
**Information technology —
Telecommunications and information
exchange between systems — Local
and metropolitan area networks —
Specific requirements —**

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

*Technologies de l'information — Télécommunications et échange
d'information entre systèmes — Réseaux locaux et métropolitains —
Exigences spécifiques —*

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

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

Frame Replication and Elimination for Reliability

Sponsor

**LAN/MAN Standards Committee
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®, IEEE 802.1CB™, IEEE 802.1Q™, local area networks (LANs), MAC Bridges, Redundancy, Time-Sensitive Networking, TSN, Virtual Bridged Local Area Networks (virtual LANs)

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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[®] 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.¹

1.3 State diagram conventions

This document uses the programming language C (ISO/IEC 9899:2011) to document the operation of conformant systems.² 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.

¹The numbers in brackets correspond to those of the bibliography in Annex D.

²Information 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).³

IEEE Std 802[®], IEEE Standard for Local and metropolitan area networks: Overview and Architecture.^{4, 5}

IEEE Std 802.1AC[™], IEEE Standard for Local and metropolitan area networks—Media Access Control (MAC) Service Definition.

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

IETF RFC 768, User Datagram Protocol, Postel, J., August 1980.⁶

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.⁷

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

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

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

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

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