

DIN EN 62439-2

ICS 35.110

Ersatzvermerk
siehe unten

**Industrielle Kommunikationsnetze –
Hochverfügbare Automatisierungsnetze –
Teil 2: Medienredundanz-Protokoll (MRP) (IEC 62439-2:2010);
Englische Fassung EN 62439-2:2010**

Industrial communication networks –
High availability automation networks –
Part 2: Media Redundancy Protocol (MRP) (IEC 62439-2:2010);
English version EN 62439-2:2010

Réseaux de communication industrielle –
Réseaux d'automatisme à haute disponibilité –
Partie 2: Protocole de redondance de média (MRP) (CEI 62439-2:2010);
Version anglaise EN 62439-2:2010

Ersatzvermerk

Mit DIN EN 62439-1:2010-09, DIN EN 62439-3:2010-09, DIN EN 62439-4:2010-09, DIN EN 62439-5:2010-09
und DIN EN 62439-6:2010-09 Ersatz für DIN EN 62439:2009-01
Siehe jedoch Anwendungsbeginn

Gesamtumfang 77 Seiten

DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE

Anwendungsbeginn

Anwendungsbeginn für die von CENELEC am 2010-03-01 angenommene Europäische Norm als DIN-Norm ist 2010-09-01.

Daneben darf DIN EN 62439:2009-01 noch bis 2013-03-01 angewendet werden.

Nationales Vorwort

Vorausgegangener Norm-Entwurf: E DIN EN 62439-2:2009-09.

Für diese Norm ist das nationale Arbeitsgremium K 956 „Feldbus“ der DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE (www.dke.de) zuständig.

Die enthaltene IEC-Publikation wurde vom SC 65C „Industrial networks“ erarbeitet.

Das IEC-Komitee hat entschieden, dass der Inhalt dieser Publikation bis zu dem Datum (maintenance result date) unverändert bleiben soll, das auf der IEC-Website unter „<http://webstore.iec.ch>“ zu dieser Publikation angegeben ist. Zu diesem Zeitpunkt wird entsprechend der Entscheidung des Komitees die Publikation

- bestätigt,
- zurückgezogen,
- durch eine Folgeausgabe ersetzt oder
- geändert.

Für den Fall einer undatierten Verweisung im normativen Text (Verweisung auf eine Norm ohne Angabe des Ausgabedatums und ohne Hinweis auf eine Abschnitsnummer, eine Tabelle, ein Bild usw.) bezieht sich die Verweisung auf die jeweils neueste gültige Ausgabe der in Bezug genommenen Norm.

Für den Fall einer datierten Verweisung im normativen Text bezieht sich die Verweisung immer auf die in Bezug genommene Ausgabe der Norm.

Der Zusammenhang der zitierten Normen mit den entsprechenden Deutschen Normen ergibt sich, soweit ein Zusammenhang besteht, grundsätzlich über die Nummer der entsprechenden IEC-Publikation. Beispiel: IEC 60068 ist als EN 60068 als Europäische Norm durch CENELEC übernommen und als DIN EN 60068 ins Deutsche Normenwerk aufgenommen.

Die Reihe DIN EN 62439 besteht aus folgenden Teilen:

Teil 1: Grundlagen und Berechnungsmethoden

Teil 2: Medienredundanz-Protokoll (MRP)

Teil 3: Parallelredundanz-Protokoll (PRP) und nahtloser Hochverfügbarkeits-Ring (HSR)

Teil 4: Redundanz-Protokoll für vermaschte Netze (CRP)

Teil 5: Funkbaken-Redundanz-Protokoll (BRP)

Teil 6: Protokoll für verteilte Redundanz (DRP)

Da sich die Benutzer des vorliegenden Norm-Entwurfs der englischen Sprache als Fachsprache bedienen, wird die englische Fassung der DIN EN 62439-2 veröffentlicht. Für die meisten der verwendeten Begriffe existieren keine gebräuchlichen deutschen Benennungen, da sich die deutschen Anwender in der Regel ebenfalls der englischen Benennungen bedienen. Dieser Norm-Entwurf steht nicht in unmittelbarem Zusammenhang mit Rechtsvorschriften und ist nicht als Sicherheitsnorm anzusehen.

Das Präsidium des DIN hat mit Präsidialbeschluss 1/2004 festgelegt, dass DIN-Normen, deren Inhalt sich auf internationale Arbeitsergebnisse der Informationsverarbeitung gründet, unter bestimmten Bedingungen allein in englischer Sprache veröffentlicht werden dürfen. Diese Bedingungen sind für die vorliegende Norm erfüllt.

Erklärung zu Schutzrechten

Die Internationale Elektrotechnische Kommission macht darauf aufmerksam, dass ihr gegenüber erklärt wurde, dass die Übereinstimmung mit dem vorgesehenen Norm-Inhalt die Anwendung von Patenten erforderlich machen könnte. Nähere Informationen hierzu befinden sich im Vorwort der Europäischen und Internationalen Norm.

Es wird darauf aufmerksam gemacht, dass Bestandteile der vorliegenden Norm Gegenstand von weiteren Patentrechten sein können. Es liegt nicht im Verantwortungsbereich der DKE, einige oder alle dieser Patentrechte zu benennen.

Der Leser der vorliegenden Norm wird jedoch gebeten, ihm bekannte derartige Patentrechte der Geschäftsstelle mitzuteilen und entsprechende Informationen zur Verfügung zu stellen.

Änderungen

Gegenüber DIN EN 62439:2009-01 wurden folgende Änderungen vorgenommen:

- a) Überführung in eine 6-teilige Normenreihe mit dem Haupttitel „Hochverfügbare Automatisierungsnetze“.

Frühere Ausgaben

DIN EN 62439: 2009-01

– Leerseite –

**Industrial communication networks –
High availability automation networks –
Part 2: Media Redundancy Protocol (MRP)
(IEC 62439-2:2010)**

Réseaux de communication industrielle –
Réseaux d'automatisme à haute
disponibilité –
Partie 2: Protocol de redondance
de média (MRP)
(CEI 62439-2:2010)

Industrielle Kommunikationsnetze –
Hochverfügbare Automatisierungsnetze –
Teil 2: Medienredundanz-Protokoll (MRP)
(IEC 62439-2:2010)

This European Standard was approved by CENELEC on 2010-03-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: Avenue Marnix 17, B – 1000 Brussels

Foreword

The text of document 65C/583/FDIS, future edition 1 of IEC 62439-2, prepared by SC 65C, Industrial networks, of IEC TC 65, Industrial-process measurement, control and automation, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 62439-2 on 2010-03-01.

This EN 62439-2 together with EN 62439-1, EN 62439-3, EN 62439-4, EN 62439-5 and EN 62439-6 supersedes EN 62439:2008.

EN 62439-2:2010 includes the following significant technical changes with respect to EN 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 EN 62439-1, which serves now as a base for the other documents,
- moving Clause 5 (MRP) to EN 62439-2 with minor editorial changes,
- moving Clause 6 (PRP) was to EN 62439-3 with minor editorial changes,
- moving Clause 7 (CRP) was to EN 62439-4 with minor editorial changes, and
- moving Clause 8 (BRP) was to EN 62439-5 with minor editorial changes,
- adding a method to calculate the maximum recovery time of RSTP in a restricted configuration (ring) to EN 62439-1 as Clause 8,
- adding specifications of the HSR (High-availability Seamless Redundancy) protocol, which shares the principles of PRP to EN 62439-3 as Clause 5, and
- introducing the DRP protocol as EN 62439-6.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

The following dates were fixed:

- | | | |
|--|-------|------------|
| – latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement | (dop) | 2010-12-01 |
| – latest date by which the national standards conflicting with the EN have to be withdrawn | (dow) | 2013-03-01 |

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 62439-2:2010 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61158-2:2007	NOTE	Harmonized as EN 61158-2:2008 (not modified).
IEC 61158-5-10	NOTE	Harmonized as EN 61158-5-10.
IEC 61784-1:2007	NOTE	Harmonized as EN 61784-1:2008 (not modified).
IEC 61784-2:2007	NOTE	Harmonized as EN 61784-2:2008 (not modified).
IEC 62439-3	NOTE	Harmonized as EN 62439-3.
IEC 62439-4	NOTE	Harmonized as EN 62439-4.
IEC 62439-5	NOTE	Harmonized as EN 62439-5.
IEC 62439-6	NOTE	Harmonized as EN 62439-6.

CONTENTS

INTRODUCTION.....	7
1 Scope.....	8
2 Normative references	8
3 Terms, definitions, abbreviations, acronyms, and conventions.....	8
3.1 Terms and definitions	8
3.2 Abbreviations and acronyms.....	8
3.3 Conventions	9
4 MRP Overview.....	9
5 MRP Media redundancy behavior	10
5.1 Ring ports	10
5.2 Media Redundancy Manager (MRM).....	11
5.3 Media Redundancy Client (MRC).....	12
5.4 Redundancy domain.....	12
5.5 Usage with diagnosis and alarms	12
5.6 Ring diagnosis.....	12
5.7 Multiple MRM in a single ring	13
5.8 BLOCKED not supported (option).....	13
6 MRP Class specification	14
6.1 General	14
6.2 Template	14
6.3 Attributes.....	14
7 MRP service specification.....	16
7.1 Start MRM	16
7.2 Stop MRM	18
7.3 State Change	19
7.4 Start MRC	19
7.5 Stop MRC.....	21
7.6 Read MRM	21
7.7 Read MRC	23
8 MRP protocol specification	25
8.1 PDU description	25
8.1.1 Basic data types	25
8.1.2 DLPDU abstract syntax reference.....	25
8.1.3 Coding of the DLPDU field SourceAddress	26
8.1.4 Coding of the DLPDU field DestinationAddress.....	26
8.1.5 Coding of the field TagControlInformation.....	26
8.1.6 Coding of the field LT	27
8.1.7 MRP APDU abstract syntax	27
8.1.8 Coding of the field MRP_TLVHeader	27
8.1.9 Coding of the field MRP_Version	28
8.1.10 Coding of the field MRP_SequenceID	28
8.1.11 Coding of the field MRP_SA	28
8.1.12 Coding of the field MRP_Prio.....	28
8.1.13 Coding of the field MRP_PortRole	29

8.1.14	Coding of the field MRP_RingState.....	29
8.1.15	Coding of the field MRP_Interval	29
8.1.16	Coding of the field MRP_Transition	30
8.1.17	Coding of the field MRP_TimeStamp	30
8.1.18	Coding of the field MRP_Blocked.....	30
8.1.19	Coding of the field MRP_ManufacturerOUI	30
8.1.20	Coding of the field MRP_ManufacturerData	30
8.1.21	Coding of the field MRP_DomainUUID.....	30
8.2	Protocol machines.....	31
8.2.1	MRM protocol machine	31
8.2.2	MRC protocol machine	40
8.2.3	MRM and MRC functions	47
8.2.4	FDB clear timer	50
8.2.5	Topology change timer	50
9	MRP installation, configuration and repair	50
9.1	Ring port parameters.....	50
9.2	Ring topology parameters.....	51
9.3	MRM parameters.....	51
9.4	MRC parameters and constraints	51
9.5	Calculation of MRP ring recovery time.....	52
9.5.1	Overview	52
9.5.2	Deduction of formula	52
9.5.3	Worst case calculation for recovery time of 10 ms	54
9.5.4	Worst case calculation for 50 devices	55
10	MRP Management Information Base (MIB)	55
10.1	General.....	55
10.2	MRP MIB with a monitoring view	55
10.3	MRP MIB with a management and monitoring view.....	63
	Bibliography.....	72
	Annex ZA (normative) Normative references to international publications with their corresponding European publications	73
	Figure 1 – MRP stack	10
	Figure 2 – MRP ring topology with one manager and clients	11
	Figure 3 – MRP open ring with MRM.....	11
	Figure 4 – MRP ring with more than one MRM	13
	Figure 5 – MRP protocol machine for MRM.....	31
	Figure 6 – MRP protocol machine for MRC	41
	Table 1 – MRP Start MRM	17
	Table 2 – MRP Stop MRM.....	18
	Table 3 – MRP Change State.....	19
	Table 4 – MRP Start MRC.....	20
	Table 5 – MRP Stop MRC	21
	Table 6 – MRP Read MRM	22
	Table 7 – MRP Read MRC.....	24
	Table 8 – MRP DLPDU syntax for ISO/IEC 8802-3 (IEEE 802.3).....	25

Table 9 – MRP OUI.....	26
Table 10 – MRP MulticastMACAddress	26
Table 11 – MRP TagControlInformation.Priority field.....	27
Table 12 – MRP LT field	27
Table 13 – MRP APDU syntax	27
Table 14 – MRP Substitutions	27
Table 15 – MRP_TLVHeader.Type.....	28
Table 16 – MRP_Version	28
Table 17 – MRP_Prio.....	29
Table 18 – MRP_PortRole	29
Table 19 – MRP_RingState.....	29
Table 20 – MRP_Interval	29
Table 21 – MRP_Transition.....	30
Table 22 – MRP_TimeStamp	30
Table 23 – MRP_Blocked.....	30
Table 24 – MRP_DomainUUID.....	31
Table 25 – MRP Local variables of MRM protocol machine	32
Table 26 – MRM State machine	33
Table 27 – MRP Local variables of MRC protocol machine	42
Table 28 – MRC state machine	42
Table 29 – MRP functions.....	48
Table 30 – MRP FDB clear timer.....	50
Table 31 – MRP topology change timer.....	50
Table 32 – MRP Network/Connection parameters	51
Table 33 – MRP MRM parameters	51
Table 34 – MRP MRC parameters.....	52

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 ring protocol given in Clause 5.

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:

Siemens AG A&D
Gleiwitzerstr. 555
Nürnberg 90475
Germany

and

Hirschmann Automation and Control GmbH
Stuttgarter Strasse 45-51
Neckartenzlingen 72654
Germany

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) and IEC (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 2: Media Redundancy Protocol (MRP)

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 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 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 60050-191:1990, *International Electrotechnical Vocabulary – Chapter 191: Dependability and quality of service*

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

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*

IEEE 802.1Q, *IEEE standards for local and metropolitan area network. Virtual bridged local area networks*

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

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, apply.

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.

MRC	Media Redundancy Client
MRM	Media Redundancy Manager
MRP	Media Redundancy Protocol

3.3 Conventions

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

4 MRP Overview

The Media Redundancy Protocol (MRP) specifies a recovery protocol based on a ring topology.

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

MRP is based on functions of ISO/IEC 8802-3 (IEEE 802.3) and IEEE 802.1D including the Filtering Data Base (FDB) and is located between the Data Link Layer and Application Layer (see Figure 1).

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

A 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.

A compliant node shall have the ability to perform as one of the following:

- media redundancy manager (MRM),
- media redundancy client (MRC), or
- both MRM and MRC (but both roles shall not be active at the same time).

Each MRP compliant node requires a switch element with two ring ports connected to the ring.

NOTE 2 Additional ring ports may be used to connect to another ring.

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 (see 5.1).

The MRP consists of a service and a protocol entity, see stack model in Figure 1.

The service entity specifies, in an abstract way, the externally visible service provided by the Data Link Layer in terms of:

- primitive actions and events of the service,
- parameters associated with each primitive action and event, and the form which they take, and
- interrelationship between these actions and events, and their valid sequences.

MRP defines the services provided to

- the Application Layer at the boundary between the Application Layer and the Data Link Layer, and
- the MRP Management at the boundary between the Data Link Layer and the MRP Management.

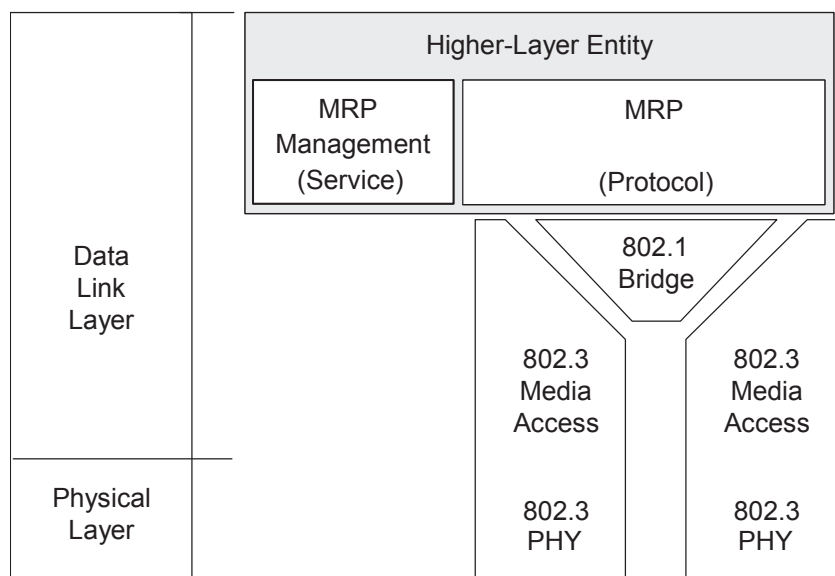


Figure 1 – MRP stack

IEC 350/10

5 MRP Media redundancy behavior

5.1 Ring ports

The MRM and the MRC shall have two ring ports.

The MRM and MRC shall be able to detect the failure or recovery of a link on a ring port with mechanisms based on ISO/IEC 8802-3 (IEEE 802.3).

The MRM and MRC shall not forward MRP_Test frames, MRP_TopologyChange frames, and MRP_LinkChange frames to non-ring ports.

A ring port shall take one of the following port states:

- **DISABLED:**
All frames shall be dropped.
- **BLOCKED:**
All frames shall be dropped except the following:
 - MRP_TopologyChange frames and MRP_Test frames.
 - MRP_LinkChange frames from an MRC.
 - Frames specified in IEEE 802.1D (2004) Table 7-10 to pass ports in “Discarding” state (e.g. LLDP, IEC 61588 (IEEE 1588) PTP).
 - Frames only produced or consumed by the higher layer entities of this node and never forwarded.
- **FORWARDING:**
All frames shall be passed through according to the forwarding behavior of IEEE 802.1D.

NOTE IEEE 802.1D refers to the port state corresponding to BLOCKED as “Discarding”.

5.2 Media Redundancy Manager (MRM)

The first ring port of the MRM shall be connected to a ring port of an MRC. The other ring port of that MRC shall be connected to a ring port of another MRC or to the second ring port of the MRM, thereby forming a ring topology as shown in Figure 2.

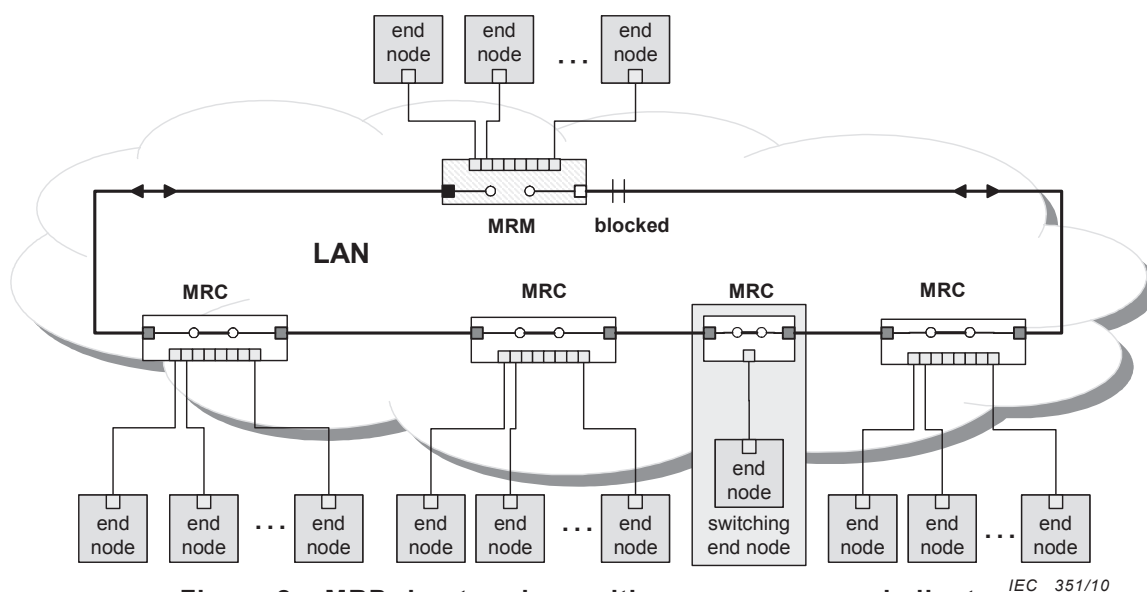


Figure 2 – MRP ring topology with one manager and clients

The MRM shall control the ring state by:

- sending MRP_Test frames at a configured time period in both directions of the ring;
- setting one ring port in FORWARDING state and the other ring port in BLOCKED state if it receives its own MRP_Test frames (this means that the ring is closed, see Figure 2);
- setting both ring ports in FORWARDING state if it does not receive its own MRP_Test frames within a configured time according to MRP_TSTdefaultT, MRP_TSTshortT and MRP_TSTNRmax in Table 33 (this means that the ring is open, see Figure 3).

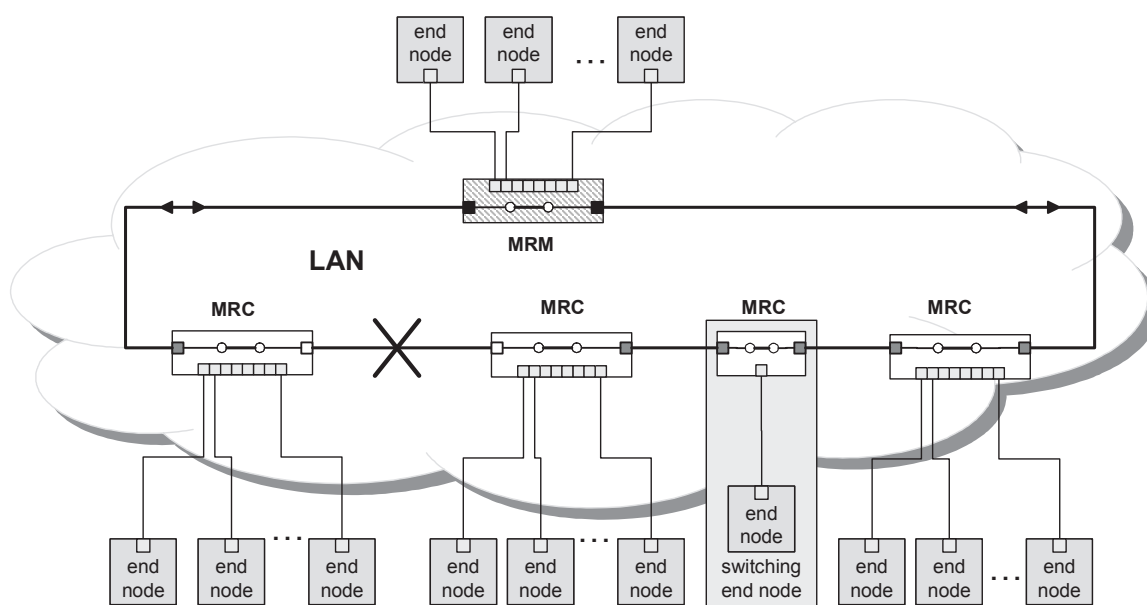


Figure 3 – MRP open ring with MRM

The following mechanism supports synchronization between MRM and MRC in ring topology changes.

The MRM shall indicate changes in the ring state to the MRCs by means of MRP_TopologyChange frames.

The MRM shall not forward MRP specific frames (MRP_Test frames, MRP_TopologyChange frames, MRP_LinkChange frames) between its ring ports.

If the MRM receives an MRP_LinkUp or MRP_LinkDown frame, then the MRM shall reduce its test monitoring time according to Table 33 to accelerate the detection of the open ring. When the open ring is detected then the MRM shall send the MRP_TopologyChange frames through both its ring ports.

Optionally the MRM shall send the MRP_TopologyChange frames through its ring ports. This option is selected by setting the parameter REACT_ON_LINK_CHANGE, see Table 26.

The MRM shall send to the MRCs an MRP_TopologyChange frame with the delay, after which the ring topology change will be performed. The parameter carrying this delay is called MRP_Interval. When this time has expired, all MRCs shall clear their filtering database (FDB).

Each MRC shall send the configured delay in MRP_Interval to the MRM in the MRP_LinkUp and MRP_LinkDown frames to tell the MRM after which time the MRC will change its port state from BLOCKED to FORWARDING (MRP_LinkUp frame) or to DISABLED (MRP_LinkDown frame).

Measures shall be included to prevent the MRM from remaining stuck in the closed state in case of node failure.

5.3 Media Redundancy Client (MRC)

Each MRC shall forward MRP_Test frames received on one ring port to the other ring port and vice versa.

If the MRC detects a failure or recovery of a ring port link, the MRC may optionally notify the change by sending MRP_LinkChange frames through both of its ring ports. Each MRC shall forward MRP_LinkChange frames received on one ring port to the other ring port and vice versa.

Each MRC shall forward MRP_TopologyChange frames received on one ring port to the other ring port and vice versa. Each MRC shall process these frames. It shall clear its FDB if requested by an MRP_TopologyChange frame in a given time interval (see Table 33, MRP_TOPchgT).

5.4 Redundancy domain

The redundancy domain represents a ring. By default, all MRM and MRCs belong to the default domain. A unique domain ID can be allocated as a key attribute, especially if an MRM or an MRC is member of multiple rings. A node shall assign exactly two unique ring ports per redundancy domain.

NOTE 1 A device may have other ports than the two assigned to MRP. These other ports are not influenced by MRP.

NOTE 2 MRP ports should behave as if RSTP is disabled.

5.5 Usage with diagnosis and alarms

If the attribute Check Media Redundancy has the value TRUE, media redundancy events shall cause diagnosis events and alarm notifications.

5.6 Ring diagnosis

In a redundancy domain the following diagnosis events handling shall be implemented by each MRM.

- If a device is configured as MRM, but not operating in the manager role, it shall signal a “MANAGER_ROLE_FAIL” diagnosis event and suspend reporting of all other media redundancy diagnosis events while not in the manager role.
- If a device is operating in manager role and this device detects another active MRM, it shall signal the “MULTIPLE_MANAGERS” event. This event can occur concurrently with the ring state event “RING_OPEN”.
- If a device is operating in manager role and detects an open ring, it shall signal the “RING_OPEN” event.

These events shall be signalled by using the State Change service see 7.3.

NOTE The presence of MRP_Test frames enables the checking of the existence of an MRM.

5.7 Multiple MRM in a single ring

There shall be only one active MRM in the ring even if several nodes have this ability.

NOTE Multiple active MRMs cause the ring to divide itself into several segments.

As an option, in case of more than one node having the ability to become an MRM in the ring, an enhanced protocol not specified in this International Standard may be used to decide which of these nodes shall become the MRM, while the other nodes take over the MRC role as shown in Figure 4. To this effect the nodes with the MRM ability have different priorities that shall be conveyed in the MRP_Prio field of the MRP_Test frame.

If an optional protocol for multiple MRM in a single ring is used then all MRM in the ring shall support the same protocol. The vendor shall specify the supported protocols.

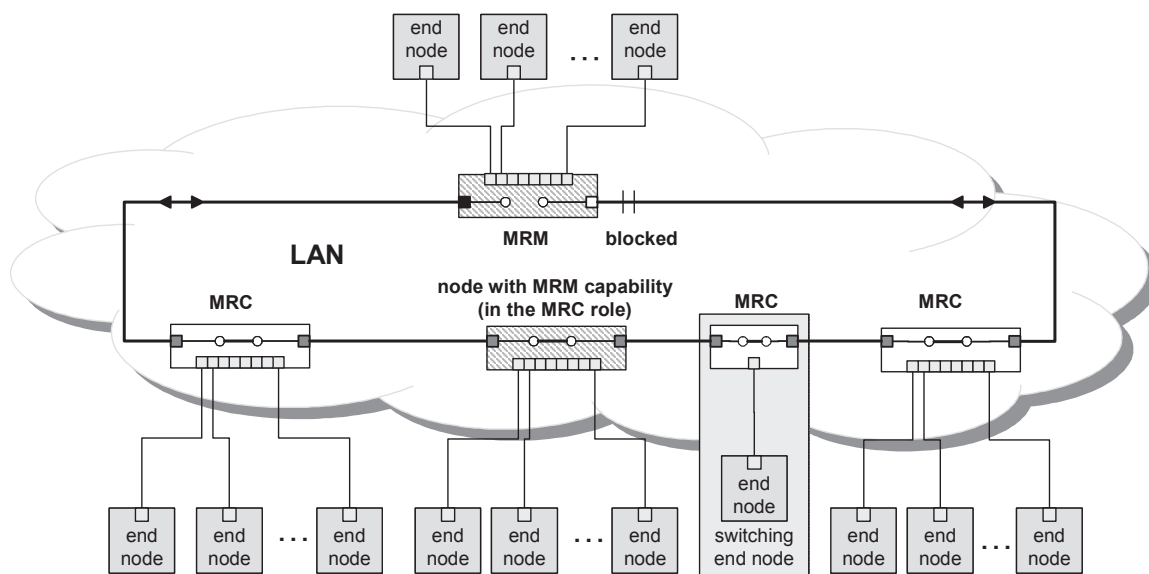


Figure 4 – MRP ring with more than one MRM

IEC 353/10

5.8 BLOCKED not supported (option)

If an MRC is not able to support the BLOCKED port state at its ring ports, the MRC shall report it in the corresponding parameter of the MRP_LinkChange frames.

If an MRC does not support the BLOCKED state in a ring, then a MRM shall support additional functionalities (see Table 26, MRP_BLOCKED_SUPPORTED).

6 MRP Class specification

6.1 General

The MRP Application Service Element (ASE) defines one object type.

6.2 Template

An MRP object is described by the following template:

ASE:		Media redundancy ASE	
CLASS:		Media redundancy	
CLASS ID:		not used	
PARENT CLASS:		IEEE 802.3, IEEE 802.1D	
ATTRIBUTES:			
1.	(m)	Key Attribute:	Domain ID
2.	(m)	Attribute:	Domain Name
3.	(m)	Attribute:	Ring Port 1 ID
4.	(m)	Attribute:	Ring Port 2 ID
5.	(o)	Attribute:	VLAN ID
6.	(m)	Attribute:	Expected Role (MANAGER, CLIENT)
7.	(c)	Constraint:	Expected Role = MANAGER
7.1	(m)	Attribute:	Manager Priority
7.2	(m)	Attribute:	Topology Change Interval
7.3	(m)	Attribute:	Topology Change Repeat Count
7.4	(m)	Attribute:	Short Test Interval
7.5	(m)	Attribute:	Default Test Interval
7.6	(m)	Attribute:	Test Monitoring Count
7.7	(m)	Attribute:	Non-blocking MRC supported (TRUE, FALSE)
7.8	(c)	Constraint:	Non-blocking MRC supported = TRUE
7.8.1	(m)	Attribute:	Test Monitoring Extended Count
7.9	(o)	Attribute:	React On Link Change (TRUE, FALSE)
7.10	(m)	Attribute:	Check Media Redundancy (TRUE, FALSE)
7.10.1	(c)	Constraint:	Check Media Redundancy = TRUE
7.10.1.1	(m)	Attribute:	Real Role State
7.10.1.2	(m)	Attribute:	Real Ring State
7.10.1.3	(o)	Attribute:	Ring Port 1 Port State
7.10.1.4	(o)	Attribute:	Ring Port 2 Port State
8.	(c)	Constraint:	Expected Role = CLIENT
8.1	(m)	Attribute:	Link Down Interval
8.2	(m)	Attribute:	Link Up Interval
8.3	(m)	Attribute:	Link Change Count
8.4	(o)	Attribute:	Ring Port 1 Port State
8.5	(o)	Attribute:	Ring Port 2 Port State
8.6	(m)	Attribute:	BLOCKED state supported (TRUE, FALSE)
SERVICES:			
1	(m)	OpsService:	Start MRM
2	(m)	OpsService:	Stop MRM
3	(o)	OpsService:	State Change
4	(m)	OpsService:	Start MRC
5	(m)	OpsService:	Stop MRC
6	(o)	OpsService:	Read MRM
7	(o)	OpsService:	Read MRC

6.3 Attributes

Domain ID

This key attribute defines the redundancy domain representing the ring the MRP object belongs to. It is set to default Domain ID or provided as unique ID by engineering.

Attribute Type: UUID

Domain Name

This attribute defines the redundancy domain representing the ring the Media redundancy object belongs to. It is set to default Domain Name or provided as unique ID by engineering.

Attribute Type: VisibleString[240]

Ring Port 1 ID

This attribute specifies one port of a switch which is assigned as ring port 1 in the redundancy domain referenced by the value of the attribute Domain ID.

Attribute Type: Unsigned16

Ring Port 2 ID

This attribute specifies another port of a switch different from Ring Port 1 ID which is assigned as ring port 2 in the redundancy domain referenced by the value of the attribute Domain ID.

Attribute Type: Unsigned16

VLAN ID

This optional attribute may be used by the MRP object and specifies its VLAN identifier in the redundancy domain.

Attribute Type: Unsigned16

Expected Role

This attribute specifies the role of the MRP object in the redundancy domain.

Attribute Type: Unsigned16

Allowed values: MANAGER, CLIENT

Manager Priority

This attribute shall contain the priority of the MRM. A lower value indicates a higher priority, 0x0000 (highest priority) to 0xF000 (lowest priority) in increments of 0x1000.

Attribute Type: Unsigned16

Topology Change Interval

This attribute specifies the interval for sending MRP_TopologyChange frames.

Attribute Type: Unsigned16

Topology Change Repeat Count

This attribute specifies the interval count which controls repeated transmissions of MRP_TopologyChange frames.

Attribute Type: Unsigned16

Short Test Interval

This attribute specifies the short interval for sending MRP_Test frames on ring ports after link changes in the ring.

Attribute Type: Unsigned16

Default Test Interval

This attribute specifies the default interval for sending MRP_Test frames on ring ports.

Attribute Type: Unsigned16

Test Monitoring Count

This attribute specifies the interval count for monitoring the reception of MRP_Test frames.

Attribute Type: Unsigned16

Non-blocking MRC supported

This attribute specifies the ability of the MRM to support MRCs without BLOCKED port state support in the ring.

Attribute Type: Boolean

Test Monitoring Extended Count

This attribute specifies the extended interval count for monitoring the reception of MRP_Test frames.

Attribute Type: Unsigned16

React On Link Change

This optional attribute specifies whether the MRM reacts on MRP_LinkChange frames or not.

Attribute Type: Boolean

Check Media Redundancy

This attribute specifies whether monitoring of MRM state is enabled (TRUE) or disabled (FALSE) in the redundancy domain.

Attribute Type: Boolean

Real Role State

This attribute specifies the actual role of the MRP object in the redundancy domain.

Attribute Type: Unsigned16

Allowed values: MANAGER, CLIENT, UNDEFINED

Real Ring State

This attribute specifies the actual ring state of the MRP object in the redundancy domain. The Ring State shall have one of the following values:

OPEN: Ring is open due to link or MRC failure in ring.

CLOSED: Ring is closed (normal operation, no error).

UNDEFINED: Shall be set if the attribute Real Role State contains the value CLIENT (i.e. MRP object was reconfigured to client role).

Attribute Type: Unsigned16

Allowed values: OPEN, CLOSED, UNDEFINED

Ring Port 1 Port State

This optional attribute specifies the actual port state of Ring Port 1. The Ring Port 1 state shall be specified according to Ring port states in 5.1.

Attribute Type: Unsigned16

Allowed values: DISABLED, BLOCKED, FORWARDING

Ring Port 2 Port State

This optional attribute specifies the actual port state of Ring Port 2. The Ring Port 2 state shall be specified according to Ring port states in 5.1.

Attribute Type: Unsigned16

Allowed values: DISABLED, BLOCKED, FORWARDING

Link Down Interval

This attribute specifies the interval for sending MRP_LinkDown frames on ring ports.

Attribute Type: Unsigned16

Link Up Interval

This attribute specifies the interval for sending MRP_LinkUp frames on ring ports.

Attribute Type: Unsigned16

Link Change Count

This attribute specifies the MRP_LinkChange frame count which controls repeated transmission of MRP_LinkChange frames.

Attribute Type: Unsigned16

BLOCKED state supported

This attribute specifies whether the MRC supports BLOCKED state at its ring ports or not.

Attribute Type: Boolean

7 MRP service specification

7.1 Start MRM

The Start MRM service creates a local instance of the MRM protocol machine.

Table 1 shows the parameters of the service.

Table 1 – MRP Start MRM

Parameter name	Req	Cnf
Argument	M	
Domain ID	M	
Ring Port 1 ID	M	
Ring Port 2 ID	M	
VLAN ID	U	
Manager Priority	U	
Topology Change Interval	U	
Topology Change Repeat Count	U	
Short Test Interval	U	
Default Test Interval	U	
Test Monitoring Count	U	
Non-blocking MRC supported	U	
Test Monitoring Extended Count	U	
React On Link Change	U	
Check Media Redundancy	U	
Result(+)		S
Domain ID		M
Result(-)		S
Domain ID		M
Error Code		M

Argument

The argument shall convey the service specific parameters of the service request.

Domain ID

This is the key attribute to identify the instance of the protocol machine.

Ring Port 1 ID

This parameter contains the ID of the port which serves as first ring port.

Ring Port 2 ID

This parameter contains the ID of the port which serves as second ring port.

VLAN ID

This optional parameter contains the value for the VLAN identifier.

Manager Priority

This parameter contains the value for the manager priority.

Topology Change Interval

This parameter contains the value of the interval for sending MRP_TopologyChange frames.

Topology Change Repeat Count

This parameter contains the value of the interval count which controls repeated transmissions of MRP_TopologyChange frames.

Short Test Interval

This parameter contains the value of the short interval for sending MRP_Test frames on ring ports after link changes in the ring.

Default Test Interval

This parameter contains the value of the default interval for sending MRP_Test frames on ring ports.

Test Monitoring Count

This parameter contains the value of the interval count for monitoring the reception of MRP_Test frames.

Non-blocking MRC supported

This parameter specifies the ability of the MRM to support MRCs without BLOCKED port state support in the ring.

Test Monitoring Extended Count

This optional parameter contains the value of the extended interval count for monitoring the reception of MRP_Test frames.

React On Link Change

This optional parameter specifies whether the MRM reacts on MRP_LinkChange frames or not.

Check Media Redundancy

This parameter selects whether monitoring of MRM state is enabled or disabled.

Result(+)

This parameter indicates that the service request succeeded.

Domain ID

This is the key attribute to identify the instance of the protocol machine.

Result(-)

This parameter indicates that the service request failed.

Domain ID

This is the key attribute to identify the instance of the protocol machine.

Error Code

The parameter Result contains the error code of the specific error.

Type: Unsigned16

Allowed values: DOMAIN_ID_MISMATCH, ROLE_NOT_SUPPORTED, INVALID_RINGPORT

7.2 Stop MRM

This service shall be used to stop the MRM protocol machine. Ring port states and switch functionality remain.

Table 2 shows the parameters of the service.

Table 2 – MRP Stop MRM

Parameter name	Req	Cnf
Argument	M	
Domain ID	M	
Result(+)		S
Domain ID		M
Result(-)		S
Domain ID		M
Error Code		M
NOTE For the meaning of Req, Cnf, M and S, refer to ISO/IEC 10164-1.		

Argument

The argument shall convey the service specific parameters of the service request.

Domain ID

This is the key attribute to identify the instance of the protocol machine.

Result(+)

This parameter indicates that the service request succeeded.

Domain ID

This is the key attribute to identify the instance of the protocol machine.

Result(-)

This parameter indicates that the service request failed.

Domain ID

This is the key attribute to identify the instance of the protocol machine.

Error Code

The parameter Result contains the error code of the specific error.

Type: Unsigned16

Allowed values: DOMAIN_ID_MISMATCH

7.3 State Change

This service shall be used to indicate a change of the MRP domain state.

Table 3 shows the parameters of the service.

Table 3 – MRP Change State

Parameter name	Ind
Argument	M
Domain ID	M
Error Type List	M
NOTE For the meaning of Ind and M refer to ISO/IEC 10164-1.	

Argument

The argument shall convey the service specific parameters of the service request.

Domain ID

This is the key attribute to identify the instance of the protocol machine.

Error Type List

This attribute consists of the following elements:

Error Type

This attribute identifies a media redundancy error.

Attribute Type: Unsigned16

Allowed values: MANAGER_ROLE_FAIL, RING_OPEN, MULTIPLE_MANAGERS

Appear

This attribute identifies whether the error appears or disappears.

Attribute Type: Boolean

Allowed values: TRUE, FALSE

7.4 Start MRC

The Start MRC service creates an instance of the MRC protocol machine.

Table 4 shows the parameters of the service.

Table 4 – MRP Start MRC

Parameter name	Req	Cnf
Argument	M	
Domain ID	M	
Ring Port 1 ID	M	
Ring Port 2 ID	M	
VLAN ID	U	
Link Down Interval	U	
Link Up Interval	U	
Link Change Count	U	
BLOCKED state supported	U	
Result(+)		S
Domain ID		M
Result(-)		S
Domain ID		M
Error Code		M
NOTE For the meaning of Req, Cnf, S, M and U, refer to ISO/IEC 10164-1.		

Argument

The argument shall convey the service specific parameters of the service request.

Domain ID

This is the key attribute to identify the instance of the protocol machine.

Ring Port 1 ID

This parameter contains the ID of the port which serves as first ring port.

Ring Port 2 ID

This parameter contains the ID of the port which serves as second ring port.

VLAN ID

This optional parameter contains the value for the VLAN identifier.

Link Down Interval

This parameter contains the value of the interval for sending MRP_LinkDown frames on ring ports.

Link Up Interval

This parameter contains the value of the interval for sending MRP_LinkUp frames on ring ports.

Link Change Count

This parameter contains the value of the MRP_LinkChange frame count which controls repeated transmissions of MRP_LinkUp or MRP_LinkDown frames.

BLOCKED state supported

This parameter specifies whether the MRC supports BLOCKED state at its ring ports or not.

Result(+)

This parameter indicates that the service request succeeded.

Domain ID

This is the key attribute to identify the instance of the protocol machine.