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Specific requirements —**

**Part 1CB:  
Frame replicaton and elimination for  
reliability**

*Technologies de l'information — Télécommunications et échange  
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Exigences spécifiques —*

*Partie 1CB: Duplication de trame et son élimination pour la fiabilité*



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**IEEE Std 802.1CB™-2017**

**IEEE Standard for  
Local and metropolitan area networks—**

# **Frame Replication and Elimination for Reliability**

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of the  
IEEE Computer Society**

Approved 28 September 2017

**IEEE-SA Standards Board**

**Abstract:** This standard specifies procedures, managed objects, and protocols for bridges and end systems that provide identification and replication of packets for redundant transmission, identification of duplicate packets, and elimination of duplicate packets. It is not concerned with the creation of the multiple paths over which the duplicates are transmitted.

**Keywords:** Bridged Local Area Networks, Bridges, Bridging, Frame Elimination, Frame Replication, IEEE 802<sup>®</sup>, IEEE 802.1CB<sup>™</sup>, IEEE 802.1Q<sup>™</sup>, local area networks (LANs), MAC Bridges, Redundancy, Time-Sensitive Networking, TSN, Virtual Bridged Local Area Networks (virtual LANs)

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## Introduction

This introduction is not part of IEEE Std 802.1CB-2017, IEEE Standard for Local and metropolitan area networks—Frame Replication and Elimination for Reliability.

This standard defines Frame Replication and Elimination for Reliability.

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

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## Contents

|         |   |    |
|---------|---|----|
| 1.      | Overview .....  | 16 |
| 1.1     | Scope .....   | 16 |
| 1.2     | Rationale .....   | 16 |
| 1.3     | State diagram conventions .....                                     | 16 |
| 1.4     | Specification model .....   | 16 |
| 1.5     | Specification precedence .....                                      | 17 |
| 1.6     | Introduction .....  | 17 |
| 2.      | Normative references .....  | 18 |
| 3.      | Definitions .....   | 19 |
| 4.      | Acronyms and abbreviations .....                                    | 21 |
| 5.      | Conformance .....   | 22 |
| 5.1     | Requirements terminology .....                                      | 22 |
| 5.2     | Conformant components and equipment .....                           | 22 |
| 5.3     | Stream identification component required behaviors .....            | 22 |
| 5.4     | Stream identification component recommended behavior .....          | 23 |
| 5.5     | Stream identification component optional behaviors .....            | 23 |
| 5.6     | Talker end system required behaviors .....                          | 23 |
| 5.7     | Talker end system recommended behaviors .....                       | 23 |
| 5.8     | Talker end system optional behaviors .....                          | 23 |
| 5.9     | Listener end system required behaviors .....                        | 24 |
| 5.10    | Listener end system recommended behavior .....                      | 24 |
| 5.11    | Listener end system optional behaviors .....                        | 24 |
| 5.12    | Relay system required behaviors .....                               | 24 |
| 5.13    | Relay system recommended behaviors .....                            | 25 |
| 5.14    | Relay system optional behaviors .....                               | 25 |
| 5.15    | FRER C-component required and optional behaviors .....              | 25 |
| 6.      | Stream identification .....   | 26 |
| 6.1     | Stream service subparameters .....                                  | 27 |
| 6.2     | Stream identification function .....                                | 28 |
| 6.3     | Stream identification in systems .....                              | 29 |
| 6.4     | Null Stream identification .....                                    | 30 |
| 6.5     | Source MAC and VLAN Stream identification .....                     | 31 |
| 6.6     | Active Destination MAC and VLAN Stream identification .....         | 31 |
| 6.7     | IP Stream identification .....                                      | 32 |
| 7.      | Frame Replication and Elimination for Reliability .....             | 33 |
| 7.1     | Overview of Frame Replication and Elimination for Reliability ..... | 33 |
| 7.1.1   | Goals and objectives .....  | 33 |
| 7.2     | Use of the term Stream .....  | 35 |
| 7.3     | Frame Replication and Elimination for Reliability functions .....   | 35 |
| 7.4     | Sequencing function .....   | 36 |
| 7.4.1   | Sequence generation function .....                                  | 36 |
| 7.4.1.1 | Events for sequence generation .....                                | 37 |
| 7.4.1.2 | Variables for sequence generation .....                             | 37 |

|           |  |    |
|-----------|--|----|
| 7.4.1.2.1 | GenSeqSpace .....  | 37 |
| 7.4.1.2.2 | GenSeqNum .....  | 37 |
| 7.4.1.3   | SequenceGenerationReset .....  | 37 |
| 7.4.1.4   | SequenceGenerationAlgorithm .....  | 37 |
| 7.4.2     | Sequence recovery function .....   | 38 |
| 7.4.3     | Base recovery function .....   | 38 |
| 7.4.3.1   | Events for sequence recovery .....   | 39 |
| 7.4.3.2   | Variables for sequence recovery .....  | 39 |
| 7.4.3.2.1 | RecovSeqSpace .....  | 39 |
| 7.4.3.2.2 | SequenceHistory .....  | 40 |
| 7.4.3.2.3 | RecovSeqNum .....  | 40 |
| 7.4.3.2.4 | RemainingTicks .....   | 40 |
| 7.4.3.2.5 | TicksPerSecond .....   | 40 |
| 7.4.3.2.6 | TakeAny .....  | 40 |
| 7.4.3.3   | SequenceRecoveryReset .....  | 40 |
| 7.4.3.4   | VectorRecoveryAlgorithm .....  | 41 |
| 7.4.3.5   | MatchRecoveryAlgorithm .....   | 43 |
| 7.4.3.6   | ShiftSequenceHistory .....   | 44 |
| 7.4.4     | Latent error detection function .....  | 45 |
| 7.4.4.1   | Events for latent error detection .....  | 45 |
| 7.4.4.2   | Variables for latent error detection .....                                     | 46 |
| 7.4.4.2.1 | CurBaseDifference .....  | 46 |
| 7.4.4.3   | LatentErrorReset .....   | 46 |
| 7.4.4.4   | LatentErrorTest .....  | 46 |
| 7.5       | Individual recovery function .....   | 47 |
| 7.6       | Sequence encode/decode function .....  | 47 |
| 7.7       | Stream splitting function .....  | 47 |
| 7.8       | Redundancy tag .....   | 48 |
| 7.8.1     | Redundancy tag EtherType .....   | 49 |
| 7.8.2     | Redundancy tag information .....   | 49 |
| 7.9       | HSR sequence tag .....   | 49 |
| 7.10      | PRP sequence trailer .....   | 50 |
| 7.11      | Autoconfiguration .....  | 51 |
| 7.11.1    | Introduction to autoconfiguration .....  | 51 |
| 7.11.2    | Creating autoconfigured Stream identity table entries .....                    | 52 |
| 8.        | Frame Replication and Elimination for Reliability in Bridges .....             | 56 |
| 8.1       | Limiting options .....   | 56 |
| 8.2       | FRER C-component input transformations .....                                   | 58 |
| 8.3       | Frame Replication and Elimination for Reliability and VLAN tags .....          | 58 |
| 8.4       | Configuring Frame Replication and Elimination for Reliability in Bridges ..... | 59 |
| 9.        | Stream Identification Management .....   | 61 |
| 9.1       | Stream identity table .....  | 61 |
| 9.1.1     | tsnStreamIdEntry .....   | 61 |
| 9.1.1.1   | tsnStreamIdHandle .....  | 61 |
| 9.1.1.2   | tsnStreamIdInFacOutputPortList .....   | 61 |
| 9.1.1.3   | tsnStreamIdOutFacOutputPortList .....  | 61 |
| 9.1.1.4   | tsnStreamIdInFacInputPortList .....  | 62 |
| 9.1.1.5   | tsnStreamIdOutFacInputPortList .....   | 62 |
| 9.1.1.6   | tsnStreamIdIdentificationType .....  | 62 |
| 9.1.1.7   | tsnStreamIdParameters .....  | 62 |
| 9.1.2     | Managed objects for Null Stream identification .....                           | 62 |

|          |  |    |
|----------|--|----|
| 9.1.2.1  | tsnCpeNullDownDestMac .....  | 62 |
| 9.1.2.2  | tsnCpeNullDownTagged .....   | 63 |
| 9.1.2.3  | tsnCpeNullDownVlan .....   | 63 |
| 9.1.3    | Managed objects for Source MAC and VLAN Stream identification .....              | 63 |
| 9.1.3.1  | tsnCpeSmacVlanDownSrcMac .....   | 63 |
| 9.1.3.2  | tsnCpeSmacVlanDownTagged .....   | 63 |
| 9.1.3.3  | tsnCpeSmacVlanDownVlan .....   | 63 |
| 9.1.4    | Managed objects for Active Destination MAC and VLAN Stream identifications ..... | 63 |
| 9.1.4.1  | tsnCpeDmacVlanDownDestMac .....  | 63 |
| 9.1.4.2  | tsnCpeDmacVlanDownTagged .....   | 64 |
| 9.1.4.3  | tsnCpeDmacVlanDownVlan .....   | 64 |
| 9.1.4.4  | tsnCpeDmacVlanDownPriority .....   | 64 |
| 9.1.4.5  | tsnCpeDmacVlanUpDestMac .....  | 64 |
| 9.1.4.6  | tsnCpeDmacVlanUpTagged .....   | 64 |
| 9.1.4.7  | tsnCpeDmacVlanUpVlan .....   | 65 |
| 9.1.4.8  | tsnCpeDmacVlanUpPriority .....   | 65 |
| 9.1.5    | Managed objects for IP Stream identification .....                               | 65 |
| 9.1.5.1  | tsnCpeIpIdDestMac .....  | 65 |
| 9.1.5.2  | tsnCpeIpIdTagged .....   | 65 |
| 9.1.5.3  | tsnCpeIpIdVlan .....   | 65 |
| 9.1.5.4  | tsnCpeIpIdIpSource .....   | 65 |
| 9.1.5.5  | tsnCpeIpIdIpDestination .....  | 65 |
| 9.1.5.6  | tsnCpeIpIdDscp .....   | 65 |
| 9.1.5.7  | tsnCpeIpIdNextProtocol .....   | 66 |
| 9.1.5.8  | tsnCpeIpIdSourcePort .....   | 66 |
| 9.1.5.9  | tsnCpeIpIdDestinationPort .....  | 66 |
| 9.2      | Operational per-port per-Stream Stream identification counters .....             | 66 |
| 9.2.1    | tsnCpsSidInputPackets .....  | 66 |
| 9.2.2    | tsnCpsSidOutputPackets .....   | 66 |
| 9.3      | Operational per-port Stream identification counters .....                        | 66 |
| 9.3.1    | tsnCpSidInputPackets .....   | 66 |
| 9.3.2    | tsnCpSidOutputPackets .....  | 66 |
| 10.      | Frame Replication and Elimination for Reliability management .....               | 67 |
| 10.1     | Counter behavior .....   | 67 |
| 10.2     | Additional tsnStreamIdEntry managed objects .....                                | 67 |
| 10.2.1   | tsnStreamIdAutoconfigured .....  | 68 |
| 10.2.2   | tsnStreamIdLanPathId .....   | 68 |
| 10.3     | Sequence generation table .....  | 68 |
| 10.3.1   | frerSeqGenEntry .....  | 68 |
| 10.3.1.1 | frerSeqGenStreamList .....   | 68 |
| 10.3.1.2 | frerSeqGenDirection .....  | 68 |
| 10.4     | Sequence recovery table .....  | 68 |
| 10.4.1   | frerSeqRcvyEntry .....   | 68 |
| 10.4.1.1 | frerSeqRcvyStreamList .....  | 68 |
| 10.4.1.2 | frerSeqRcvyPortList .....  | 69 |
| 10.4.1.3 | frerSeqRcvyDirection .....   | 69 |
| 10.4.1.4 | frerSeqRcvyReset .....   | 69 |
| 10.4.1.5 | frerSeqRcvyAlgorithm .....   | 69 |
| 10.4.1.6 | frerSeqRcvyHistoryLength .....   | 69 |
| 10.4.1.7 | frerSeqRcvyResetMSec .....   | 69 |
| 10.4.1.8 | frerSeqRcvyInvalidSequenceValue .....  | 69 |
| 10.4.1.9 | frerSeqRcvyTakeNoSequence .....  | 70 |

|             |   |    |
|-------------|---|----|
| 10.4.1.10   | frerSeqRcvyIndividualRecovery .....                     | 70 |
| 10.4.1.11   | frerSeqRcvyLatentErrorDetection .....                   | 70 |
| 10.4.1.12   | Latent error detection managed objects .....            | 70 |
| 10.4.1.12.1 | frerSeqRcvyLatentErrorDifference .....                  | 70 |
| 10.4.1.12.2 | frerSeqRcvyLatentErrorPeriod .....                      | 70 |
| 10.4.1.12.3 | frerSeqRcvyLatentErrorPaths .....                       | 70 |
| 10.4.1.12.4 | frerSeqRcvyLatentResetPeriod .....                      | 71 |
| 10.5        | Sequence identification table .....                     | 71 |
| 10.5.1      | frerSeqEncEntry .....                                   | 71 |
| 10.5.1.1    | frerSeqEncStreamList .....                              | 71 |
| 10.5.1.2    | frerSeqEncPort .....                                    | 71 |
| 10.5.1.3    | frerSeqEncDirection .....                               | 71 |
| 10.5.1.4    | frerSeqEncActive .....                                  | 71 |
| 10.5.1.5    | frerSeqEncEncapsType .....                              | 71 |
| 10.5.1.6    | frerSeqEncPathIdLanId .....                             | 71 |
| 10.6        | Stream split table .....                                | 72 |
| 10.6.1      | frerSplitEntry .....                                    | 72 |
| 10.6.1.1    | frerSplitPort .....                                     | 72 |
| 10.6.1.2    | frerSplitDirection .....                                | 72 |
| 10.6.1.3    | frerSplitInputIdList .....                              | 72 |
| 10.6.1.4    | frerSplitOutputIdList .....                             | 72 |
| 10.7        | Managed objects for autoconfiguration .....             | 72 |
| 10.7.1      | Sequence autoconfiguration table .....                  | 72 |
| 10.7.1.1    | frerAutSeqEntry .....                                   | 73 |
| 10.7.1.1.1  | frerAutSeqSeqEncaps .....                               | 73 |
| 10.7.1.1.2  | frerAutSeqReceivePortList .....                         | 73 |
| 10.7.1.1.3  | frerAutSeqTagged .....                                  | 73 |
| 10.7.1.1.4  | frerAutSeqVlan .....                                    | 73 |
| 10.7.1.1.5  | frerAutSeqRecoveryPortList .....                        | 73 |
| 10.7.1.1.6  | frerAutSeqDestructMSec .....                            | 73 |
| 10.7.1.1.7  | frerAutSeqResetMSec .....                               | 73 |
| 10.7.1.1.8  | frerAutSeqAlgorithm .....                               | 73 |
| 10.7.1.1.9  | frerAutSeqHistoryLength .....                           | 74 |
| 10.7.1.1.10 | frerAutSeqCreateIndividual .....                        | 74 |
| 10.7.1.1.11 | frerAutSeqCreateRecovery .....                          | 74 |
| 10.7.1.1.12 | frerAutSeqLatErrDetection .....                         | 74 |
| 10.7.1.1.13 | frerAutSeqLatErrDifference .....                        | 74 |
| 10.7.1.1.14 | frerAutSeqLatErrPeriod .....                            | 74 |
| 10.7.1.1.15 | frerAutSeqLatErrResetPeriod .....                       | 74 |
| 10.7.2      | Output autoconfiguration table .....                    | 74 |
| 10.7.2.1    | frerAutOutEntry .....                                   | 74 |
| 10.7.2.1.1  | frerAutOutPortList .....                                | 74 |
| 10.7.2.1.2  | frerAutOutEncaps .....                                  | 75 |
| 10.7.2.1.3  | frerAutOutLanPathId .....                               | 75 |
| 10.8        | Operational per-port and per-Stream FRER counters ..... | 75 |
| 10.8.1      | Per-Stream vs. per-Stream-per-port counters .....       | 75 |
| 10.8.2      | frerCpsSeqGenResets .....                               | 75 |
| 10.8.3      | frerCpsSeqRcvyOutOfOrderPackets .....                   | 75 |
| 10.8.4      | frerCpsSeqRcvyRoguePackets .....                        | 76 |
| 10.8.5      | frerCpsSeqRcvyPassedPackets .....                       | 76 |
| 10.8.6      | frerCpsSeqRcvyDiscardedPackets .....                    | 76 |
| 10.8.7      | frerCpsSeqRcvyLostPackets .....                         | 76 |
| 10.8.8      | frerCpsSeqRcvyTaglessPackets .....                      | 76 |
| 10.8.9      | frerCpsSeqRcvyResets .....                              | 76 |

|  |   |     |
|--|---|-----|
| 10.8.10  | frerCpsSeqRcvyLatentErrorResets .....                                     | 76  |
| 10.8.11  | frerCpsSeqEncErroredPackets .....   | 76  |
| 10.9   | Operational per-port FRER counters .....                                  | 76  |
| 10.9.1   | frerCpSeqRcvyPassedPackets .....  | 77  |
| 10.9.2   | frerCpSeqRcvyDiscardPackets .....   | 77  |
| 10.9.3   | frerCpSeqEncErroredPackets .....  | 77  |
| Annex A (normative) Protocol Implementation Conformance Statement (PICS) proforma .....  |   | 78  |
| A.1  | Introduction .....  | 78  |
| A.1.1  | Abbreviations and special symbols .....                                   | 78  |
| A.1.2  | Instructions for completing the PICS proforma .....                       | 79  |
| A.1.3  | Additional information .....  | 79  |
| A.1.4  | Exceptional information .....   | 79  |
| A.1.5  | Conditional items .....   | 80  |
| A.1.6  | Identification .....  | 80  |
| A.2  | PICS proforma for Frame Replication and Elimination for Reliability ..... | 81  |
| A.2.1  | Major capabilities/options .....  | 81  |
| A.2.2  | Stream identification component .....                                     | 81  |
| A.2.3  | Talker end system .....   | 82  |
| A.2.4  | Listener end system .....   | 83  |
| A.2.5  | Relay system .....  | 84  |
| A.2.6  | FRER 802.1Q C-component .....   | 86  |
| A.2.7  | Common requirements .....   | 86  |
| Annex B (informative) Interoperability with other standards .....                        |   | 87  |
| B.1  | Sequence number size .....  | 87  |
| B.2  | Per-Stream versus per-source sequencing .....                             | 87  |
| Annex C (informative) Frame Replication and Elimination for Reliability in systems ..... |   | 88  |
| C.1  | Example 1: End-to-end FRER .....  | 88  |
| C.2  | Example 2: Various stack positions .....                                  | 89  |
| C.3  | Example 3: Ladder redundancy .....  | 92  |
| C.4  | Example 4: Multicast trees .....  | 93  |
| C.5  | Example 5: Protocol interworking .....                                    | 93  |
| C.6  | Example 6: Chained two-port end systems .....                             | 94  |
| C.7  | Cautions .....  | 95  |
| C.8  | Balancing tag insertion and removal .....                                 | 95  |
| C.9  | FRER and reserved bandwidth .....   | 95  |
| C.10   | Use of the Individual recovery function .....                             | 97  |
| C.11   | Use of autoconfiguration .....  | 97  |
| C.11.1   | Routing and labeling Member Streams .....                                 | 97  |
| C.11.2   | Recognizing packets that trigger autoconfiguration .....                  | 98  |
| C.11.3   | Per-port packet decoding and encoding .....                               | 99  |
| C.11.4   | Individual and Sequence recovery functions .....                          | 99  |
| Annex D (informative) Bibliography .....   |   | 100 |



## List of figures

|   |    |
|---|----|
| Figure 6-1—Stream identification service.....   | 26 |
| Figure 6-2—A Stream with three Listeners.....   | 26 |
| Figure 6-3—Stream identification function: single upper SAP.....                            | 28 |
| Figure 6-4—Stream identification function: array of upper SAPs.....                         | 28 |
| Figure 6-5—Stream functions in a relay system (three views of same system).....             | 29 |
| Figure 6-6—In- and out-facing functions.....  | 30 |
| Figure 7-1—Compound Stream built from four Member Streams.....                              | 33 |
| Figure 7-2—Frame Replication and Elimination for Reliability functions.....                 | 35 |
| Figure 7-3—Sequence recovery functions and Individual recovery functions.....               | 47 |
| Figure 7-4—R-TAG format.....  | 48 |
| Figure 8-1—FRER functions in an FRER C-component.....                                       | 56 |
| Figure 8-2—Augmented Forwarding Process does sequence recovery.....                         | 57 |
| Figure 8-3—Example Ethernet frame format.....   | 59 |
| Figure C-1—Dual-homed end systems using Link Aggregation.....                               | 88 |
| Figure C-2—Protocol stack for End System B in Figure C-1.....                               | 89 |
| Figure C-3—Protocol stack for End System G in Figure C-1 and Figure C-4.....                | 89 |
| Figure C-4—Frame Replication and Elimination for Reliability flexible positioning.....      | 90 |
| Figure C-5—Protocol stack for relay system B, proxying for End System A, in Figure C-4..... | 91 |
| Figure C-6—Protocol stack for relay system C in Figure C-4.....                             | 91 |
| Figure C-7—Protocol stack for relay system F in Figure C-4.....                             | 92 |
| Figure C-8—Ladder redundancy.....   | 92 |
| Figure C-9—Multicast trees.....   | 93 |
| Figure C-10—Protocol interworking.....  | 93 |
| Figure C-11—Dual-homed end systems using 3-port bridge.....                                 | 94 |
| Figure C-12—Protocol stacks for Systems B and G in Figure C-11.....                         | 94 |
| Figure C-13—Explicit path causing a loop.....   | 95 |
| Figure C-14—Example of Long and short paths.....  | 96 |
| Figure C-15—Autoconfiguration example.....  | 98 |

## List of tables

|   |    |
|---|----|
| Table 6-1—Stream identification functions .....                 | 27 |
| Table 7-1—R-TAG EtherType .....                                 | 49 |
| Table 8-1—Managed objects for FRER in an FRER C-component ..... | 59 |
| Table 9-1—Stream identification types .....                     | 62 |
| Table 10-1—Enumerated values for frerSeqRcvyAlgorithm .....     | 69 |
| Table 10-2—Sequence Encode/Decode types .....                   | 72 |

## IEEE Standard for Local and metropolitan area networks—

# Frame Replication and Elimination for Reliability

## 1. Overview

### 1.1 Scope

This standard specifies procedures, managed objects, and protocols for bridges and end systems that provide identification and replication of packets for redundant transmission, identification of duplicate packets, and elimination of duplicate packets. It is not concerned with the creation of the multiple paths over which the duplicates are transmitted.

### 1.2 Rationale

The reason for Frame Replication and Elimination for Reliability (FRER) is to increase the probability that a given packet will be delivered. It is expected that, in many applications, other means to increase the probability of delivery are likely to be used as well. When FRER is used over paths that are fixed to a specific topology, and that are protected against congestion loss (e.g., by using techniques described by IEEE Std 802.1BA™ [B1]), FRER can substantially reduce the probability of packet loss due to equipment failures.<sup>1</sup>

### 1.3 State diagram conventions

This document uses the programming language C (ISO/IEC 9899:2011) to document the operation of conformant systems.<sup>2</sup> C functions are distinguished with `this special fixed-width font` (e.g., 7.4.3.3). Each C function is executed when a given event occurs, as described for that code segment or in the accompanying text. Events are assumed to take place sequentially, not simultaneously, and code routines execute instantaneously.

### 1.4 Specification model

The model of operation documented by this standard is simply a basis for describing the functionality of 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.

<sup>1</sup>The numbers in brackets correspond to those of the bibliography in Annex D.

<sup>2</sup>Information on references can be found in Clause 2.

## 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

This standard is one of a number of IEEE 802.1™ and other standards suitable for Time-Sensitive Networking (TSN) that together have the overall goal of providing extremely low packet loss rates and finite, low, and stable end-to-end latencies. TSN supports unicast and multicast Streams of packets that implement a wide range of demanding real-time applications including audio/video studios, industrial processes, and the control of machines and vehicles. The TSN goals are not achieved at the expense of hampering the ability of the network to carry traffic for non-time-critical applications.

At the highest level, this standard posits the existence of one Talker end system and one or more Listener end systems per Stream. A Stream is characterized by a maximum packet size and number of packets transmitted per time interval. Because the Stream's maximum throughput is known, the resources, including link bandwidth, buffer space, and control parameters, required at every hop along the Stream's path to guarantee that Stream zero congestion loss and finite latency, can be provided (by other standards, e.g., Clause 35 of IEEE Std 802.1Q™-2014). This provisioned path carrying the Stream is called a *Reservation*.

On the assumption that the time required for a dynamic network control protocol to recover from an equipment failure is unacceptable in certain applications, this standard defines Frame Replication and Elimination for Reliability (FRER), which divides a Stream into one or more linked Member Streams, thus making the original Stream a Compound Stream. It replicates the packets of the Stream, splitting the copies into the multiple Member Streams, and then rejoins those Member Streams at one or more other points, eliminates the replicates, and delivers the reconstituted Stream from those points.

In order to accommodate existing applications and to promote interoperability with similar standards, this standard defines a number of schemes for identifying packets belonging to Streams and distinguishing them from other 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 D.

IEC 62439-3:2016, Industrial communication networks—High availability automation networks—Part 3: Parallel Redundancy Protocol (PRP) and High-availability Seamless Redundancy (HSR).<sup>3</sup>

IEEE Std 802<sup>®</sup>, IEEE Standard for Local and metropolitan area networks: Overview and Architecture.<sup>4, 5</sup>

IEEE Std 802.1AC<sup>™</sup>, IEEE Standard for Local and metropolitan area networks—Media Access Control (MAC) Service Definition.

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

IETF RFC 768, User Datagram Protocol, Postel, J., August 1980.<sup>6</sup>

IETF RFC 791, Internet Protocol, Postel, J., Ed., September 1981.

IETF RFC 793, Transmission Control Protocol, Postel, J., Ed., September 1981.

IETF RFC 2460, Internet Protocol, Version 6 (IPv6) Specification, Deering, S. and R. Hinden, December 1998.

IETF RFC 2474, Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers, Nichols, K., et al., December 1998.

IETF RFC 4960, Stream Control Transmission Protocol, Stewart, R., Ed., September 2007.

ISO/IEC 9899:2011, Information technology—Programming languages—C.<sup>7</sup>

<sup>3</sup>IEC publications are available from the International Electrotechnical Commission (<http://www.iec.ch>) and the American National Standards Institute (<http://www.ansi.org/>).

<sup>4</sup>The IEEE standards or products referred to in Clause 2 are trademarks owned by The Institute of Electrical and Electronics Engineers, Incorporated.

<sup>5</sup>IEEE publications are available from The Institute of Electrical and Electronics Engineers (<http://standards.ieee.org>).

<sup>6</sup>IETF documents (i.e., RFCs) are available for download at <http://www.rfc-archive.org/>.

<sup>7</sup>ISO/IEC publications are available from the International Organization for Standardization (<http://www.iso.org/>) and the American National Standards Institute (<http://www.ansi.org/>).