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English Version

Industrial communication networks - High availability automation networks - Part 3: Parallel Redundancy Protocol (PRP) and High-availability Seamless Redundancy (HSR) (IEC 62439-3:2021/COR1:2023)

Réseaux de communication industriels - Réseaux de haute disponibilité pour l'automatisation - Partie 3: Protocole de redondance en parallèle (PRP) et redondance transparente de haute disponibilité (HSR) (IEC 62439-3:2021/COR1:2023)

Industrielle Kommunikationsnetze - Hochverfügbare Automatisierungsnetze - Teil 3: Parallelredundanz-Protokoll (PRP) und nahtloser Hochverfügbarkeits-Ring (HSR) (IEC 62439-3:2021/COR1:2023)

This corrigendum becomes effective on 28 April 2023 for incorporation in the English language version of the EN.

CENELEC

European Committee for Electrotechnical Standardization
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Europäisches Komitee für Elektrotechnische Normung

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Endorsement notice

The text of the corrigendum IEC 62439-3:2021/COR1:2023 was approved by CENELEC as EN IEC 62439-3:2022/AC:2023-04 without any modification.

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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IEC 62439-3	**IEC 62439-3**
Edition 4.0 2021-12	Edition 4.0 2021-12
INDUSTRIAL COMMUNICATION NETWORKS – **HIGH AVAILABILITY AUTOMATION NETWORKS –** Part 3: Parallel Redundancy Protocol (PRP) and High-availability Seamless Redundancy (HSR)	**RÉSEAUX DE COMMUNICATION INDUSTRIELS –** **RÉSEAUX DE HAUTE DISPONIBILITÉ POUR L'AUTOMATISATION –** Partie 3: Protocole de redondance en parallèle (PRP) et redondance transparente de haute disponibilité (HSR)

CORRIGENDUM 1

Corrections to the French version appear after the English text. Please note that some corrections are different for the English and French texts.

Les corrections à la version française sont données après le texte anglais. Veuillez noter que certaines corrections sont différentes pour les textes anglais et français.

Corrections to the English version:

INTRODUCTION to Corrigendum 1

This Corrigendum 1 corrects errors and possible misinterpretations in IEC 62439-3:2021, which were discovered during the first field implementations based on this International Standard. All corrections are only intended to improve the consistency of implementations of the specifications and do not introduce new features to the technology.

NOTE   This Corrigendum 1 includes corrections for the MIBs in Clause 7 and Annex E. These MIBs are provided as code components in companion documents, see https://www.iec.ch/sc65c/supportingdocuments. The corrections for Clause 7 and Annex E are provided for convenience, while the versions in the companion documents IEC_62439-3_2021B1.mib and IEC_62439-100_2021B1.mib contain the corrected code and prevail in case of discrepancies.

4   Parallel Redundancy Protocol (PRP)

4.2.7.2   NodesTable

Replace, in the last paragraph (two occurrences), "Supervision Frames" *with* "supervision frames".

4.2.7.5.5 Receiving and NodesTable

Replace, in the first row of the table, "If this frame is not a PRP_Supervision frame or an HSR Supervision frame" *with* "If this frame is neither a PRP_Supervision frame nor an HSR_Supervision frame".

Replace, in the third row of the table, "Else if this frame is a PRP_Supervision frame" *with* "Else (i.e. if this frame is a PRP_Supervision frame or an HSR_Supervision frame)".

Replace, in the fifth row of the table, "Supervision Frame" *with* "supervision frame".

Replace, in NOTE 1, "a well-formed RCT" *with* "a well-formed RCT on one port only".

Replace, in NOTE 2, "Supervision Frames" *with* "supervision frames" *and* "Supervision Frame" *with* "supervision frame".

5 High-availability Seamless Redundancy (HSR)

5.2.2.3 HSR-PRP RedBox for ring connection to a PRP network

Add, at the beginning of subclause 5.2.2.3, the following new headline 5.2.2.3.1:

"5.2.2.3.1 Configuration and operation"

Add, at the end of subclause 5.2.2.3, the following new subclause 5.2.2.3.2:

5.2.2.3.2 Handling of supervision frames

5.2.2.3.2.1 Forwarding supervision frames between HSR and PRP networks

Special processing has to be applied to supervision frames received by the RedBox because PRP_Supervision frames (see 4.3) and HSR_Supervision frames (see 5.7.2) have a slightly different format, so DANPs could be unable to recognize HSR_Supervision frames, while DANHs could be unable to recognize PRP_Supervision frames.

To resolve such potential incompatibility, an HSR-PRP RedBox shall perform a proxy translation of supervision frames in both directions (HSR→PRP and PRP→HSR).

The translation shall include the following:

1) Translate TLV1.TYPE
   a) If its value is 20 or 21 (PRP_Supervision frame), replace it with 23 before forwarding the frame to the HSR network
   b) If its value is 23 (HSR_Supervision frame), replace it with 20 (duplicate discard) before forwarding the frame to the PRP network
2) If TLV2 is not present,
   a) Insert TLV2
   b) Replace the supervision frame's sequence number with the RedBox's local sequence number
3) If TLV2 is present, leave it and the supervision frame's sequence number unmodified
4) Replace the frame's source MAC address with the MAC address of the RedBox and replace the RedundancyTag sequence number with the RedBox's local sequence number

In an HSR-PRP RedBox, it is mandatory to provide a configuration possibility to enable or disable this translation process. The translation can be disabled if, in the particular network, all DANPs accept a TLV1.TYPE equal to 23 and all DANHs accept a TLV1.TYPE equal to 20 and 21.

If the proxy translation is disabled, supervision frames shall still be forwarded, without modification, between HSR and PRP networks in both directions.

5.2.2.3.2.2 Generating supervision frames

An HSR-PRP RedBox shall send its own supervision frames (see 4.3.3 and 5.7.2.1) both to the HSR network (in the HSR_Supervision frame format) and to the PRP network (in the PRP_Supervision frame format) with the same supervision frame sequence number and RedundancyTag sequence number.

5.2.2.3.2.3 Clarification of supervision frames proxy-translation scenarios (informative)

Scenario 1: DANP sends PRP_Supervision frame:

- PRP_Supervision frame received by HSR-PRP-A RedBox

- HSR-PRP-A RedBox translates the frame to HSR_Supervision frame, also inserting TLV2 and replacing supervision sequence number, and sends it to HSR ring in both directions

- PRP_Supervision frame received by HSR-PRP-B RedBox

- HSR-PRP-B RedBox translates the frame to HSR_Supervision frame, also inserting TLV2 and replacing supervision sequence number, and sends it to HSR ring in both directions

- DANHs receive two copies of the HSR_Supervision frames from HSR-PRP-A RedBox (DANP appears as VDANH behind HSR-RedBox A)

- DANHs receive two copies of the HSR_Supervision frames from HSR-PRP-B RedBox (DANP appears as VDANH behind HSR-RedBox B)

Scenario 2: PRP-RedBox sends PRP_Supervision frame on behalf of VDANPs:

- PRP_Supervision frame received by HSR-PRP-A RedBox

- HSR-PRP-A RedBox translates the frame to HSR_Supervision frame, only modifying TLV1 and replacing source MAC address and RedundancyTag sequence number, and sends it to HSR ring in both directions

- PRP_Supervision frame received by HSR-PRP-B RedBox

- HSR-PRP-B RedBox translates the frame to HSR_Supervision frame, only modifying TLV1 and replacing source MAC address and RedundancyTag sequence number, and sends it to HSR ring in both directions

- DANHs receive two copies of the HSR_Supervision frame from HSR-PRP-A RedBox (originating PRP-RedBox appears as HSR-RedBox; VDANPs appear as VDANHs behind the HSR-RedBox)

- DANHs receive two copies of the HSR_Supervision frame from HSR-PRP-B RedBox (originating PRP-RedBox appears as HSR-RedBox; VDANPs appear as VDANHs behind the HSR-RedBox)

Scenario 3: DANH sends HSR_Supervision frame:

- HSR_Supervision frame (two copies) received by HSR-PRP-A RedBox

- HSR-PRP-A RedBox translates the frame to PRP_Supervision frame, also inserting TLV2 and replacing supervision sequence number, and sends it to PRP LAN-A

- HSR_Supervision frame (two copies) received by HSR-PRP-B RedBox

- HSR-PRP-B RedBox translates the frame to PRP_Supervision frame, also inserting TLV2 and replacing supervision sequence number, and sends it to PRP LAN-B

- DANPs in LAN-A receive (potentially two copies of, depending on whether HSR-PRP-A RedBox applies duplicate discard to supervision frames or not) the PRP_Supervision frame from HSR-PRP-A RedBox (DANH appears as VDANP behind PRP-RedBox A)

- DANPs in LAN-B receive (potentially two copies of, depending on whether HSR-PRP-B RedBox applies duplicate discard to supervision frames or not) the PRP_Supervision frame from HSR-PRP-B RedBox (DANH appears as VDANP behind PRP-RedBox B)

Scenario 4: HSR-RedBox sends HSR_Supervision frame on behalf of VDANHs:

- HSR_Supervision frame (two copies) received by HSR-PRP-A RedBox

- HSR-PRP-A RedBox translates the frame to PRP_Supervision frame, only modifying TLV1 and replacing source MAC address and RedundancyTag sequence number, and sends it to PRP LAN-A

- HSR_Supervision frame (two copies) received by HSR-PRP-B RedBox

- HSR-PRP-B RedBox translates the frame to PRP_Supervision frame, only modifying TLV1 and replacing source MAC address and RedundancyTag sequence number, and sends it to PRP LAN-B

- DANPs in LAN-A receive (potentially two copies of, depending on whether HSR-PRP-A RedBox applies duplicate discard to supervision frames or not) the PRP_Supervision frame from HSR-PRP-A RedBox (originating HSR-RedBox appears as PRP-RedBox; VDANHs appear as VDANPs behind the PRP-RedBox)

- DANPs in LAN-B receive (potentially two copies of, depending on whether HSR-PRP-B RedBox applies duplicate discard to supervision frames or not) the PRP_Supervision frame from HSR-PRP-B RedBox (originating HSR-RedBox appears as PRP-RedBox; VDANHs appear as VDANPs behind the PRP-RedBox)

Scenario 5: HSR-PRP-A RedBox sends a supervision frame on behalf of VDANHs both to PRP LAN-A and to HSR ring:

- HSR_Supervision frame (two copies) received by HSR-PRP-B RedBox

- HSR-PRP-B RedBox translates the frame to PRP_Supervision frame, only modifying TLV1 and replacing source MAC address and RedundancyTag sequence number, and sends it to PRP LAN-B

- DANPs in LAN-B receive (potentially two copies of, depending on whether HSR-PRP-B RedBox applies duplicate discard to supervision frames or not) the PRP_Supervision frame from HSR-PRP-B RedBox (originating HSR-PRP-A RedBox appears as PRP-RedBox; VDANHs appear as VDANPs behind the PRP-RedBox)

- DANHs receive two copies of the HSR_Supervision frame from HSR-PRP-A RedBox – same as from a regular HSR-RedBox

- DANPs in LAN-A receive one copy of the PRP_Supervision frame from HSR-PRP-A RedBox (HSR-PRP-A RedBox appears as PRP-RedBox; VDANHs appear as VDANPs behind the PRP-RedBox)

Scenario 6: HSR-PRP-B RedBox sends a supervision frame – everything is symmetrical to Scenario 5.

Scenario 7: HSR-PRP-A RedBox does not have VDANHs connected and acts as a DANH itself. It sends a supervision frame to both PRP LAN-A and HSR ring:

- HSR_Supervision frame (two copies) received by HSR-PRP-B RedBox

- HSR-PRP-B RedBox translates the frame to PRP_Supervision frame, also inserting TLV2 and replacing supervision sequence number, and sends it to PRP LAN-B

- DANPs in LAN-B receive (potentially two copies of, depending on whether HSR-PRP-B RedBox applies duplicate discard to supervision frames or not) the PRP_Supervision frame from HSR-PRP-B RedBox (HSR-PRP-A RedBox appears as VDANP behind PRP-RedBox B)

- DANHs receive two copies of the HSR_Supervision frame from HSR-PRP-A RedBox – same as from a regular DANH

- DANPs in LAN-A receive one copy of the PRP_Supervision frame from HSR-PRP-A RedBox (HSR-PRP-A RedBox appears as VDANP)

Scenario 8: HSR-PRP-B RedBox acts a DANH and sends a supervision frame – everything is symmetrical to Scenario 7.

5.4.1   RedBox properties

Replace, in NOTE 1, "A RedBox sends Supervision frames" *with* "A RedBox sends supervision frames".

5.4.3   RedBox receiving from port A or port B (HSR ring)

Delete, in the first sentence of the first paragraph, the word "valid".

Replace the complete pseudo-code table with the following new table:

If this frame is not HSR-tagged:				
	If the frame carries a non-forwardable address (IEEE 802.1Q Table 8-1 & 8-2)			
		consume the frame and do not forward it.		
	Else if the node is in Mode M			
		enqueue the unchanged frame to port C. forward to the other HSR port in accordance with IEEE 802.1Q forwarding rules		
	Else if the node is in Mode T			
		enqueue the unchanged frame for passing to its link layer interface. enqueue the unmodified frame for sending over the second port.		
	Else			
		enqueue the unchanged frame for passing to its link layer interface. do not forward this frame to the other HSR port		
Else (frame is HSR-tagged):				
	If the node is in Mode T (transparent)			
		remove the HSR tag send the modified frame over the second port send the modified frame to its link layer interface		
	Else (node is not in transparent mode)			
		If this node is a destination:		
			If this is the first occurrence of the frame:	
				remove the HSR tag and pass the modified frame to its link layer interface.
			Else (this is not the first occurrence of the frame over the link layer interface):	
				do not pass the frame to the link layer interface.
		Else (if this node is not a destination):		
			do not pass the frame to the link layer interface.	
		If this node is not the unique destination or the node is in Mode U:		
			If the destination is in the ProxyNodeTable and the node is not in Mode U:	
				do not enqueue the unchanged frame to the other HSR port.

			If this is the first occurrence of the frame and the node is not in Mode N:			
			enqueue the unmodified frame for sending over the other HSR port(s).			
			Else (this is not the first occurrence of the frame or the node is in Mode N):			
			do not enqueue the unchanged frame to the other HSR port.			
			If this is the first occurrence of the frame in direction of port C:			
				If the destination is registered in the NodesTable and the node is not in Mode U:			
				discard the frame			
				If the RedBox is in HSR-SAN mode:			
				remove the HSR tag;			
					If the source is registered in the ProxyNodeTable:		
					discard the frame		
				Else			
					validate and enqueue frame for passing to port C.		
				Else if the RedBox is in HSR-PRP mode (RedBox A or RedBox B):			
					If the NetId matches that of the RedBox		
					discard the frame		
					Else		
						remove the HSR tag and append the PRP RCT with PathId "1010" (RedBox A) or "1011" (RedBox B), reusing the HSR sequence number.	
						validate and enqueue frame for passing to the port C.	
				Else (if the RedBox is in HSR-HSR mode)			
					do not modify the frame.		
					enqueue frame for passing to port C.		
			Else (If this is not the first occurrence of the frame in direction of port C:			
				discard the frame			
		Else (If this node is the only (unicast) destination and the node is not in Mode U:				
			discard the frame.			

Delete the two paragraphs and the NOTE at the end of the subclause, after the pseudo code table.

5.7.2.1 Sending

Insert, between NOTE 1 and Table 9, the following new paragraph:

A RedBox connected to HSR and PRP (see 5.2.2.3) is itself also a DANH and has to send its own supervision frame to both networks using the same sequence number.

Replace, in NOTE 3, "Supervision Frames" *with* "supervision frames" *and* "Supervision Frame" *with* "supervision frame".

5.7.2.3 Reception of an HSR_Supervision frame and NodesTable

Replace, in the first sentence of the first paragraph, "When receiving a first HSR_Supervision frame" *with* "When receiving a first HSR_Supervision frame or PRP_Supervision frame (see 4.2.7.5.5)".

Add, at the end of the first paragraph, the sentence "Nodes shall also be added to the NodesTable based on normal traffic messages with an HSR tag.".

7 PRP/HSR Management Information Base (MIB)

Replace "<CODE BEGIN>" *with* "<CODE BEGINS>" *and* "<CODE END>" *with* "<CODE ENDS>".

These corrections apply to the English version only.

Replace, in the section "iec62439 MODULE-IDENTITY", *in the line* "LAST-UPDATED", "201405220000Z" -- 2014, May 22" *with* ""202212140000Z" -- 2022, December 14".

Replace, in the same section, the lines

```
DESCRIPTION    "
               65c-62439-3-Ed4-FDIS
               Copyright (C) IEC. This version of this MIB module is part
               of 65c-62439-3-Ed4-FDIS;
               see 65c-62439-3-Ed4-FDIS for full legal notices.
               This MIB module defines the Network Management interfaces
               for the redundancy protocols defined by the IEC 62439 suite.
               This MIB exposes the IEC62439-3 objects (PRP + HSR)
               "
```

with the following lines:

```
DESCRIPTION    "
               65c-62439-3:2021/COR1:2023
               Copyright (C) IEC. This version of this MIB module is part
               of 65c-62439-3:2021/COR1:2023;
               see 65c-62439-3:2021 for full legal notices.
               This MIB module defines the Network Management interfaces
               for the redundancy protocols defined by the IEC 62439 suite.
               This MIB exposes the IEC62439-3 objects (PRP + HSR)
               "

REVISION       "202212140000Z" -- 2022, December 14
  DESCRIPTION    "
               replacement of FDIS version with final (corrected) IS version
               "

REVISION       "202210260000Z" -- 2022, October 26
  DESCRIPTION    "
               added configuration option for turning translation of
               Supervision Frames on or off in both directions
               (i.e., one option for the translation of HSR to PRP,
               and one option for the translation of PRP to HSR);
               added Mode X and description
               "
```

Add, at the end of the section "`-- Objects for lreConfigurationGeneralGroup`*", the following lines:*

```
lreProxyTranslationPrpToHsrEnabled OBJECT-TYPE
  SYNTAX TruthValue
  MAX-ACCESS read-write
  STATUS current
  DESCRIPTION         "
                      This value is only applicable if the system is a RedBox.
                      It turns proxy translation of Supervision Frames on (TRUE)
                      or off (FALSE) for the translation of PRP to HSR.
                      "
::= { lreConfigurationGeneralGroup 3 }

lreProxyTranslationHsrToPrpEnabled OBJECT-TYPE
  SYNTAX TruthValue
  MAX-ACCESS read-write
  STATUS current
  DESCRIPTION         "
                      This value is only applicable if the system is a RedBox.
                      It turns proxy translation of Supervision Frames on (TRUE)
                      or off (FALSE) for the tranlation of HSR to PRP.
                      "
::= { lreConfigurationGeneralGroup 4 }
```

Replace, in the section "`-- Objects for lreConfigurationInterfacesGroup`*", the line "*`    modem (5)`*" with the following lines:*

```
    modem (5),
    modex (6)
```

Replace, in the same section, above the line "`::= { lreInterfaceConfigEntry 13}`*", the line "*`        with 802.1Q bridging rules"`*" with the following lines:*

```
        with 802.1Q bridging rules
    (6) Optional mode: The HSR LRE is configured in mode x. A port refrains from
        sending a frame if it already received a duplicate of that frame from the
        opposite direction.
                      "
```

Add, in the section "`-- Conformance Information`*", above the line "*`    lreRowStatus,`*" the following lines:*

```
    lreProxyTranslationPrpToHsrEnabled,
    lreProxyTranslationHsrToPrpEnabled,
```

Annex A Synchronization of clocks over redundant paths

A.2.5.1 Sending in the DACs

Delete, in the middle of the sentence, "with no RCT appended".

Delete NOTE.

Annex E   Management Information base for singly and doubly attached clocks

Replace "<CODE BEGIN>" *with* "<CODE BEGINS>" *and* "<CODE END>" *with* "<CODE ENDS>".

These corrections apply to the English version only.

Replace, in the section "ptp MODULE-IDENTITY", *the lines*

```
    LAST-UPDATED    "202103271411Z" -- 2021-03-27 14:11:52 UTC
    ORGANIZATION     "IEC/TC 65/SC 65C/WG 15"
    CONTACT-INFO     "International Electrotechnical Commission,
Central Office, 3, rue de Varambe 22, CH-1211 Geneva 20, Switzerland"
```

with the following lines:

```
    LAST-UPDATED    "202212140000Z" – 2022-12-14
    ORGANIZATION     "IEC/TC 65/SC 65C/WG 15"
    CONTACT-INFO "
             International Electrotechnical Commission
             IEC Central Office
             3, rue de Varembe
             P.O. Box 131
             CH 1211 GENEVA 20
             Switzerland
             Phone: +41 22 919 02 11
             Fax: +41 22 919 03 00
             email: info@iec.ch
        "
```

Replace, in the same section, the lines

```
    DESCRIPTION
    "65c-62439-3-Ed4-FDIS
     Copyright (C) IEC. This version of this MIB module is part
     of 65c-62439-3-Ed4-FDIS;
     see 65c-62439-3-Ed4-FDIS for full legal notices.
     The Management Information Base module of the  IEC 62439 PRP-HSR Precision Time
Protocol."
```

with the following lines:

```
    DESCRIPTION
    "65c-62439-3:2021/COR1:2023
     Copyright (C) IEC. This version of this MIB module is part
     of 65c-62439-3:2021/COR1:2023;
     see 65c-62439-3:2021 for full legal notices.
     The Management Information Base module of the  IEC 62439 PRP-HSR Precision Time
Protocol."

    REVISION     "202212140000Z" – 2022-12-14
    DESCRIPTION   "replacement of FDIS version with final IS version"
```

Annex F

F.3.9.3 Test for DANP or RedBox for OC (master-capable)

Replace, in Table F.30, in row "hPtpM18", "When port A receives a Sync frame" *with* "When port B receives a Sync frame".