Recommendation X.25 (10/1996), Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit.

[23] ITU-T publications are available from the International Telecommunications Union (https://www.itu.int/).

[B52] MEF Technical Specification 4 (MEF 4), Metro Ethernet Network Architecture Framework—Part 1: Generic Framework, May 2004.[24]

[B53] MEF Technical Specification 16 (MEF 16), Ethernet Local Management Interface (E-LMI), January 2006.

[B54] MEF Technical Specification 26 (MEF 26), External Network Network Interface (ENNI)—Phase 1, January 2010.

[B55] MEF 35.1, Service OAM Performance Monitoring Implementation Agreement.

[B56] MoCA MAC/PHY Specification Extensions v1.1, MoCA-M/P-SPEC-V1.1-06162009, June 2009.[25]

[B57] MoCA MAC/PHY Specification v2.0, MoCA_Specification_v2-131121, November 2013.

[B58] Multiprotocol Label Switching (MPLS): A standard for label-based forwarding in an IP network. The standard is specified in several RFCs, (see https://datatracker.ietf.org/doc/charter-ietf-mpls/) and ITU-T recommendations (see https://www.itu.int/ITU-T/).

[B59] OMG Unified Modeling Language (OMG UML), Version 2.5.1, December 2017.

[B60] Rocher-Gonzalez, J., J. Escudero-Sahuquillo, P. J. Garcia, F. J. Quiles, "On the Impact of Routing Algorithms in the Effectiveness of Queuing Schemes in High-Performance Interconnection Networks," *2017 IEEE 25th Annual Symposium on High-Performance Interconnects (HOTI)*, Santa Clara, CA, 2017, pp. 65–72. doi:10.1109/HOTI.2017.16.

[B61] Seaman, M., "Preemption and MACsec replay protection," available at https://www.ieee802.org/1/files/public/docs2014/ae-seaman-preemption-1114-v04.pdf, November 2014.

[B62] SMPTE 259M-2008, SMPTE Standard for Television—SDTV Digital Signal/Data—Serial Digital Interface, 2008. See section 8.[26]

[B63] SMPTE 292M-2008, SMPTE Standard 1.5 Gb/s Signal/Data Serial Interface, 2008.

[B64] SMPTE 424M-2012, SMPTE Standard for Television—3 Gb/s Signal/Data Serial Interface.

[B65] Specht, J., and S. Samii, "Urgency-Based Scheduler for Time-Sensitive Switched Ethernet Networks," *28th Euromicro Conference on Real-Time Systems (ECRTS)*, pp. 75–85, 2016.

[B66] Teener, M. J., "Peristaltic Shaper: updates, multiple speeds," available at https://www.ieee802.org/1/files/public/docs2014/new-tsn-mjt-peristaltic-shaper-0114.pdf, January 2014.

[B67] Xu, L., K. Harfoush, and I. Rhee, "Binary increase congestion control (BIC) for fast long-distance networks," *IEEE INFOCOM 2004*, vol. 4, pp. 2514-2524, Mar. 2004.

[B68] Zhu, Y., H.Eran, D. Firestone, C. Guo, M. Lipshteyn, Y. Liron, J. Padhye, S. Raindel, M. H. Yahia, and M. Zhang, 2015. "Congestion Control for Large-Scale RDMA Deployments," *ACM SIGCOMM Computer Communication Review*, 45(4), pp. 523–536. doi:10.1145/2785956.2787484.

[24] MEF publications are available from the MEF Forum (https://www.mef.net/).
[25] MoCa publications are available from the Multimedia over Coax Alliance (https://mocalliance.org).
[26] SMPTE publications are available from the Society of Motion Picture and Television Engineers (https://www.smpte.org).

IEEE SA
STANDARDS ASSOCIATION

RAISING THE WORLD'S STANDARDS

Connect with us on:

Twitter: twitter.com/ieeesa
Facebook: facebook.com/ieeesa
LinkedIn: linkedin.com/groups/1791118
Beyond Standards blog: beyondstandards.ieee.org
YouTube: youtube.com/ieeesa

standards.ieee.org
Phone: +1 732 981 0060

IEEE