IEEE P802.1DC/contrib.

Suggested text for Draft Standard for Local and metropolitan area networks —

Quality of Service Provision by Network Systems

1 Contents

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for: Draft Standard for
Local and metropolitan area networks—

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1. Overview

1.1 Scope

This standard specifies procedures and managed objects for Quality of Service (QoS) features specified in IEEE Std 802.1Q, such as per-stream filtering and policing, queuing, transmission selection, stream control and preemption, in a network system which is not a bridge.

1.2 Purpose

1.3 State diagram conventions

This document uses the state diagram conventions defined in Annex E of IEEE Std 802.1Q-2018.

1.4 Specification model

The model of operation documented by this standard is simply a basis for describing the functionality of a compliant equipment. Implementations can adopt any internal model of operation compatible with the externally visible behavior that this standard specifies. Conformance of equipment to this standard is purely in respect of observable protocol.

1.5 Specification precedence

If any conflict among parts of this standard become apparent, C functions (see 1.3) take precedence over other parts of the standard, followed by information in normative Tables, followed by that in normative text, followed by that in normative Figures. Non-normative Tables, Figures, and text are in Annexes and are clearly marked as such.

1.6 Introduction

IEEE Std 802.1Q™ specifies the operation of Bridges and Bridged Networks. Certain parts of that specification can be classified as describing Quality of Service processes (QoS). QoS processes are those that affect the following parameters:

a) Latency: The time required to forward a frame[1] from source to destination through a bridged network.

b) Frame loss: The likelihood of discarding a frame, rather than forwarding it, due to various events occurring between the source and destination.

c) Variations in the above parameters.

These parameters can be applied to individual frames, or to collections of frames, such as a single flow of frames from one source application instance to another, all frames sharing the same priority value, or all frames bound for a particular destination. Minimums, maximums, averages, or any other mathematical function can be applied to the collection.

Processes that are *not* a part of QoS for the purposes of the present standard include:

d) Forwarding: the choice of output port(s), to which a given frame is forwarded by a Bridge.

e) Transformations that frames may undergo as they are forwarded due to forwarding decisions, e.g adding VLAN tags or updating fields in an IPv4 header.

Clauses 2, 3, and 4 contain the normative references, definitions, and abbreviations used in this standard, respectively. Clause 5 is the starting point for the requirements for various types of systems to claim compliance to this standard. Clause 6 helps the reader understand the specifications for QoS processes in IEEE Std 802.1Q. Clause 7 contains the specifications for non-Bridge systems to implement those QoS processes. Clauses 8, 9, and 10 define the managed objects to control these processes, and their YANG and MIB representations.

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1. Bridges, by definition, receive, transmit, and forward frames, as defined in IEEE Std 802. Other standards from IEEE and other organizations use the term "packet" for a unit if transmitted data. The casual reader can equate "frames" with "packets".

2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies. Non-normative references (i.e., that provide additional information not required for the application of this document) are given in Annex B.

NOTE—The inclusion of a document in this list of normative references indicates that information in that document is necessary to implement the present standard. It does not imply the that any other part of that referenced document is required to be implemented by a system conformant to the present standard.

IEEE Std 802™, IEEE Standards for Local and Metropolitan Area Networks: Overview and Architecture.[1, 2]

IEEE Std 802.1Q™, IEEE Standard for Local and metropolitan area networks—Bridges and Bridged Networks.

IEEE Std 802.1AX™, IEEE Standard for Local and metropolitan area networks—Link Aggregation.

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3. Definitions

The following terms are specific to this standard:

Company Identifier (CID): A 24-bit value, obtained from the IEEE Registration Authority Committee, that can be used for protocol identification.

Bridge: (From IEEE Std 802.1Q-2018) A system that includes Media Access Control (MAC) Bridge or Virtual Local Area Network (VLAN) Bridge component functionality and that supports a claim of conformance to Clause 5 of IEEE Std 802.1Q-2018 for system behavior.

end station: (From IEEE Std 802) A device attached to a LAN or MAN, which acts as a source of and/or destination for data traffic carried on the LAN or MAN.

end system: A system attached to a network that is an initial source or a final destination of data transmitted across that network.

NOTE—The term "end system" is often used in this document in places where the reader of IEEE 802 standards would expect the term, "end station," in order to avoid confusion caused by standards relating to routers. For example, a router, as defined by IETF, is an IEEE 802 "end station," but not an "end system." Where this standard specifically refers to the use of IEEE 802 services, the term "end station" is used. Where it refers to more generalized instances of associationless services, the term "end system" is used.

frame: (From IEEE Std 802) The format of aggregated bits from a medium access control (MAC) sublayer entity that are transmitted together in time.

Organizationally Unique Identifier (OUI): A 24-bit value, obtained from the IEEE Registration Authority Committee, that can be used for protocol identification.

relay system: A router or a bridge.

NOTE—The term "relay system" is often used in this document in places where the reader of IEEE 802 standards would expect the term, "bridge." A relay system can, in theory, be a router, a bridge, or some other kind of forwarding device. Where this standard specifically refers to one or the other, the terms "router" or "bridge" are used. Where it refers to more generalized instances of associationless services, the term "relay system" is used.

system: An end system or a relay system.

4. Abbreviations

This standard contains the following abbreviations:

CID   Company Identifier
OUI   Organizationally Unique Identifier
QoS   Quality of Service

5. Conformance

This clause specifies the mandatory and optional capabilities provided by conformant implementations of this standard.

5.1 Requirements terminology

For consistency with existing IEEE and IEEE 802.1 standards, requirements placed upon conformant implementations of this standard are expressed using the following terminology:

a) Shall is used for mandatory requirements;

b) May is used to describe implementation or administrative choices. "May" means "is permitted to," and hence, "may" and "may not" mean precisely the same thing;

c) Should is used for recommended choices. The behaviors described by "should" and "should not" are both permissible but not equally desirable choices.

The Protocol Implementation Conformance Statement (PICS) proformas (see Annex A) reflect the occurrences of the words "shall," "may," and "should" within the standard.

The standard avoids needless repetition and apparent duplication of its formal requirements by using is, is not, are, and are not for definitions and the logical consequences of conformant behavior. Behavior that is permitted but is neither always required nor directly controlled by an implementor or administrator, or whose conformance requirement is detailed elsewhere, is described by can. Behavior that never occurs in a conformant implementation or system of conformant implementations is described by cannot. The word allow is used as a replacement for the phrase "Support the ability for," and the word capability means "can be configured to."

5.2 End system required behaviors

An end system conformant to this standard shall, on one or more ports:

a) Conform to the end system architecture (7.1.1, 7.1.3).

b) Support all of the items listed in 5.6.

5.3 End system optional behaviors

An end system conformant to this standard may:

a) Support flow identification (7.2.1).

b) Support flow filtering (7.2.2).

c) Support flow metering (7.2.3).

d) Support any of the items listed in 5.7 on at least one port.

5.4 Relay system required behaviors

A relay system conformant to this standard shall, on more than one port:

a) Conform to the relay system architecture (7.1.2, 7.1.3).

b) Support all of the items listed in 5.6.

5.5 Relay system optional behaviors

A relay system conformant to this standard may:

    a)   Support any of the items listed in 5.7 on more than one port.

5.6 Common required behaviors

Any system conformant to this standard shall:

    a)   Support transmission selection by strict priority (7.2.4).

5.7 Common optional behaviors

Any system conformant to this standard may:

    a)   Support transmission selection by priority flow control (7.2.5).
    b)   Support transmission selection by enhanced transmission selection (7.2.6).
    c)   Support transmission selection by the credit-based shaper (7.2.7).
    d)   Support transmission selection by time-scheduled transmissions (7.2.8).
    e)   Support cyclic queuing and forwarding (7.2.9).
    f)   Support transmission selection by the asynchronous traffic shaper (7.2.10).

6. IEEE Std 802.1Q Quality of Service provision

6.1 Introduction

This purpose of this Clause 6 is to serve as a guide to the reader to understand the model for Quality of Service (QoS) provision in IEEE Std 802.1Q-2018. This clause contains no normative specifications. It lists the processes, gives some clue to their relationships, and provides references to the clauses in IEEE Std 802.1Q-2018 that specify the operation of these processes.

6.2 Bridge and end station model

6.2.1 Bridge model

6.2.2 End station model

6.3 Quality of service model

6.3.1 The forwarding process

The overall forwarding process is described succinctly in clause 8.6 of IEEE Std 802.1Q-2018. This clause describes "a day in the life of a frame"; it is a linear description of the processes through which a forwarded frame progresses. Some of these processes are not relevant to QoS, in that they are concerned with addressing, forwarding, VLAN classifications, and other matters that are tied to whether, or to which port, a Bridge forwards a frame, rather than how fast or how reliably the frame is forwarded. The following clauses call out the process that are relevant to QoS.

6.3.2 Flow identification, filtering, and metering

6.3.3 Forwarding

6.3.4 Class of service assignment

6.3.5 Queue management

   a)   Residence time exceeded

   b)   Drop precedence

6.3.5.1 Deterministic or probabilistic discard

6.3.6 Transmission selection

   a)   Strict priority

   b)   Priority flow control

   c)   Enhanced transmission selection

   d)   Credit-based shaper

   e)   Time-scheduled transmission

   f)   Cyclic queuing and forwarding

   g)   Asynchronous traffic shaper

1 **6.4 Other bridge processes relevant to QoS provision**

2 **6.4.1 Bridge port transmit and receive Y**

3 **6.4.2 Link Aggregation**

4 **6.4.3 Security Y**

7. Quality of Service Provision by Network Systems

7.1 Adapting the bridge QoS architecture to non-bridge systems

<< Contributor's note: These sections give a model for an end system (upper layers and one or more ports) and a relay system (ports and a relay function). The relay function is not specified, of course. The only functions of the ports that are discussed are QoS functions. The QoS functions in7.2 are ordered, insofar as they must be ordered for the model and managed object to make sense, and shown in the diagram. This section will also have text explaining that this clause is not an implementation guide, but is a model for matching the managed objects to externally-visible behaviors. >>

7.1.1 End systems

7.1.2 Non-bridge relay systems

7.1.3 Interpreting IEEE Std 802.1Q for non-bridges

<< Contributor's note: Basically for "Bridge", read, "relay system". For "bridge port", read "interface". However, no "shall" or "should" in IEEE Std 802.1Q-2018 is a requirement on a relay system conformant to the present standard except as called out in this Clause 7. >>

7.2 Quality of service specification

<< The following elements are mostly independent. The relationships among them are discussed in 7.1. Each

section, belows, tells you what, in IEEE 802.1Q, you must do in order to claim this feature for your non-Bridge

relay system. >>

7.2.1 Flow identification

<< Contributor's note: Flow identification, filtering, and metering are lumped together as "Per-Stream Filtering and Policing". They will be broken out as more-or-less separate features, all referencing the same areas of the text. >>

7.2.2 Flow filtering

7.2.3 Flow metering

7.2.4 Strict priority

7.2.5 Priority flow control

7.2.6 Enhanced transmission selection

7.2.7 Credit-based shaper

7.2.8 Time-scheduled transmission

7.2.9 Cyclic queuing and forwarding

7.2.10 Asynchronous traffic shaper

8. Managed Objects

<< Contributor's note: At present, it is unclear whether this will be a reference to clause 12 of IEEE 802.1Q-2018, or whether new managed objects will be needed. >>

9. YANG models

<< Contributor's note: At this time, it is not known to the contributor whether the brand-new IEEE 802.1Q YANG models are sufficiently separated from the rest of the Bridge YANG models to be usable by reference, so that a new YANG model for QoS is not needed in this document. If so, this clause will be deleted. If not, we have issues to deal with. See Clause 10 for similar issues with the MIB. >>

10. MIB modules

<< Contributor's note: The MIB modules that control queuing in IEEE Std 802.1Q are not usable by P802.1DC, because they are part of the Bridge MIB, and are indexed by Bridge Component and Bridge Port. A new MIB, tied to the interface stack, instead of the Bridge MIB, is required for P802.1DC. It is To Be Determined whether that new MIB is:

a)   A new MIB in P802.1DC that parallels the Bridge MIB.

b)   A new MIB in P802.1DC that is intended to replace part of the Bridge MIB.

c)   A new MIB in the next revision of 802.1Q that is referenced by P802.1DC.

d)   Some combination of the above.

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Annex A

(normative)

Protocol Implementation Conformance Statement (PICS) proforma

A.1 Introduction[1]

The supplier of an implementation that is claimed to conform to this standard shall complete the following protocol implementation conformance statement (PICS) proforma.

A completed PICS proforma is the PICS for the implementation in question. The PICS is a statement of which capabilities and options of the protocol have been implemented. A PICS is included at the end of each clause as appropriate. The PICS can be used for a variety of purposes by various parties, including the following:

a) As a checklist by the protocol implementor, to reduce the risk of failure to conform to the standard through oversight;

b) As a detailed indication of the capabilities of the implementation, stated relative to the common basis for understanding provided by the standard PICS proforma, by the supplier and acquirer, or potential acquirer, of the implementation;

c) As a basis for initially checking the possibility of interworking with another implementation by the user, or potential user, of the implementation (note that, while interworking can never be guaranteed, failure to interwork can often be predicted from incompatible PICS);

d) As the basis for selecting appropriate tests against which to assess the claim for conformance of the implementation, by a protocol tester.

A.1.1 Abbreviations and special symbols

The following symbols are used in the PICS proforma:

M	mandatory field/function
!	negation
O	optional field/function
O.<n>	optional field/function, but at least one of the group of options labeled by the same numeral <n> is required
O/<n>	optional field/function, but one and only one of the group of options labeled by the same numeral <n> is required
X	prohibited field/function
<item>:	simple-predicate condition, dependent on the support marked for <item>
<item1>*<item2>:	AND-predicate condition, the requirement must be met if both optional items are implemented
<item1>+<item2>:	OR-predicate condition, the requirement must be met if either of the optional items are implemented

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

A.1.2 Instructions for completing the PICS proforma

The first part of the PICS proforma, Implementation Identification and Protocol Summary, is to be completed as indicated with the information necessary to identify fully both the supplier and the implementation.

The main part of the PICS proforma is a fixed-format questionnaire divided into subclauses, each containing a group of items. Answers to the questionnaire items are to be provided in the right-most column, either by simply marking an answer to indicate a restricted choice (usually Yes, No, or Not Applicable), or by entering a value or a set or range of values. (Note that there are some items where two or more choices from a set of possible answers can apply; all relevant choices are to be marked.)

Each item is identified by an item reference in the first column; the second column contains the question to be answered; the third column contains the reference or references to the material that specifies the item in the main body of the standard; the sixth column contains values and/or comments pertaining to the question to be answered. The remaining columns record the status of the items—whether the support is mandatory, optional or conditional—and provide the space for the answers.

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

A completed PICS proforma, including any Additional Information and Exception Information, is the protocol implementation conformance statement for the implementation in question.

Note that where an implementation is capable of being configured in more than one way, according to the items listed under Major Capabilities/Options, a single PICS may be able to describe all such configurations. However, the supplier has the choice of providing more than one PICS, each covering some subset of the implementation's configuration capabilities, if that would make presentation of the information easier and clearer.

A.1.3 Additional information

Items of Additional Information allow a supplier to provide further information intended to assist the interpretation of the PICS. It is not intended or expected that a large quantity will be supplied, and the PICS can be considered complete without any such information. Examples might be an outline of the ways in which a (single) implementation can be set up to operate in a variety of environments and configurations; or a brief rationale, based perhaps upon specific application needs, for the exclusion of features that, although optional, are nonetheless commonly present in implementations.

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

A.1.4 Exceptional information

It may occasionally happen that a supplier will wish to answer an item with mandatory or prohibited status (after any conditions have been applied) in a way that conflicts with the indicated requirement. No preprinted answer will be found in the Support column for this; instead, the supplier is required to write into the Support column an X<i> reference to an item of Exception Information, and to provide the appropriate rationale in the Exception item itself.

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

2 Note that a possible reason for the situation described above is that a defect in the standard has been
3 reported, a correction for which is expected to change the requirement not met by the implementation.

A.1.5 Conditional items

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

8 Individual conditional items are indicated by a conditional symbol of the form "<item>:<s>" in the Status
9 column, where "<item>" is an item reference that appears in the first column of the table for some other
10 item, and "<s>" is a status symbol, M (Mandatory), O (Optional), or X (Not Applicable).

11 If the item referred to by the conditional symbol is marked as supported, then 1) the conditional item is
12 applicable, 2) its status is given by "<s>", and 3) the support column is to be completed in the usual way.
13 Otherwise, the conditional item is not relevant and the Not Applicable (N/A) answer is to be marked.

14 Each item whose reference is used in a conditional symbol is indicated by an asterisk in the Item column.

A.1.6 Identification

A.1.6.1 Implementation identification

Supplier (Note 1)	
Contact point for queries about the PICS (Note 1)	
Implementation Name(s) and Version(s) (Notes 1 and 3)	
Other information necessary for full identification—e.g., name(s) and version(s) of machines and/or operating system names (Note 2)	
NOTE 1—Required for all implementations. NOTE 2—May be completed as appropriate in meeting the requirements for the identification. NOTE 3—The terms Name and Version should be interpreted appropriately to correspond with a supplier's terminology (e.g., Type, Series, Model).	

A.1.6.2 Protocol summary

Identification of protocol specification	IEEE P802.1DC, Quality of Service Provision by Network Systems.
Identification of amendments and corrigenda to the PICS proforma that have been completed as part of the PICS	Amd : _____ Cor: _____ Amd : _____ Cor: _____
Have any exceptions been noted? (See A.1.4. The answer, "Yes" means that the implementation does not conform to IEEE P802.1DC.	Yes [ ] No [ ]

A.2 PICS proforma for Quality of Service Provision by Network Systems

A.2.1 Major capabilities/options

Item	Feature	Subclause	Value/Comment	Status	Support
				O	Yes [ ] No [ ]

Annex B

(informative)

Bibliography

[B1]   IEEE Std 802.3™, IEEE Standard for Ethernet.

Annex Z

(informative)

Commentary

<< Contributor's Note: This is a temporary Annex intended to record issues and their resolutions as the project proceeds. It will be removed prior to Sponsor ballot. >>