International Standard

ISO/IEC/IEEE 8802-1Q

Telecommunications and exchange between information technology systems — Requirements for local and metropolitan area networks —

Part 1Q: Bridges and bridged networks

AMENDMENT 38: Configuration enhancements for time-sensitive networking

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

Partie 1Q: Ponts et réseaux pontés

AMENDEMENT 38: Améliorations de la configuration pour les réseaux à temps critique

Third edition
2024-08

AMENDMENT 38
2025-09

Reference number
ISO/IEC/IEEE 8802-1Q:2024/
Amd.38:2025(en)

© IEEE 2024



COPYRIGHT PROTECTED DOCUMENT

© IEEE 2024

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from IEEE at the address below.

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

Email: stds.ipr@ieee.org
Website: www.ieee.org

Published in Switzerland

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted.

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.

ISO and IEC draw attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO and IEC take no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO and IEC had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents and https://patents.iec.ch. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html. In the IEC, see www.iec.ch/understanding-standards.

ISO/IEC/IEEE 8802-1Q:2024/Amd 38 was prepared by the LAN/MAN of the IEEE Computer Society (as IEEE Std 802.1Qdj-2024) and drafted in accordance with its editorial rules. It was adopted, under the “fast-track procedure” defined in the Partner Standards Development Organization cooperation agreement between ISO and IEEE, by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 6, *Telecommunications and information exchange between systems*.

A list of all parts in the ISO/IEC/IEEE 8802 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

© IEEE 2024 – All rights reserved

IEEE Standard for
Local and Metropolitan Area Networks—

Bridges and Bridged Networks

Amendment 38: Configuration Enhancements for Time-Sensitive Networking

(This amendment is based on IEEE Std 802.1Q™-2022 as amended by IEEE Std 802.1Qcz™-2023, IEEE Std 802.1Qcw™-2023, and IEEE Std 802.1Qcj™-2023.)

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.

© IEEE 2024 – All rights reserved

1. Overview

1.3 Introduction

Change the paragraph beginning "This standard specifies enhancements to protocols, procedures, and managed objects for the configuration of network resources" (as amended by IEEE Std 802.1Qcw-2023) as follows, and renumber the subsequent list items accordingly:

This standard specifies enhancements to protocols, procedures, and managed objects for the configuration of network resources for time-sensitive ~~(i.e., bounded latency)~~ applications that require timely, high probability, delivery of frames without end station retransmission. ~~The enhancements address Time-Sensitive Networking (TSN) application requirements beyond audio/video (AV) traffic.~~ To this end, it:

~~em) Specifies a software interface between the user (i.e., time-sensitive application) and network components, such that the user provides Stream requirements (e.g., for bounded latency), and the network configures resources from Talker to Listeners to meet those requirements. This user/network interface (UNI) is specified as an information model that can be applied to any protocol.~~

cm) Describes three approaches to network configuration: ~~Specifies three models for the UNI:~~ fully distributed, centralized network/distributed user, and fully centralized.

~~eo) Specifies enhancements to the Stream Reservation Protocol (SRP), using a new application version, MSRPv1. MSRPv1 integrates the UNI TLVs for the benefits of enhanced configuration. For compatibility, MSRPv1 translates to the previous version (MSRPv0).~~

cn) Specifies ~~enhancements to the~~ managed objects for forwarding and queuing enhancements for time-sensitive streams (FQTSS).

~~eq) Specifies enhancements to the managed objects for SRP.~~

co) Describes Centralized User Configuration (CUC) and Centralized Network Configuration (CNC) entities.

cp) Specifies managed objects for configuration of Bridges by a ~~Centralized Network Configuration (~~CNC~~) component~~.

cq) ~~Define~~ Specifies YANG configuration and operational state models (Clause 48) in support of Scheduled Traffic, frame preemption, ~~and~~ Per-Stream Filtering and Policing, and CUC configuration.

© IEEE 2024 – All rights reserved

3. Definitions

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

3.1 Configuration Domain: A set of stations that are under a common configuration and management scheme, and a single administration.

3.2 TSN features: The protocols and mechanisms that constitute the set of tools available for building a time-sensitive network.

© IEEE 2024 – All rights reserved

5. Conformance

5.29 TSN CNC station requirements

Change 5.29, as follows:

This subclause (5.29) defines the conformance requirements for a station that supports the Time-Sensitive Networking (TSN) Centralized Network Configuration (CNC) requirements (46.1.3). The TSN CNC station component is implemented within an end station or Bridge.

A TSN CNC station implementation that conforms to the provisions of this standard shall:

a) Support the use of a remote management protocol. The TSN CNC claiming to support remote management shall state the following:
   1) Which remote management protocol standard(s) or specification(s) are supported for the client implementation.
   2) Which standard(s) or specification(s) for managed object definitions and encodings are supported for use by the remote management protocol.

b) Support the managed object definitions and encodings for Stream reservation remote management (12.32).

c) Support the use of at least one protocol for User/network configuration information that complies with the requirements for protocol integration defined in 46.2. The TSN CNC shall state which User/network configuration information protocol standard(s) or specification(s) are supported.

~~d) If a YANG-based protocol is supported by the TSN CNC for the User/network configuration information, that protocol shall use the YANG module specified in 46.3.~~

d) If SRP (Clause 35) is supported by the TSN CNC for the User/network configuration information, the TSN CNC shall support MRP External Control (12.32.4).

A TSN CNC station implementation that conforms to the provisions of this standard may:

e) Use the YANG modules identified in 46.3.

© IEEE 2024 – All rights reserved

46. Time-Sensitive Networking (TSN) configuration

46.1 Overview of TSN configuration

Change the title and text of 46.1.1 as follows:

46.1.1 ~~User/Network Interface (UNI)~~Streams, Talkers, and Listeners

TSN configuration uses the concept of a Stream that is transmitted by a Talker to one or more Listeners. The Talkers and Listeners are located within end stations.

This clause specifies configuration information ~~that is exchanged over a User/Network Interface (UNI). The user side of the interface represents~~ for Streams requested by Talkers and Listeners, or by network management entities acting on their behalf. ~~The network side of the interface represents the Bridges that transfer frames of the Stream from each Talker to its Listeners. Each user specifies~~ Stream requirements ~~for its data, but~~ are initially specified by, or for, Talker and Listener without detailed knowledge of the network. ~~The network~~ Network entities or administrators obtain~~s~~ these requirements ~~from users~~, analyze~~s~~ the topology and ~~TSN~~ capabilities of the Bridges, and configure~~s the~~ Bridges to meet ~~user~~ the requirements. The network returns the success or failure of each Stream's configuration to ~~the user~~ its Talker(s) and Listener(s).

Change the title and text of 46.1.2 as follows:

46.1.2 ~~Modeling of user/network~~TSN configuration ~~information~~ protocols

A variety of protocols can be used for the exchange of configuration information ~~over the TSN UNI~~ (e.g., signaling protocols, remote network management protocols). ~~These protocols can exchange the configuration information as text or as binary fields. To enable flexible integration of TSN configuration into a variety of protocols, 46.2 specifies the TSN user/network configuration information in a manner that is independent of schema, encoding, or protocol.~~

Specific TSN-capable products list the ~~user/network~~ protocol that is supported as part of their conformance [e.g., 5.18.3, item c) in 5.29]. Each user/network protocol will specify a specific schema and/or encoding for the configuration information in 46.2. Examples of these protocols are described for each of the TSN configuration models in 46.1.3.

46.1.3 TSN configuration models

Change the introductory text of 46.1.3 as follows:

~~This subclause describes three~~Three models for TSN user/network configuration are described. These models provide an architectural context for subsequent specifications. Each model specification shows the logical flow of ~~user/network~~ configuration information between various entities in the network.

46.1.3.1 Fully distributed model

Change 46.1.3.1 as follows:

In the fully distributed model, the end stations that contain ~~users of Streams (i.e.,~~ Talkers and Listeners~~)~~ communicate the user requirements directly ~~over the TSN user/network protocol~~ to the neighboring Bridge. The network is configured in a fully distributed manner, without a centralized network configuration entity. The distributed network configuration is performed using a protocol that propagates ~~TSN user/network~~ configuration information along the active topology for the Stream (i.e., Bridges in the tree from Talker to Listeners).

© IEEE 2024 – All rights reserved

As ~~user~~ Stream requirements propagate through each Bridge, management of the Bridge's resources is effectively performed locally. This local management is limited to the information that the Bridge has knowledge of and does not necessarily include knowledge of the entire network.

Figure 46-1 provides a graphical representation of the fully distributed model.

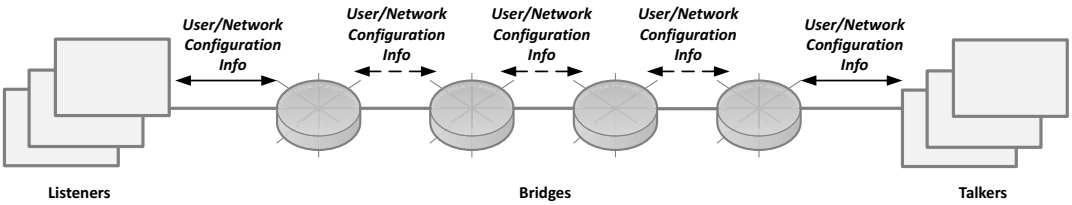


Figure 46-1—Fully distributed model

In the figure, the solid arrows represent the protocol that is used ~~as the UNI for~~ to exchange ~~of configuration~~ information between Talkers/Listeners (users) and Bridges (network). This ~~configuration~~ information is specified in 46.2.

In the figure, the dashed arrows represent the protocol that propagates ~~configuration~~ information within the network. This protocol carries ~~the TSN user/network~~ Stream configuration information (46.2) as well as additional information ~~that is~~ specific to network configuration.

The following TSN features can be configured by Bridges using this model:

a) Credit-based shaper algorithm (8.6.8.2) and its configuration (Clause 34)

The Stream Reservation Protocol (SRP) of Clause 35 can be used ~~as the UNI~~ by Talkers and Listeners, and to propagate configuration information throughout the network of Bridges. ~~SRP exchanges configuration information as binary fields using the Type Length Value (TLV) technique. Using this technique, the protocol's top level message contains a list of one or more TLVs. Each TLV consists of a Type field that specifies what the Value field contains, a Length field that specifies the number of octets in the Value field, and the Value field. In SRP specifications, each TLV Type identifies one of the groups specified in 46.2, and the TLV Value contains a binary representation of the elements in that group.~~

46.1.3.2 Centralized network/distributed user model

Change 46.1.3.2 as follows:

Some TSN use cases are computationally complex. For example, for scheduled traffic (8.6.8.4), computation of the gate control list of each Port can take significant time. For such use cases, it is helpful to centralize the computation in a single entity (Bridge or end station), rather than perform the computation in all Bridges.

Some TSN use cases can benefit from a complete knowledge of all Streams in the network. For example, if the bandwidth for multiple Streams is greater than the available bandwidth along the shortest path between Talkers and Listeners, it is helpful to forward a subset of those Streams along a path other than the shortest. For these use cases, a centralized entity can gather information for the entire network in order to find the best configuration.

~~The~~ In the centralized network/distributed user model, ~~is similar to the fully distributed model in that~~ end stations communicate their Talker/Listener requirements directly ~~over the TSN UNI~~ to the neighboring Bridge, just as in the fully distributed model. However, in the centralized network/distributed user model, a

© IEEE 2024 – All rights reserved

Centralized Network Configuration (CNC, 46.1.6) entity configures Bridges to pass Talker/ Listener Stream requirements directly to the CNC, rather than propagating that information along the path to be taken by Stream data. ~~In contrast, in the centralized network/distributed user model, the configuration information is directed to/from a Centralized Network Configuration (CNC) entity.~~ All configuration of Bridges for ~~TSN~~ Streams is performed by this CNC using a remote network management protocol.

The CNC has a complete view of the physical topology of the network as well as the capabilities of each Bridge. This enables the CNC to centralize complex computations. The CNC can exist in either an end station or a Bridge.

~~The CNC knows the address of all Bridges at the edge of the network (those with an end station connected). The CNC configures those edge Bridges to act as a proxy, transferring Talker/Listener information directly between the edge Bridge and the CNC, rather than propagate the information to the interior of the network.~~

Figure 46-2 provides a graphical representation of the centralized network/distributed user model.

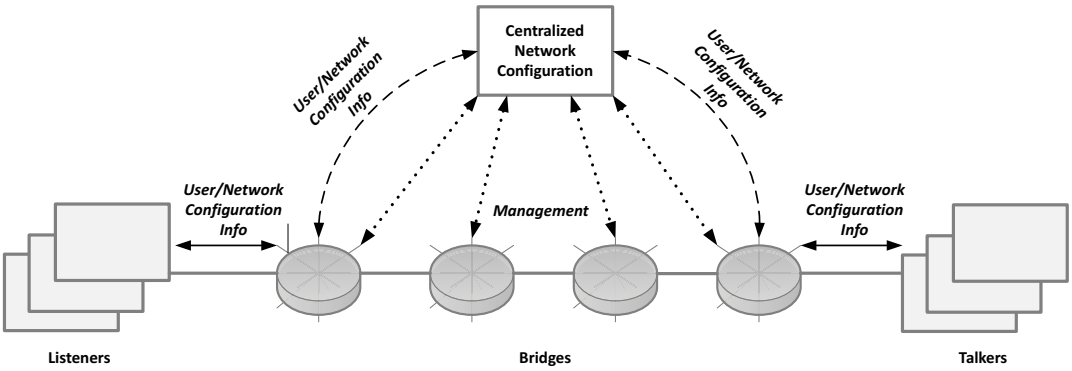


Figure 46-2—Centralized network/distributed user model

In the figure, the solid arrows represent the protocol that is used ~~as the UNI for~~ to exchange ~~of configuration~~ Stream information between Talkers/Listeners (users) and Bridges (network). This ~~configuration~~ information is specified in 46.2.

In the figure, the dashed arrows represent the protocol that transfers Stream configuration information between ~~edge~~ Bridges and the CNC. This ~~configuration~~ information is specified in 46.2.

In the figure, dotted arrows represent the remote network management protocol. The CNC acts as the management client, and each Bridge acts as the management server. The CNC uses remote management to discover physical topology, retrieve Bridge capabilities, and configure TSN features in each Bridge. Talkers and Listeners are not required to participate in this remote network management protocol. The information carried by the remote network management protocol is specified in Clause 12.

NOTE 1—If the Talker/Listener protocol of the fully distributed model is selected to be the same as the Talker/Listener protocol of the centralized network/distributed user model, end stations can support both models without explicit knowledge of how the network is configured.

The following TSN features can be configured by the CNC using this model:

a) Credit-based shaper algorithm (8.6.8.2) and its configuration (Clause 34)
b) Frame preemption (6.7.2)
c) Scheduled traffic (8.6.8.4, 8.6.9)

© IEEE 2024 – All rights reserved