

This is a preview - click here to buy the full publication



**IEC 62439-4**

Edition 1.0 2010-02

# **INTERNATIONAL STANDARD**

---

**Industrial communication networks – High availability automation networks –  
Part 4: Cross-network Redundancy Protocol (CRP)**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

PRICE CODE



---

ICS 25.040, 35.040

ISBN 978-2-88910-707-0

## CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references.....	7
3 Terms, definitions, abbreviations, acronyms, and conventions.....	7
3.1 Terms and definitions.....	7
3.2 Abbreviations and acronyms.....	7
3.3 Conventions.....	7
4 CRP overview.....	8
5 CRP nodes.....	8
6 CRP LAN topology.....	8
7 CRP key components.....	10
7.1 CRP general protocol operation.....	10
7.1.1 Doubly-attached nodes (DANCs).....	10
7.1.2 Singly attached nodes.....	11
7.2 CRP statistics.....	11
7.3 CRP Network_Status_Table.....	12
7.4 CRP recovery time.....	15
7.4.1 Recovery time calculation.....	15
7.4.2 Maximum repair time.....	16
7.5 CRP multicast messages.....	16
7.5.1 Sending.....	16
7.5.2 Receiving.....	16
7.6 CRP unicast messages.....	16
7.6.1 Sending a frame.....	16
7.6.2 Receiving a frame.....	17
7.7 CRP redundancy information.....	17
7.8 CRP redundancy statistics.....	17
8 CRP protocol.....	17
8.1 CRP singly attached node.....	17
8.2 CRP doubly attached node.....	17
8.3 CRP Installation, configuration and repair.....	17
8.4 CRP LRE model attributes.....	18
8.4.1 Attribute specification.....	18
8.4.2 Impact of LRE configuration attributes.....	22
8.5 CRP encoding of the DiagnosticFrame.....	23
8.6 CRP Encoding of the AnnunciationFrame.....	24
8.7 CRP common protocol.....	26
8.7.1 AnnunciationFrames.....	26
8.7.2 DiagnosticFrames.....	26
8.7.3 Detection of duplicate Node_Index.....	27
8.7.4 Detection of duplicate Node_Name.....	27
8.7.5 Failure detection based on arrival of DiagnosticFrames.....	27
8.7.6 Status array entries.....	28
8.7.7 Other failure detection.....	28
8.8 CRP operational messages.....	28

8.8.1	Load balancing .....	28
8.8.2	LAN and port maintenance .....	28
8.8.3	Selecting transmission path .....	29
8.8.4	Selecting reception adapter .....	30
8.8.5	Crossed_cable_status .....	30
8.8.6	Configured parameters .....	30
8.9	CRP services .....	31
8.9.1	Configuration options and services .....	31
8.9.2	LAN redundancy service specification .....	31
9	CRP Management Information Base (MIB) .....	38
	Bibliography.....	41
	Figure 1 – CRP stack architecture .....	8
	Figure 2 – CRP single LAN topography.....	9
	Figure 3 – CRP double LAN topology.....	9
	Figure 4 – CRP DiagnosticFrame pair approach .....	10
	Figure 5 – CRP example system .....	11
	Table 1 – CRP example Network_Status_Table for node 3 .....	11
	Table 2 – CRP Network_Status_Table for singly connected nodes.....	13
	Table 3 – CRP Network_Status_Table for DANC .....	14
	Table 4 – CRP Path_Status_Sets .....	21
	Table 5 – CRP example of a Path_Status_Set .....	21
	Table 6 – CRP configuration attributes impact on LAN operation .....	22
	Table 7 – CRP DiagnosticFrame format .....	23
	Table 8 – CRP AnnunciationFrame .....	24
	Table 9 – CRP unicast destination address handling.....	29
	Table 10 – CRP configuration parameters.....	30
	Table 11 – CRP Set_Assignment_Info service parameters.....	31
	Table 12 – CRP Get_Redundancy_Info service.....	33
	Table 13 – CRP Set_Redundancy_Info service .....	35
	Table 14 – CRP Get_Redundancy_Statistics service .....	37

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

### **INDUSTRIAL COMMUNICATION NETWORKS – HIGH AVAILABILITY AUTOMATION NETWORKS –**

#### **Part 4: Cross-network Redundancy Protocol (CRP)**

#### FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

International Standard IEC 62439-4 has been prepared by subcommittee 65C: Industrial Networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This standard cancels and replaces IEC 62439 published in 2008. This first edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to IEC 62439 (2008):

- adding a calculation method for RSTP (rapid spanning tree protocol, IEEE 802.1Q),
- adding two new redundancy protocols: HSR (High-availability Seamless Redundancy) and DRP (Distributed Redundancy Protocol),
- moving former Clauses 1 to 4 (introduction, definitions, general aspects) and the Annexes (taxonomy, availability calculation) to IEC 62439-1, which serves now as a base for the other documents,
- moving Clause 5 (MRP) to IEC 62439-2 with minor editorial changes,

- moving Clause 6 (PRP) was to IEC 62439-3 with minor editorial changes,
- moving Clause 7 (CRP) was to IEC 62439-4 with minor editorial changes, and
- moving Clause 8 (BRP) was to IEC 62439-5 with minor editorial changes,
- adding a method to calculate the maximum recovery time of RSTP in a restricted configuration (ring) to IEC 62439-1 as Clause 8,
- adding specifications of the HSR (High-availability Seamless Redundancy) protocol, which shares the principles of PRP to IEC 62439-3 as Clause 5, and
- introducing the DRP protocol as IEC 62439-6.

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

FDIS	Report on voting
65C/583/FDIS	65C/589/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 International Standard is to be read in conjunction with IEC 62439-1:2010, *Industrial communication networks – High availability automation networks – Part 1: General concepts and calculation methods*.

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

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

The committee has decided that the contents of this amendment and the base 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.

A bilingual version of this standard may be issued at a later date.

## 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 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 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 a full-duplex Ethernet in which each device periodically transmits a message representing its connectivity to the other devices, allowing them to choose a redundant path in case of failure, given in 7.1 and 7.3.

IEC takes no position concerning the evidence, validity and scope of this patent right.

The holder of this patent right has assured the IEC that he/she is willing to negotiate licences either free of charge or under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with IEC. Information may be obtained from:

Fieldbus Foundation

9005 Mountain Ridge Drive – Bowie Bldg

Suite 190

Austin, TX 78759

USA

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights other than those identified above. IEC shall not be held responsible for identifying any or all such patent rights.

ISO ([www.iso.org/patents](http://www.iso.org/patents)) and IEC ([http://www.iec.ch/tctools/patent\\_decl.htm](http://www.iec.ch/tctools/patent_decl.htm)) maintain on-line data bases of patents relevant to their standards. Users are encouraged to consult the data bases for the most up to date information concerning patents.

## **INDUSTRIAL COMMUNICATION NETWORKS – HIGH AVAILABILITY AUTOMATION NETWORKS –**

### **Part 4: Cross-network Redundancy Protocol (CRP)**

#### **1 Scope**

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

This part of the IEC 62439 series specifies a redundancy protocol that is based on the duplication of the network, the redundancy protocol being executed within the end nodes, as opposed to a redundancy protocol built in the switches. The switchover decision is taken in each node individually. The cross-network connection capability enables single attached end nodes to be connected on either of the two networks.

#### **2 Normative references**

The following referenced documents are indispensable for the application of this document. 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 62439-1:2010, *Industrial communication networks – High availability automation networks – Part 1: General concepts and calculation methods*

ISO/IEC 8802-3:2000, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*