IEC 62439-2

Edition 2.0 2016-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Industrial communication networks – High availability automation networks – Part 2: Media Redundancy Protocol (MRP)

Réseaux de communication industriels – Réseaux d'automatisme à haute disponibilité – Partie 2: Protocole de redondance du support (MRP)

IEC 62439-2:2016-03(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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FOREWORD

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International Standard IEC 62439-2 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This second edition cancels and replaces the first edition published in 2010. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

– adding a protocol extension to select the media redundancy manager automatically;
– adding a protocol to redundantly connect media redundancy protocol rings.

The text of this standard is based on the following documents:

FDIS	Report on voting
65C/834/FDIS	65C/841/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with ISO/IEC Directives, Part 2.

This International Standard is to be read in conjunction with IEC 62439-1.

A list of all parts of the IEC 62439 series, published under the general title *Industrial communication networks – High availability automation networks*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

The IEC 62439 series specifies relevant principles for high availability networks that meet the requirements for industrial automation networks.

In the fault-free state of the network, the protocols of the IEC 62439 series provide ISO/IEC/IEEE 8802-3 (IEEE 802.3) compatible, reliable data communication, and preserve determinism of real-time data communication. In cases of fault, removal, and insertion of a component, they provide deterministic recovery times.

These protocols retain fully the typical Ethernet communication capabilities as used in the office world, so that the software involved remains applicable.

The market is in need of several network solutions, each with different performance characteristics and functional capabilities, matching diverse application requirements. These solutions support different redundancy topologies and mechanisms which are introduced in IEC 62439-1 and specified in the other Parts of the IEC 62439 series. IEC 62439-1 also distinguishes between the different solutions, giving guidance to the user.

The IEC 62439 series follows the general structure and terms of the IEC 61158 series.

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning ring protocol given in Clause 5. Table 1 gives an overview of the relevant patents.

Table 1 – Patent information

No.	Status	Country	Granted Patent Number or Application Number (if pending)	Title
1	granted	US	US 6430151	Local networking with redundancy properties having a redundancy manager
	granted	CA	CA 2323429	
	granted	CN	CN 117195	
	granted	NO	NO 330908	
	granted	EP (AT, BE, CH, DE, DK, ES, FR, GB, IT, NL, SE)	EP 1062787	

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Munich 81739
Germany

and

Hirschmann Automation and Control GmbH
Stuttgarter Strasse 45-51

Neckartenzlingen 72654

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INDUSTRIAL COMMUNICATION NETWORKS – HIGH AVAILABILITY AUTOMATION NETWORKS –

Part 2: Media Redundancy Protocol (MRP)

1 Scope

The IEC 62439 series is applicable to high-availability automation networks based on the ISO/IEC/IEEE 8802-3 (IEEE 802.3) (Ethernet) technology.

This part of the IEC 62439 series specifies a recovery protocol based on a ring topology, designed to react deterministically on a single failure of an inter-switch link or switch in the network, under the control of a dedicated media redundancy manager node.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-191, *International Electrotechnical Vocabulary – Chapter 191: Dependability and quality of service*

IEC 61158-6-10:2014, *Industrial communication networks – Fieldbus specifications – Part 6-10: Application layer protocol specification – Type 10 elements*

IEC 61784-1, *Industrial communication networks – Profiles – Part 1: Fieldbus profiles*

IEC 61784-2, *Industrial communication networks – Profiles – Part 2: Additional fieldbus profiles for real-time networks based on ISO/IEC 8802-3*

IEC 62439-1:2010, *Industrial communication networks – High availability automation networks – Part 1: General concepts and calculation methods*
IEC 62439-1:2010/AMD1:2012[1]

ISO/IEC 10164-1, *Information technology – Open Systems Interconnection – Systems Management: Object Management Function*

ISO/IEC/IEEE 8802-3 *Standard for Ethernet*

IEEE 802.1D:2004, *IEEE Standard for Local and metropolitan area networks – Media Access Control (MAC) Bridges*

IEEE 802.1Q:2011, *IEEE Standard for Local and metropolitan area networks – Media Access Control (MAC) Bridges and Virtual Bridge Local Area Network*

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[1] A consolidated version of this publication exists, comprising IEC 62439-1:2010 and IEC 62439-1:2010/AMD1:2012.

3 Terms, definitions, abbreviations, acronyms, and conventions

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-191, as well as in IEC 62439-1, as well as the following, apply.

3.1.1
interconnection port
port of a switch that is used to interconnect two ring topologies

3.1.2
interconnection topology
topology in which two ring topologies are connected

3.2 Abbreviations and acronyms

For the purposes of this document, the abbreviations and acronyms given in IEC 62439-1 apply, in addition to the following.

ASE	Application Service Element
CCM	Continuity Check Messages
CFM	Connectivity Fault Management
CFM-MRP	Connectivity Fault Management for MRP
CPU	Central Processing Unit
FDB	Filtering Database
LC-mode	Link Check mode
LSB	Least Significant Bit
MAID	Maintenance Association ID
MD	Maintenance Domain
MD Level	Maintenance Domain Level
MEP	Maintenance End Point
MEPID	Maintenance Association End Point ID
MIB	Management Information Base
MRA	Media Redundancy Automanager
MRC	Media Redundancy Client
MRM	Media Redundancy Manager
MRP	Media Redundancy Protocol
MIC	Media Redundancy Interconnection Client
MIM	Media Redundancy Interconnection Manager
RC-mode	Ring Check mode

3.3 Conventions

This document follows the conventions defined in IEC 62439-1.

4 MRP Overview

This document specifies the Media Redundancy Protocol (MRP), a recovery protocol based on a ring topology, and the redundant interconnection of MRP rings via the Media Redundancy Interconnection Protocol as shown in Figure 1.

MRP is designed to react deterministically on a single failure of an inter-switch link or switch in the ring or interconnection topology.

MRP is based on functions of ISO/IEC/IEEE 8802-3 (IEEE 802.3) and IEEE 802.1Q including the Filtering Database (FDB) and is located between the Data Link Layer and Application Layer (see Figure 2).

NOTE Layering is assumed to be according to IEC 61158-1.

A MRP compliant network shall have a ring topology with multiple nodes.

One of the nodes has the role of a Media Redundancy Manager (MRM). The function of the MRM is to observe and to control the ring topology in order to react on network faults. The MRM does this by sending frames on one ring port over the ring and receiving them from the ring over its other ring port, and vice–versa in the other direction.

The other nodes in the ring have the role of Media Redundancy Clients (MRC). An MRC reacts on received reconfiguration frames from the MRM and can detect and signal link changes on its ring ports.

Certain nodes or all nodes in the ring may also start as a Media Redundancy Automanager (MRA). MRAs select one MRM among each other by using a voting protocol. The remaining MRAs transition to the role MRC.

Each node in the ring is able to detect the failure or recovery of an inter-switch link or the failure or recovery of a neighboring node.

To redundantly connect two MRP rings, two nodes of each ring are assigned additional roles.

One of the nodes has the role of a media redundancy interconnection manager (MIM), in addition to the role of a MRC or MRM. The function of the MIM is to observe and to control the redundant interconnection topology in order to react on interconnection faults. To cover a maximum of applications, two detection methods are provided by this international standard. The MIM can observe the interconnection topology by either reacting directly on interconnection port link change notification messages (LC-mode) or by sending test frames on the interconnection port over the connected rings and receiving them over its ring ports, and vice–versa in the other direction (RC-mode).

The other three nodes in the interconnection topology have the role of media redundancy interconnection clients (MIC), in addition to the role of a MRC or MRM. The MIC reacts on received reconfiguration frames from the MIM, it can detect and signal link changes of its interconnection port, and it can issue link change notification messages.

As described in the course of this international standard, LC-mode has the advantage of restricting the interconnection test frame load only to the interconnection links, whereas RC-mode has the advantage of deloading the MICs from interconnection test frame processing. The selection of the mode has to be made in accordance with the requirements of the application and is outside the scope of this international standard.

The vendor may implement only the LC-mode or only the RC-mode or both modes. The MIM and all MICs of one MRP interconnection topology shall be configured to the same mode.