

DIN EN 62439-100

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Einsprüche bis 2015-04-20
Ersatzvermerk
siehe unten

Entwurf

**Industrielle Kommunikationsnetze –
Hochverfügbare Automatisierungsnetze
(IEC 65C/781/CDV:2014);
Englische Fassung FprEN 62439-X:2014**

Industrial communication networks –
High availability automation networks
(IEC 65C/781/CDV:2014);
English version FprEN 62439-X:2014

Réseaux industriels de communication –
Réseaux d'automatisme à haute disponibilité
(CEI 65C/781/CDV:2014);
Version anglaise FprEN 62439-X:2014

Anwendungswarnvermerk

Dieser Norm-Entwurf mit Erscheinungsdatum 2015-02-20 wird der Öffentlichkeit zur Prüfung und Stellungnahme vorgelegt.

Weil die beabsichtigte Norm von der vorliegenden Fassung abweichen kann, ist die Anwendung dieses Entwurfes besonders zu vereinbaren.

Stellungnahmen werden erbeten

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- oder in Papierform an die DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE, Stresemannallee 15, 60596 Frankfurt am Main.

Die Empfänger dieses Norm-Entwurfs werden gebeten, mit ihren Kommentaren jegliche relevanten Patentrechte, die sie kennen, mitzuteilen und unterstützende Dokumentationen zur Verfügung zu stellen.

Ersatzvermerk

Vorgesehen als Ersatz für DIN EN 62439-1:2010-09, DIN EN 62439-1/A1:2013-06, DIN EN 62439-2:2010-09, DIN EN 62439-3:2013-06 und DIN EN 62439-5:2010-09

Gesamtumfang 361 Seiten

DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE

Nationales Vorwort

Die englische Fassung des europäischen Dokuments FprEN 62439-X:2014 „Industrielle Kommunikationsnetze – Hochverfügbare Automatisierungsnetze“ (Entwurf in der Umfrage) ist unverändert in diesen Norm-Entwurf übernommen worden.

Die Internationale Elektrotechnische Kommission (IEC) und das Europäische Komitee für Elektrotechnische Normung (CENELEC) haben vereinbart, dass ein auf IEC-Ebene erarbeiteter Entwurf für eine Internationale Norm zeitgleich (parallel) bei IEC und CENELEC zur Umfrage (CDV-Stadium) und Abstimmung als FDIS (en: Final Draft International Standard) bzw. Schluss-Entwurf für eine Europäische Norm gestellt wird, um eine Beschleunigung und Straffung der Normungsarbeit zu erreichen. Dem entsprechend ist das internationale Dokument IEC 65C/781/CDV:2014 „Industrial communication networks – High availability automation networks“ unverändert in den Entwurf FprEN 62439-X:2014 übernommen worden.

Das internationale Dokument wurde vom SC 65C „Industrial networks“ der Internationalen Elektrotechnischen Kommission (IEC) erarbeitet.

Bei der Abstimmung zu dem Europäischen Schluss-Entwurf bei CENELEC und dem Internationalen Schluss-Entwurf bei IEC [Final Draft International Standard (FDIS)] sind jeweils nur „JA/NEIN“-Entscheidungen möglich, wobei „NEIN“-Entscheidungen fundiert begründet werden müssen. Dokumente, die bei CENELEC als Europäische Norm angenommen und ratifiziert werden, sind unverändert als Deutsche Normen zu übernehmen.

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

Für den Fall einer undatierten Verweisung im normativen Text (Verweisung auf eine Norm ohne Angabe des Ausgabedatums und ohne Hinweis auf eine Abschnittsnummer, 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.

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 den vorliegenden Normentwurf erfüllt.

Da sich die Benutzer des vorliegenden Normentwurfs der englischen Sprache als Fachsprache bedienen, wird die Englische Fassung der EN 62439-100 veröffentlicht. Zu deren Abschnitt 1, der den Anwendungsbereich festlegt, und Abschnitt 3, der die Begriffe festlegt, wurde eine Übersetzung angefertigt und als Nationaler Anhang NA der vorliegenden Norm hinzugefügt. Für viele der verwendeten Begriffe existieren keine gebräuchlichen deutschen Benennungen, da sich die deutschen Anwender in der Regel ebenfalls der englischen Benennungen bedienen. Dieser Normentwurf steht nicht in unmittelbarem Zusammenhang mit Rechtsvorschriften und ist nicht als Sicherheitsnorm anzusehen.

Es ist vorgesehen, auch bei der entsprechenden zukünftigen Deutschen Norm auf die deutsche Sprachfassung zu verzichten und diese in der englischsprachigen Fassung zu veröffentlichen.

Das Original-Dokument enthält Bilder in Farbe, die in der Papierversion in einer Graustufen-Darstellung wiedergegeben werden. Elektronische Versionen dieses Dokuments enthalten die Bilder in der originalen Farbdarstellung.

Es wird auf die Möglichkeit hingewiesen, dass einige Elemente dieses Dokuments Patentrechte berühren können. ISO [und/oder] IEC sind nicht dafür verantwortlich, einige oder alle diesbezüglichen Patentrechte zu identifizieren.

Änderungen

Gegenüber DIN EN 62439-1:2010-09, DIN EN 62439-1/A1:2013-06, DIN EN 62439-2:2010-09, DIN EN 62439-3:2013-06 und DIN EN 62439-5:2010-09 wurden folgende Änderungen vorgenommen:

- a) Für IEC 62439-1 ist ein Amendement geplant;
- b) Hinzufügen einer Protokollerweiterung zur automatischen Auswahl des Mediaredundanz-Managers in IEC 62439-2;
- c) Hinzufügen eines Protokolls zum redundanten Verbinden von Media-Redundanzprotokollringen in IEC 62439-2;
- d) geringe redaktionelle Änderungen in IEC 62439-2;
- e) technische Verbesserung und Erweiterungen der Anforderungen in IEC 62439-3;
- f) Berücksichtigung der IEC 61588 Uhrzeitsynchronisierung mit End-zu-End-Verzögerungsmessung entlang der bestehenden Peer-to-Peer-Verzögerungsmessung in PRP in IEC 62439-3;
- g) in IEC 62439-5 ist das Protokoll nun unabhängig von der Anwendung (Path_Check_Request wird periodisch gesendet);
- h) die Failure_Notify Meldung wurde entfernt in IEC 62439-5;
- i) das Rahmenformat wurde geändert in IEC 62439-5;
- j) eine neue MAC-Adresse wurde hinzugefügt in IEC 62439-5.

Nationaler Anhang NA (informativ)

62439-2

1 Anwendungsbereich

Die Normenreihe IEC 62439 gilt für hochverfügbare Automatisierungsnetzwerke auf der Basis der (Ethernet-) Technologie nach ISO/IEC 8802-3 (IEEE 802.3).

Der vorliegende Teil der Normenreihe IEC 62439 legt ein Wiederherstellungsprotokoll auf der Basis einer Ringtopologie fest, das so konzipiert ist, dass es unter der Kontrolle eines fest zugeordneten Medien-redundanz-Managerknotens deterministisch auf einen Einzelfehler einer Inter-Switch-Verbindung oder eines Switches im Netzwerk reagiert.

3.1 Begriffe

Für die Anwendung dieses Dokuments gelten die Begriffe nach IEC 60050-191, nach IEC 62439-1 und die folgenden Begriffe.

3.1.1

Inter-Verbindungsport

(en:interconnection port)

Port eines Switches, welcher verwendet wird um zwei Ring Topologien zu verbinden

3.1.2

Inter-Verbindungsstopologie

(en: interconnection topology)

Topologie in welcher zwei Ring Topologien verbunden sind.

62439-3

1 Anwendungsbereich

Die Normenreihe IEC 62439 gilt für hochverfügbare Automatisierungsnetzwerke auf der Basis der (Ethernet-) Technologie nach ISO/IEC 8802-3 (IEEE 802.3).

Dieser Teil der Normenreihe IEC 62439 beschreibt zwei Redundanzprotokolle, welche ausgelegt sind, um übergangslose Wiederherstellung im Falle eines einzelnen Fehlers einer Inter-Bridge-Verbindung oder Bridge im Netzwerk bereitzustellen. Dies auf Basis desselben Schema: Verdopplung des LAN, bzw. Verdopplung der übertragenen Information.

3.1 Begriffe

Für die Anwendung dieses Dokuments gelten die Begriffe nach IEC 60050-191, nach IEC 62439-1 und die folgenden Begriffe.

3.1.1

interlink

(en: interlink)

Verbindung, die zwei Netzwerkhierarchien miteinander koppelt

3.1.2

RedBox

(en: RedBox)

Gerät, das einfach angebundene Netzwerkteilnehmer mit einem redundanten Netzwerk verbindet

3.1.3

QuadBox

(en: QuadBox)

Gerät mit vierfachem Netzwerkanschluss, das zwei hierarchisch gleichrangige HSR-Ringstrukturen miteinander verbindet, das sich in jedem HSR-Ring wie ein HSR-Netzwerkteilnehmer verhält und den Netzwerkverkehr filtern und zwischen den zwei Ringen übertragen kann

3.1.4

HSR-Datenrahmen

(en: HSR frame)

Datenrahmen, der als auszeichnendes Merkmal „EtherType“ den HSR_ethertype trägt

3.1.5

Vermittlungslogik

(en: switching logic)

Hardware, die einen Datenrahmen von einem Netzanschluss an einen anderen Netzanschluss vermittelt, unter Umständen durch Verwendung von cut-through-Übertragung

ANMERKUNG 1 In diesem Dokument werden die Begriffe „Netzwerkbrücke (en: bridge)“ beziehungsweise „bridging“ und „Netzwerkweiche (en: switch)“ beziehungsweise „switching“ synonym verwendet, wenn sie angewendet werden, um Verbindungen auf der Sicherungsschicht („layer 2“) zu beschreiben

62439-5

1 Anwendungsbereich

Die Normenreihe IEC 62439 gilt für hochverfügbare Automatisierungsnetzwerke auf der Basis der (Ethernet-) Technologie nach ISO/IEC 8802-3 (IEEE 802.3).

Dieser Teil der Normenreihe IEC 62439 beschreibt ein Redundanzprotokoll, welches auf die Verdopplung des Netzwerks basiert und innerhalb der Endknoten ausgeführt wird. Im Gegensatz dazu gibt es ein Redundanzprotokoll welches in Switchen eingebaut ist. Schnelle Fehlererkennung wird von zwei Lichtsignalknoten bereitgestellt, die Entscheidung zur Umschaltung wird in jedem Knoten individuell getroffen. Die Kreuz-Netzwerkverbindungsfähigkeit, erlaubt es einzelnen beigefügten Endknoten mit beiden der zwei Netzwerke verbunden zu werden.

3 Begriffe

Für die Anwendung dieses Dokuments gelten die Begriffe nach IEC 60050-191 und nach IEC 62439-1.

– Leerseite –

INCLUDED SUBPARTS

NOTE 1: The page numbers of each subpart are prefixed with the subpart number to facilitate identification, and so that the numbering of each subpart can be independent of those that precede it. Similarly, line numbers are also prefixed with a multiple of 10 000 to facilitate referencing of comments.

NOTE 2: The Contents of each subpart begins on page xxx2, so that the page numbering will be unchanged when the final International Standard is issued with its IEC-Central-Office-provided cover sheet.

NOTE 3: Part 4 (Ed 1.0), Part 6 (Ed 1.0), and Part 7 (Ed 1.0) are not included since they are simply reconfirmed, as indicated in 65C/717A/RR.

IEC 62439-1 Ed1.0 Amd2, Industrial communication networks - High availability automation networks –
Part 2: Media Redundancy Protocol (MRP) 1002

IEC 62439-2 Ed3.0, Industrial communication networks - High availability automation networks –
Part 2: Media Redundancy Protocol (MRP) 2002

IEC 62439-3 Ed3.0, Industrial communication networks - High availability automation networks –
Part 3: Parallel Redundancy Protocol (PRP) and High-availability Seamless Redundancy (HSR) . 3002

IEC 62439-5 Ed2.0, Industrial communication networks - High availability automation networks –
Part 5: Beacon Redundancy Protocol (BRP)..... 5002

FOREWORD

This amendment has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation, working group 15.

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

FDIS	Report on voting
65C/XXX/FDIS	65C/XXX/RVD

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

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.

The National Committees are requested to note that for this publication the stability date is 2020.

THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE DELETED AT THE PUBLICATION STAGE.

3.4 Reserved network addresses

Add, between items "PRP" and "CRP" of the list given in the third paragraph, the following new item:

- HSR (see IEC 62439-3) uses 0x892F.

5.1.4 Comparison and indicators

Replace, in the existing Table 2, the existing rows "MRP" and "BRP" with the following:

MRP	IEC 62439-2	Yes	Within the network	Single	Ring, meshed	500 ms, 200 ms, 30 ms or 10 ms worst case for 50 switches depending on the parameter set and network topology
BRP	IEC 62439-5	Yes	In the end nodes	Double	Doubly meshed, connected	8,88 ms worst case for 100 end nodes

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –
HIGH AVAILABILITY AUTOMATION NETWORKS –****Part 2: Media Redundancy Protocol (MRP)**

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.
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- International Standard 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, and
 - update of IEC 62439-2 edition 1 with minor editorial changes.

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

FDIS	Report on voting
XX/XX/FDIS	XX/XX/RVD

10054
10055 Full information on the voting for the approval of this standard can be found in the report on
10056 voting indicated in the above table.

10057 This publication has been drafted in accordance with ISO/IEC Directives, Part 2.

10058 This International Standard is to be read in conjunction with IEC 62439-1, *Industrial*
10059 *communication networks – High availability automation networks – Part 1: General concepts*
10060 *and calculation methods*.

10061 A list of all parts of the IEC 62439 series, published under the general title *Industrial*
10062 *communication networks – High availability automation networks*, can be found on the IEC
10063 website.

10064 The committee has decided that the contents of this publication will remain unchanged until
10065 the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data
10066 related to the specific publication. At this date, the publication will be

- 10067 • reconfirmed,
10068 • withdrawn,
10069 • replaced by a revised edition, or
10070 • amended.

10071

10072 The National Committees are requested to note that for this publication the stability date
10073 is 2020

10074 THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE
10075 DELETED AT THE PUBLICATION STAGE.

10076

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

10077

10078

10079

10080 INTRODUCTION

10081 The IEC 62439 series specifies relevant principles for high availability networks that meet the
10082 requirements for industrial automation networks.

10083 In the fault-free state of the network, the protocols of the IEC 62439 series provide
10084 ISO/IEC 8802-3 (IEEE 802.3) compatible, reliable data communication, and preserve
10085 determinism of real-time data communication. In cases of fault, removal, and insertion of a
10086 component, they provide deterministic recovery times.

10087 These protocols retain fully the typical Ethernet communication capabilities as used in the
10088 office world, so that the software involved remains applicable.

10089 The market is in need of several network solutions, each with different performance
10090 characteristics and functional capabilities, matching diverse application requirements. These
10091 solutions support different redundancy topologies and mechanisms which are introduced in
10092 IEC 62439-1 and specified in the other Parts of the IEC 62439 series. IEC 62439-1 also
10093 distinguishes between the different solutions, giving guidance to the user.

10094 The IEC 62439 series follows the general structure and terms of IEC 61158 series.

10095 The International Electrotechnical Commission (IEC) draws attention to the fact that it is
10096 claimed that compliance with this document may involve the use of a patent concerning ring
10097 protocol given in Clause 5.

10098 IEC takes no position concerning the evidence, validity and scope of this patent right.

10099 The holder of this patent right has assured the IEC that he/she is willing to negotiate licences
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10112 Attention is drawn to the possibility that some of the elements of this document may be the
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10115 ISO (www.iso.org/patents) and IEC (http://www.iec.ch/tctools/patent_decl.htm) maintain on-
10116 line data bases of patents relevant to their standards. Users are encouraged to consult the
10117 data bases for the most up to date information concerning patents.

10118

**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 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 62439-1, *Industrial communication networks – High availability automation networks – Part 1: General concepts and calculation methods*

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

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 802.1D: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*

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

10158 **3.1.2**
10159 **interconnection topology**
10160 topology in which two ring topologies are connected

10161 **3.2 Abbreviations and acronyms**

10162 For the purposes of this document, the abbreviations and acronyms given in IEC 62439-1
10163 apply, in addition to the following.

10164	CCM	Continuity Check Messages
10165	CFM	Connectivity Fault Management
10166	LC-mode	Link Check mode
10167	MRA	Media Redundancy Automanager
10168	MRC	Media Redundancy Client
10169	MRM	Media Redundancy Manager
10170	MRP	Media Redundancy Protocol
10171	MIC	Media Redundancy Interconnection Client
10172	MIM	Media Redundancy Interconnection Manager
10173	RC-mode	Ring Check mode

10174 **3.3 Conventions**

10175 This document follows the conventions defined in IEC 62439-1.

10176 **4 MRP Overview**

10177 This document specifies the Media Redundancy Protocol (MRP), a recovery protocol based
10178 on a ring topology, and the redundant interconnection of MRP rings via the Media
10179 Redundancy Interconnection Protocol as shown in Figure 1.

10180 MRP is designed to react deterministically on a single failure of an inter-switch link or switch
10181 in the ring or interconnection topology.

10182 MRP is based on functions of ISO/IEC 8802-3 (IEEE 802.3) and IEEE 802.1Q including the
10183 Filtering Data Base (FDB) and is located between the Data Link Layer and Application Layer
10184 (see Figure 2).

10185 NOTE Layering is assumed to be according to IEC 61158-1.

10186 A MRP compliant network shall have a ring topology with multiple nodes.

10187 One of the nodes has the role of a Media Redundancy Manager (MRM). The function of the
10188 MRM is to observe and to control the ring topology in order to react on network faults. The
10189 MRM does this by sending frames on one ring port over the ring and receiving them from the
10190 ring over its other ring port, and vice-versa in the other direction.

10191 The other nodes in the ring have the role of Media Redundancy Clients (MRC). An MRC
10192 reacts on received reconfiguration frames from the MRM and can detect and signal link
10193 changes on its ring ports.

- 10194 Certain nodes or all nodes in the ring may also start as a Media Redundancy Automanager
10195 (MRA). MRAs select one MRM among each other by using a voting protocol. The remaining
10196 MRAs transition to the role MRC.
- 10197 Each node in the ring is able to detect the failure or recovery of an inter-switch link or the
10198 failure or recovery of a neighboring node.
- 10199 To redundantly connect two MRP rings, two nodes of each ring are assigned additional roles.
- 10200 One of the nodes has the role of a media redundancy interconnection manager (MIM), in
10201 addition to the role of a MRC or MRM. The function of the MIM is to observe and to control the
10202 redundant interconnection topology in order to react on interconnection faults. To cover a
10203 maximum of applications, two detection methods are provided by this specification. The MIM
10204 can observe the interconnection topology by either reacting directly on interconnection port
10205 link change notification messages (LC-mode) or by sending test frames on the interconnection
10206 port over the connected rings and receiving them over its ring ports, and vice-versa in the
10207 other direction (RC-mode).
- 10208 The other three nodes in the interconnection topology have the role of media redundancy
10209 interconnection clients (MIC), in addition to the role of a MRC or MRM. The MIC reacts on
10210 received reconfiguration frames from the MIM, it can detect and signal link changes of its
10211 interconnection port, and it can issue link change notification messages.
- 10212 As described in the course of this specification, LC-mode has the advantage of restricting the
10213 interconnection test frame load only to the interconnection links, whereas RC-mode has the
10214 advantage of deloading the MICs from interconnection test frame processing. The selection of
10215 the mode must be made in accordance with the requirements of the application and is outside
10216 the scope of this specification.
- 10217 The vendor may implement only the LC-mode or only the RC-mode or both modes. The MIM
10218 and all MICs of one MRP interconnection topology shall be configured to the same mode.

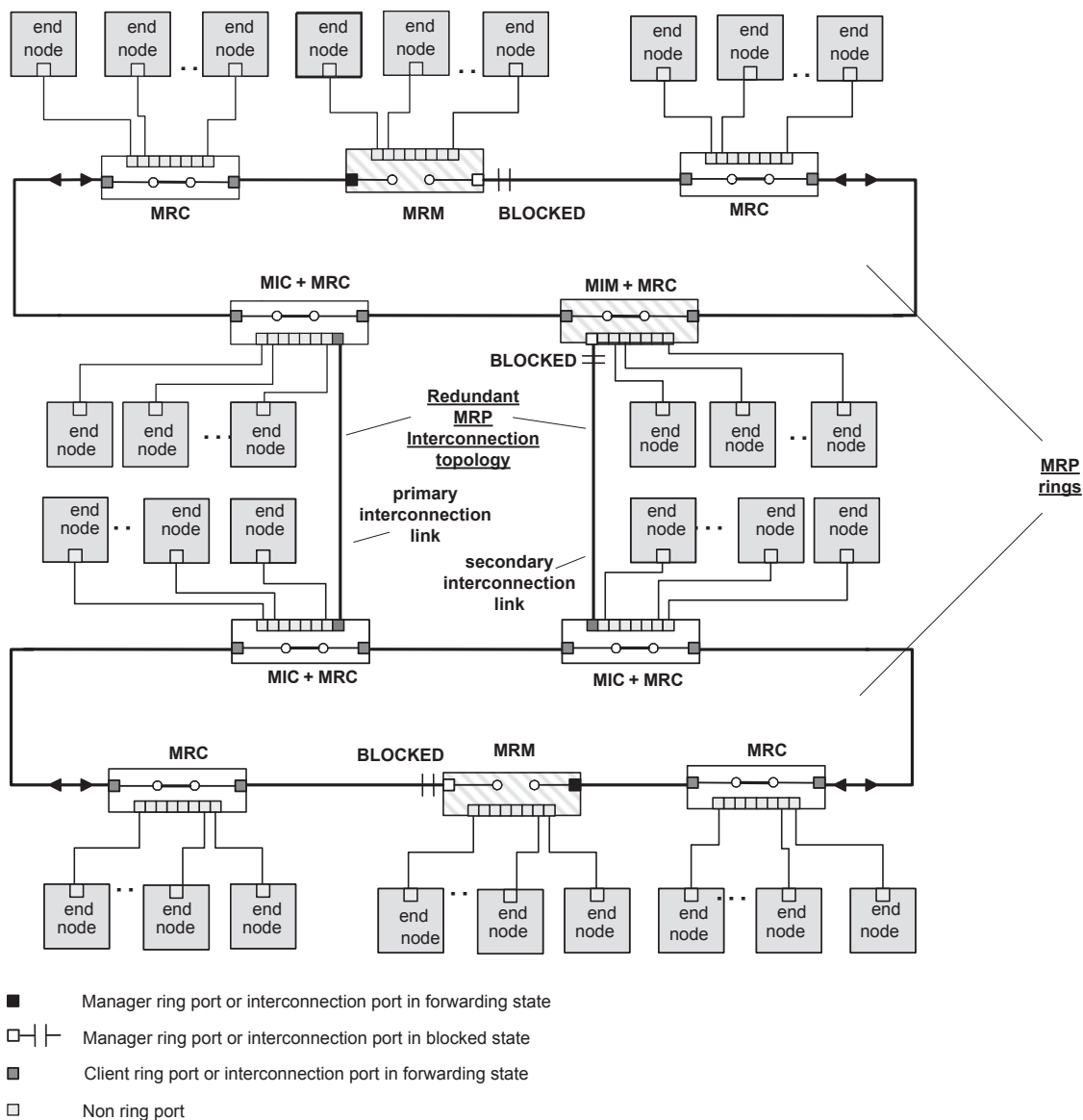


Figure 1 – Two MRP rings redundantly connected via MRP Interconnection

10219

10220 Each MRP compliant node requires a IEEE 802.1 compliant switch element with two ring ports
 10221 connected to one ring and shall have the ability to perform at least as one of the following:

- 10222 • media redundancy manager (MRM), or
- 10223 • media redundancy client (MRC), or
- 10224 • both MRM or MRC (but both roles shall not be active at the same time for the same ring).

10225 Each Media Redundancy Interconnection compliant node requires a IEEE 802.1 compliant
 10226 switch element with two ring ports connected to one ring, and with one interconnection port
 10227 connected to another MRP ring and shall have the ability to perform at least as one of the
 10228 following:

- 10229 • both MRC and media redundancy interconnection manager (MIM) (both roles shall be
 10230 active at the same time), or
- 10231 • both MRM and MIM (both roles shall be active at the same time), or
- 10232 • both MRC and media redundancy interconnection client (MIC) (both roles shall be active
 10233 at the same time), or
- 10234 • both MRM and MIC (both roles shall be active at the same time).

10235 More than two MRP rings may be redundantly connected by applying the redundant
10236 interconnection topology multiple times from one ring to other rings. This leads to rings
10237 containing multiple nodes configured to MIM and multiple nodes configured to MIC. A
10238 redundant connection of more than two rings may also be achieved by two nodes of a ring
10239 containing multiple instances of MIMs or MICs.

10240 A MRP compliant node may implement multiple instances of the MRC, MRM, MRA, MIM or
10241 MIC functionality. In this case it shall obey the following configuration rules:

10242 • If one or more MIM or MIC instances are active on one node, then there shall be only one
10243 MRC or one MRM or one MRA instance be active on this node at the same time.

10244 • If more than one MRC or MRM or MRA instances are active on one node, then no MIC or
10245 MIM shall be active on this node at the same time.

10246 • If more than one MRC or MRM or MRA instances are active on one node, thereby
10247 connecting the related rings connected to the ring ports of this node, then there shall be
10248 no other node in the network connecting the same rings over its MRC or MRM or MRA
10249 instances.

10250 The following definitions and chapters with MRP and MRP Interconnection definitions always
10251 apply to one MRP instance or one MRP Interconnection instance per compliant node. Multiple
10252 activation of MRP instances or MRP Interconnection instances, according to the configuration
10253 rules stated above, might demand additional requirements as to correct frame processing and
10254 frame forwarding, which are out of the scope of this document.

10255 NOTE Additional interconnection ports may be used to connect to additional ring.

10256 The MRP consists of a service and a protocol entity, see stack model in Figure 2.

10257 The service entity specifies, in an abstract way, the externally visible service provided by the
10258 Data Link Layer in terms of:

- 10259 • primitive actions and events of the service,
10260 • parameters associated with each primitive action and event, and the form which they take,
10261 and
10262 • interrelationship between these actions and events, and their valid sequences.

10263 MRP defines the services provided to:

- 10264 • the Application Layer at the boundary between the Application Layer and the Data Link
10265 Layer, and
10266 • the MRP Management at the boundary between the Data Link Layer and the MRP
10267 Management.

10268

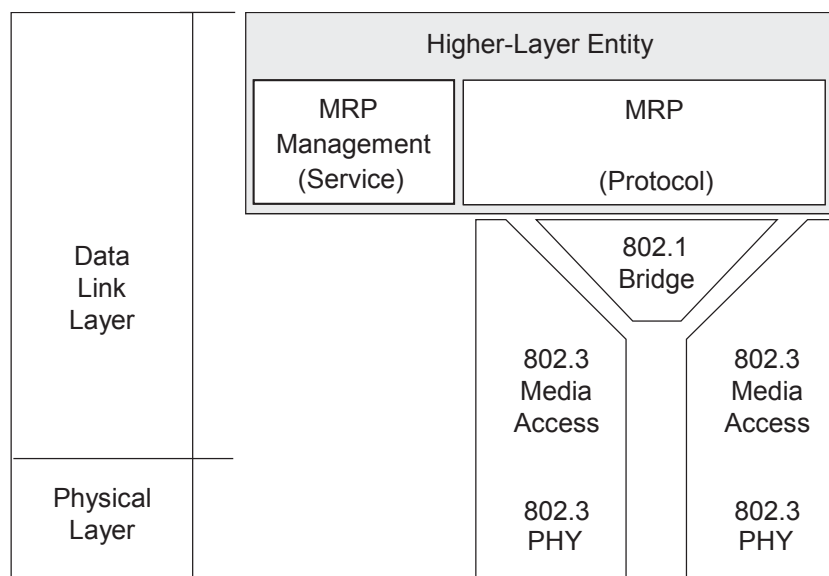


Figure 2 – MRP stack

5 MRP Media redundancy behavior

The following definitions for Media redundancy protocol roles always refer to one instance of the MRP role.

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.

NOTE Ring ports should behave as if STP, RSTP or MSTP is disabled.

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:

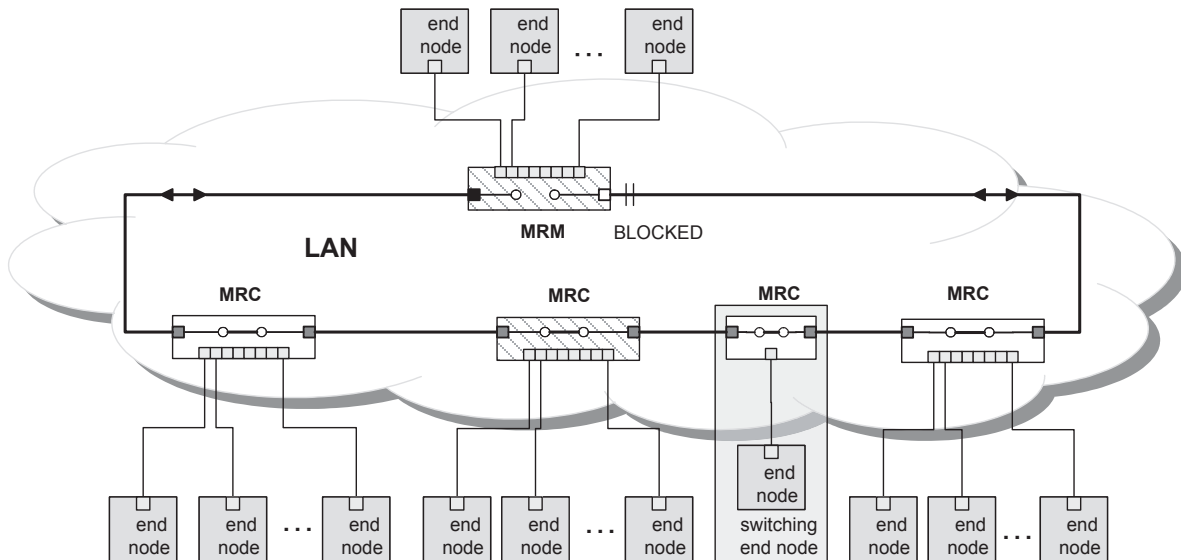
 - MRP_TopologyChange frames, MRP_Test frames and MRP_TestMgrNAck frames.
 - MRP_LinkChange frames and MRP_TestPropagate from a MRC.
 - MRP_Option frames.
 - MRP_InTopologyChange and MRP_InLinkStatusPoll from a MIM.
 - MRP_InLinkChange frames from a MIC.
 - Frames specified in IEEE 802.1D-2004 Table 7-10 to pass ports in “Discarding” state (e.g. LLDP, IEEE 1588-2008 PTP peer to peer frames).
 - Frames only produced or consumed by the higher layer entities of this node and never forwarded.
- FORWARDING

10295 All frames shall be passed through according to the forwarding behavior of IEEE 802.1D.

10296 NOTE IEEE 802.1D refers to the port state corresponding to BLOCKED as “Discarding”.

10297 5.2 Media Redundancy Manager (MRM)

10298 One ring port of the MRM shall be connected to a ring port of an MRC. The other ring port of
10299 that MRC shall be connected to a ring port of another MRC or to the second ring port of the
10300 MRM, thereby forming a ring topology as shown in Figure 3.



10301
10302

10303 **Figure 3 – MRP ring topology with one manager and clients**

10304 The MRM shall control the ring state by:

- 10305 • sending MRP_Test frames at a configured time period in both directions of the ring;
- 10306 • setting one ring port to FORWARDING state and the other ring port to BLOCKED state if it
10307 receives its own MRP_Test frames (this means that the ring is closed, see Figure 3);
- 10308 • setting both ring ports to FORWARDING state if it does not receive its own MRP_Test
10309 frames on both ring ports within a configured time according to MRP_TSTdefaultT,
10310 MRP_TSTshortT and MRP_TSTNRmax in Table 58 (this means that the ring is open,
10311 see Figure 4).

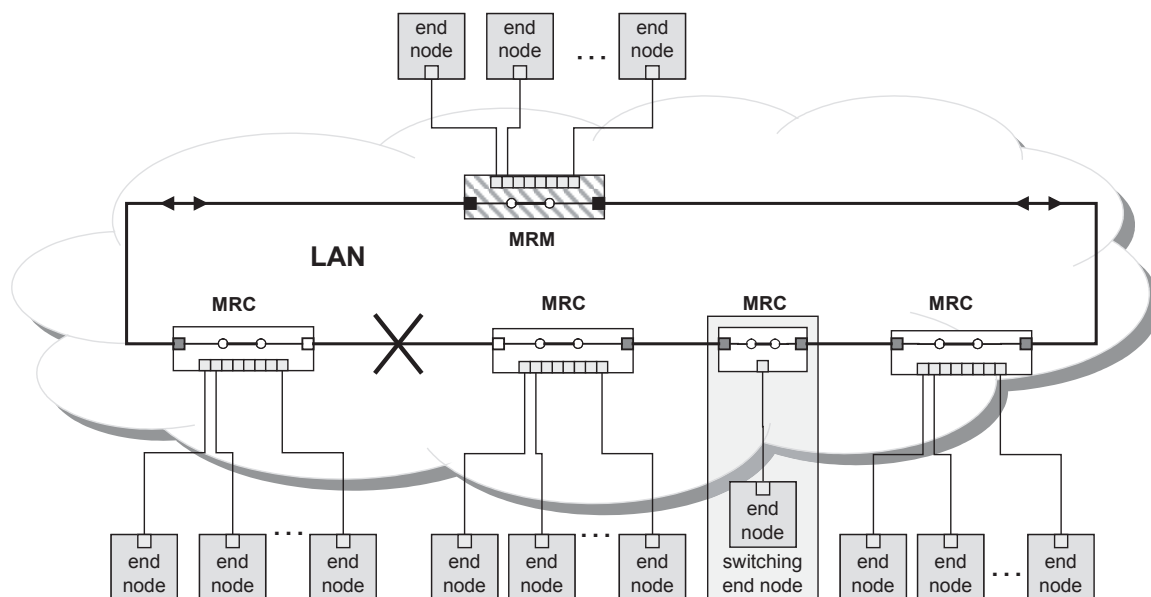


Figure 4 – MRP open ring with MRM

10312

10313 The following mechanism supports synchronization between MRM and MRC in ring topology
10314 changes.

10315 The MRM shall indicate changes in the ring state to the MRCs by means of
10316 MRP_TopologyChange frames.

10317 The MRM shall not forward MRP specific frames (MRP_Test frames, MRP_TopologyChange
10318 frames, MRP_LinkChange frames) between its ring ports.

10319 If the MRM receives an MRP_LinkUp or MRP_LinkDown frame, then the MRM shall reduce its
10320 test monitoring time according to Table 58 to accelerate the detection of the open ring. When
10321 the open ring is detected then the MRM shall set one ring port to forwarding state and shall
10322 send the MRP_TopologyChange frames through both its ring ports.

10323 If parameter MRP_REACT_ON_LINK_CHANGE is set, see Table 40, the MRM shall, on
10324 receiving a MRP_LinkDown frame, immediately set one ring port to forwarding state and shall
10325 then send the MRP_TopologyChange frames through its ring ports..

10326 The MRM shall send to the MRCs an MRP_TopologyChange frame containing the delay, after
10327 which the ring topology change will be performed. The parameter carrying this delay is called
10328 MRP_Interval. When this time has expired, all MRCs shall clear their filtering database (FDB)
10329 information for their ring ports.

10330 Each MRC shall send the configured delay in MRP_Interval to the MRM in the MRP_LinkUp
10331 and MRP_LinkDown frames to tell the MRM after which time the MRC will change its port
10332 state from BLOCKED to FORWARDING (MRP_LinkUp frame) or from FORWARDING to
10333 BLOCKED (MRP_LinkDown frame).

10334 Measures shall be included to prevent the MRM from remaining stuck in the closed state in
10335 case of node failure.

10336 The MRM shall not forward MRP_InTest frames, MRP_InLinkChange frames,
10337 MRP_InLinkStatusPoll frames and MRP_InTopologyChange frames between its ring ports, if
10338 one of its ring port is in the port state BLOCKED.

10339 The MRM shall process MRP_InTopologyChange frames. It shall clear its FDB if requested by
10340 a MRP_InTopologyChange frame in a given time interval MRP_Interval. It shall send a

10341 MRP_TopologyChange frame if requested by the MRP_InTopologyChange frame, in order to
10342 ensure that all MRC, MIM and MIC in the ring domain clear their FDB at the same time.

10343 **5.3 Media Redundancy Client (MRC)**

10344 Each MRC shall forward MRP_Test frames received on one ring port to the other ring port and
10345 vice versa.

10346 If the MRC detects a failure or recovery of a ring port link, the MRC may optionally notify the
10347 change by sending MRP_LinkChange frames through both of its ring ports. Each MRC shall
10348 forward MRP_LinkChange frames received on one ring port to the other ring port and vice
10349 versa.

10350 Each MRC shall forward MRP_TopologyChange frames received on one ring port to the other
10351 ring port and vice versa. Each MRC shall process these frames. It shall clear its FDB if
10352 requested by an MRP_TopologyChange frame in a given time interval MRP_Interval.

10353 Each MRC shall forward MRP_InTest frames, MRP_InLinkChange frames,
10354 MRP_InTopologyChange frames and MRP_InLinkStatusPoll frames between its ring ports, if
10355 no MIM and no MIC is active on the node at the same time.

10356 **5.4 Redundancy domain**

10357 The redundancy domain represents a ring. By default, all MRM and MRCs belong to the
10358 default domain. A unique domain ID can be allocated to all ring nodes of one ring as a key
10359 attribute. This is especially essential to distinguish frames, if a device is member of multiple
10360 rings by implementing multiple instances of MRMs or MRCs. A node shall assign exactly two
10361 unique ring ports per redundancy domain.

10362 NOTE 1 A device may have other ports than the two assigned to MRP. These other ports are not influenced by
10363 MRP.

10364 **5.5 Media Link Check**

10365 To enhance the quality of the link detection of certain ring or interconnection ports, a media
10366 link check protocol may be used. It shall be used for LC-mode.

10367 The Continuity Check Message (CCM) protocol, defined in the Connectivity Fault
10368 Management (CFM) protocol suite within IEEE 802.1Q-2011 and further specified in this
10369 document under the name CFM-CCM, shall be supported as media link check protocol.

10370 CFM-CCM shall be used at the interconnection ports of the MIM and MICs when operating the
10371 ring interconnection in LC-mode. CFM-CCM may be used at the interconnection ports if
10372 operating the ring interconnection in RC-mode.

10373 CFM-CCM may also be used at the ring ports of MRP devices.

10374 **5.6 Application of the Continuity Check protocol**

10375 When applying the CFM-CCM protocol according to 802.1Q-2011 to check the links between
10376 ring- or interconnection ports, then the ring- and interconnection ports represent Maintenance
10377 End Points (MEP) belonging to a Maintenance Domain (MD) and a Maintenance Association
10378 (MA) in the sense of 802.1Q-2011.

10379 An MRP device, applying the CFM-CCM protocol on its interconnection ports or ring ports,
10380 shall internally produce a MAUTypeChangeInd event when the Continuity Check receiver
10381 instance on its MRP port has detected a remote Maintenance End Point (MEP) error by
10382 detecting a lifetime violation of the Continuity Check messages from the linked remote MRP
10383 devices MEP CFM-CCM initiator.

10384 **5.6.1 CCM Interval**

10385 The CCM Interval to be used shall be either 3.33 ms or 10 ms according to IEEE 802.1Q-2011.

10386 **5.6.2 Maintenance Domain Level**

10387 The Maintenance Domain Level (MD Level) to be used between two ring- or interconnection
 10388 ports of two MRP devices shall be level 0 for lowest level physical connections. Thereby also
 10389 the fixed CCM Multicast MAC Address 01-80-C2-00-00-30 is assigned according to
 10390 IEEE 802.1Q-2011.

10391 **5.6.3 Maintenance Association ID (MAID)**

10392 The Maintenance Association ID (MAID) according to IEEE 802.1Q-2011 to be used may be
 10393 as specified in table Table 1

10394 **Table 1 – Coding of the Maintenance Association ID (MAID)**

Subfield	Value
Maintenance Domain Name Format (Character String)	4
Maintenance Domain Name Length	Variable
Maintenance Domain Name	Character string containing: <ul style="list-style-type: none"> - for ring ports: the MRP Domain name - for interconnection ports: The Interconnection name plus either a string extension .prm for primary link or .sec for secondary link or .na during startup.^a
Short MA Name Format (2-octet integer)	3
Short MA Name Length	2
Short MA Name	two Octets containing: <ul style="list-style-type: none"> - for ring ports: 0x0000 - for interconnection ports: Interconnection ID MRP_InID.
^a for a CCM MEP initiator to know whether it is sending on a secondary link is given by the fact that the MEP initiator either resides on a MIM or a MEP receiver receives CCM frames from a MEP initiator with the MIM role specified in the IEC specific TLV. Otherwise it is sending on a primary link.	

10395

10396 **5.6.4 Maintenance Association End Point ID (MEPID)**

10397 The content of the 2-octet Maintenance Association End Point ID is out of the scope of this
 10398 document.

10399 **5.6.5 Sender ID TLV**

10400 The use of the Sender ID TLV according to IEEE 802.1Q is optional for MRP.

10401 **5.6.6 Port Status TLV**

10402 The use of the Port Status TLV according to IEEE 802.1Q is optional for MRP

10403 **5.6.7 Interface Status TLV**

10404 The use of the Interface Status TLV according to IEEE 802.1Q is optional for MRP.

10405 **5.7 Usage with diagnosis and alarms**

10406 If the attribute Check Media Redundancy has the value TRUE, media redundancy events shall
10407 cause diagnosis events and alarm notifications.

10408 **5.8 Ring diagnosis**

10409 In a redundancy domain the following diagnosis events handling shall be implemented by
10410 each MRM:

- 10411 • If a device is configured as MRM, but not operating in the manager role, it shall signal a
10412 “MANAGER_ROLE_FAIL” diagnosis event and suspend reporting of all other media
10413 redundancy diagnosis events while not in the manager role.
- 10414 • If a device is operating in manager role and this device detects another active MRM, it
10415 shall signal the “MULTIPLE MANAGERS” event. This event can occur concurrently with
10416 the ring state event “RING_OPEN”.
- 10417 • If a device is operating in manager role and detects an open ring, it shall signal the
10418 “RING_OPEN” event.

10419 These events shall be signaled by using the State Change service see 7.3.

10420 NOTE The presence of MRP_Test frames enables the checking of the existence of an MRM.

10421 **5.9 Multiple MRM in a single ring: Manager voting option**

10422 There shall be only one active MRM in the ring even if several nodes have this ability.

10423 NOTE Multiple active MRMs cause the ring to divide itself into several segments.

10424 As an alternative to manual MRP-role configuration, in case of more than one node having the
10425 ability to become an MRM in the ring, an enhanced manager voting option, specified in this
10426 International Standard, may be used to decide which of these nodes shall finally become the
10427 MRM, while the other nodes take over the MRC role as shown in Figure 5 and Figure 6. To
10428 this effect the nodes with the MRM ability have different priorities that shall be conveyed in
10429 the MRP_Prio field of the MRP_Test frame.

10430 If an option for multiple MRM in a single ring is used, then all MRM in the ring shall support
10431 the same manager voting option, as it is defined here.

10432 MRM supporting the manager voting option are named Media Redundancy Automanager or
10433 MRA

10434 The MRA role is not an operational MRP role like MRM or MRC. It is only an administrative,
10435 temporary role at device startup and compulsory ends up in either the MRM role or the MRC
10436 role after the device has started up and the manager voting process has selected the MRP
10437 roles.

10438 Figure 5 shows a MRP ring at network startup with two devices in the administrative MRA role.

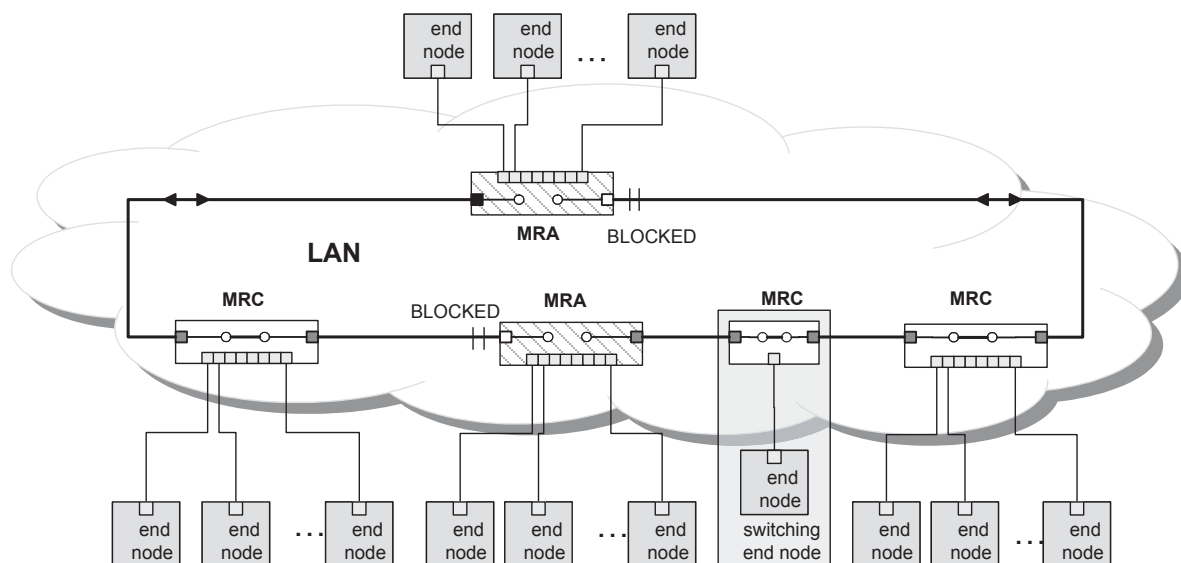


Figure 5 – MRP ring with MRA at network startup

Figure 6 shows the same network ring after the manager voting process has taken place. The MRA transitioned to the MRP roles MRM and MRC.

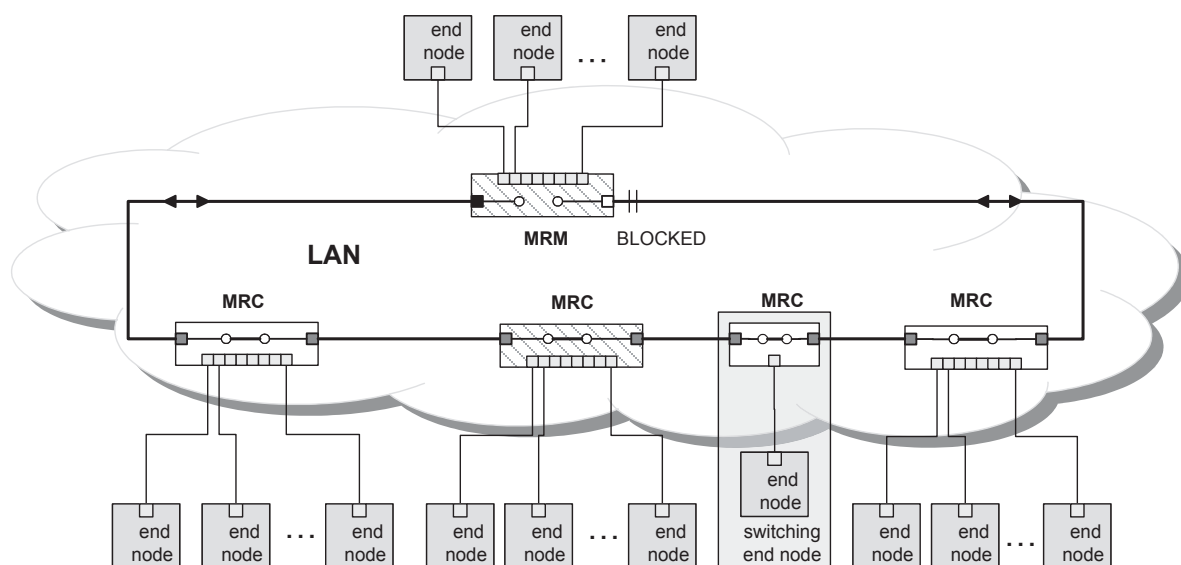


Figure 6 – MRP ring after the manager voting process

5.9.1 Basic principle of the manager voting process

The manager voting is an optional process only for devices which are capable of taking over the MRM role within MRP.

The manager voting phase of MRP shall take place right after device startup, and before the device starts to take one of the possible MRP-roles MRM or MRC.

10452 The basic functionality of the manager voting process shall be as follows:

- 10453 • Each network node of the ring with MRM-capability and manager voting option support,
10454 thereby being a so-called “Manager (Auto)” or short “MRA”, should be set to the MRP-role
10455 “Manager (Auto)” by factory-default.
- 10456 • Each MRA shall have assigned a priority (MRP_Prio) value. This MRP_Prio-value,
10457 combined with the MAC address, results in a finally unique priority. A lower MRP_Prio-
10458 value means a higher priority. If devices have identical MRP_Prio values, then the value of
10459 the device MAC address decides. A lower MAC address means a higher priority.
- 10460 • At startup, each MRA network node shall start up with the manager voting process and
10461 shall send MRP_Test frames.
- 10462 • Other MRA shall receive the MRP_Test frames and shall compare their own priority with
10463 the priority of the next MRA and shall withdraw from the MRA-role into the MRC-role if
10464 they do not have the higher priority.
- 10465 • The MRA or MRM with the highest priority shall become the one and only MRM of the ring
10466 and shall now start to manage the ring according to MRP.
- 10467 • If the MRM, which has been elected via the manager voting option, is taken out of the ring
10468 or fails to operate, the voting process shall start again and the next priority MRA shall
10469 become the managing MRM.
- 10470 • If an additional MRA is inserted into a ring containing an already elected MRM, then the
10471 already elected MRM and the newly inserted MRA will exchange MRP_Test frames and
10472 will thereby vote the new remaining MRM among each other.
- 10473 • For the manager voting option to work correctly, all devices in the ring supporting the
10474 manager role shall be set to MRP-role “Manager (Auto)” or shall remain in the MRP-role
10475 “Client”. At least one device of a ring shall be set to either the MRP-role “Manager (Auto)”
10476 or “Manager” though.
- 10477 • If a MRM without MRA capability is part of the network ring, regardless whether the ring is
10478 open or closed, all MRA shall be configured to the MRC role.

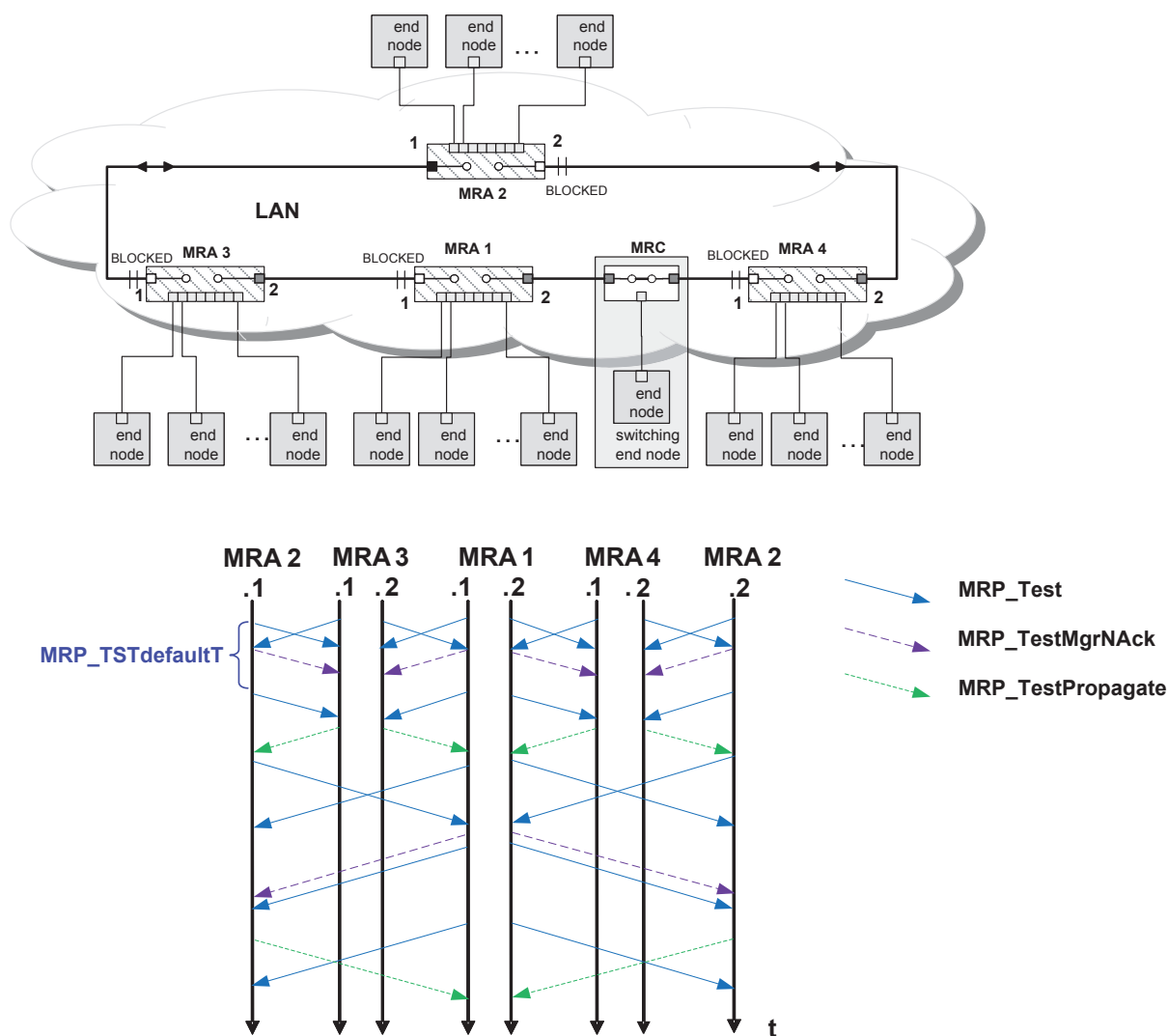
10479 **5.9.2 The manager voting process**

10480 The manager voting process shall be as follows:

- 10481 • At power on, all MRA shall start with the manager voting process
- 10482 • Each MRA shall start to send MRP_Test frames on both ring-ports. The MRP_Test frame
10483 shall contain the MRAs priority value MRP_Prio.
- 10484 • Received MRP_Test frames shall be forwarded to the local host only.
- 10485 • The remote managers priority values contained in the received MRP_Test frames shall be
10486 compared with the own priority, as described in 5.9.1. If the own priority is higher than the
10487 received priority, a negative test manager acknowledgement (“MRP_TestMgrNack”) frame,
10488 with the remote managers MAC address as additional information, shall be sent.
- 10489 • If a negative test manager acknowledgement (“MRP_TestMgrNack”) with own MAC
10490 address is received, the receiving MRA shall initiate the transition into client (MRC) role by:
 - 10491 • recording the MAC address and priority of the higher priority manager.
 - 10492 • entering the client role and propagating the role change and the higher priority
10493 manager information via a “MRP_TestPropagate” frame sent on both ring-ports.
- 10494 • On reaching the MRP client role it shall forward MRP_Test frames between ring ports like
10495 a standard MRC. Additionally, it shall also forward MRP_Test frames to the host CPU.
- 10496 • From now on, the MRA in client role shall monitor whether the recorded higher priority
10497 manager is still alive, i. e. whether it still receives MRP_Test frames from that manager.
- 10498 • The MRP_TestPropagate frame shall be used to inform other MRA devices in client role
10499 about the role change and the new higher priority manager. The clients receiving this
10500 frame shall update their higher priority manager information accordingly. This ensures that
10501 clients stay in client role in case of a role change of the monitored higher priority manager.

- 10502 • The frames `MRP_TestMgrNack` and `MRP_TestPropagate` shall be sent using the
10503 destination multicast address `MC_TEST`.
- 10504 • If the MRA in client role recognises (via `MRP_Test` frame reception monitoring timeout)
10505 that the higher priority manager has failed, it shall fall back into manager role and shall
10506 thereby start a new manager voting process with the other MRA, which have fallen back
10507 into manager role in the same way and for the same reason.

10508 Figure 7 shows the frame exchanges over the time during the manager voting phase:



10509
10510

10511 **Figure 7 – Manager voting process**

- 10512 • A handshake (negative test acknowledgement) is required to ensure the higher priority
10513 manager is located in the ring. This is necessary, as due to the switch frame forwarding
10514 rules, which allow `MRP_Test` frames from a manager device located outside the ring,
10515 connected via its ring-port to a non-ring port of a MRP device being part of the ring, are
10516 also forwarded into the ring, if a switch without “inbound” filtering capability (“ingress
10517 filtering”) is used.

10518 Figure 8 shows an MRP ring with one MRA (MRA2) located outside the ring. MRA2 is
10519 connected via one of its ring ports to a non-ring port of a device which is part of the ring. The
10520 frames follow the forwarding rules as defined in 5.1.

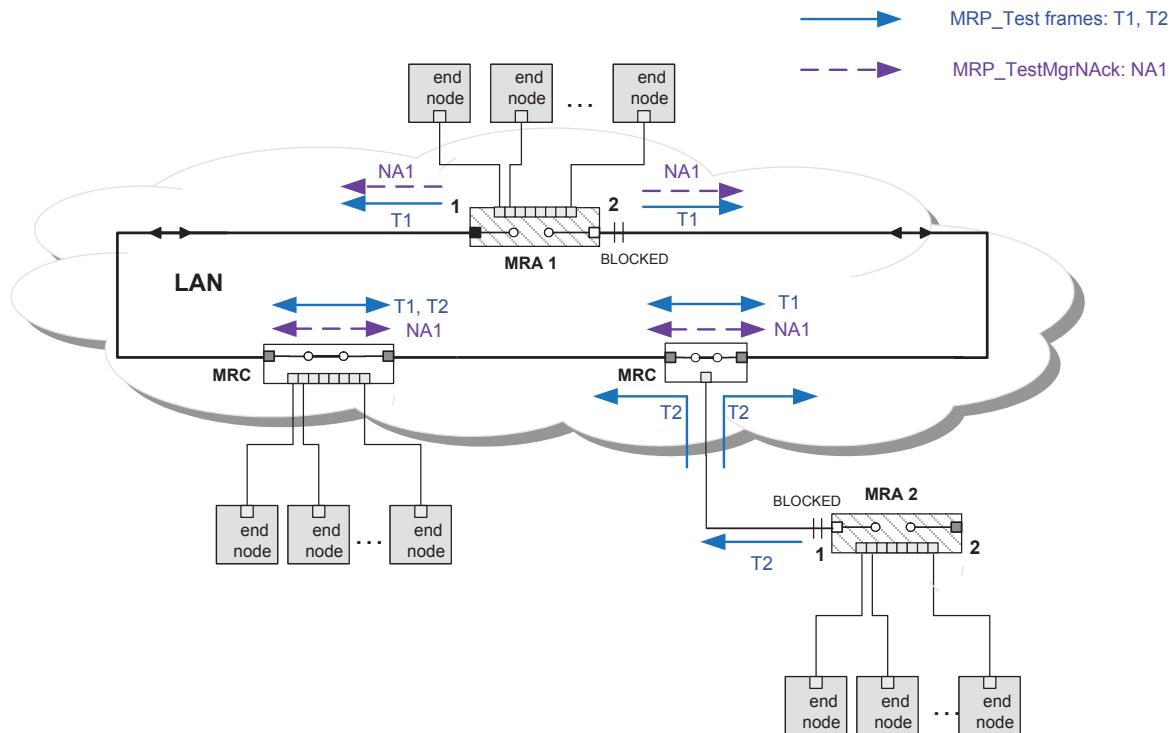


Figure 8 – MRA located outside the MRP ring

- While lower priority manager MRA1 receives test frames from higher priority manager MRA2, MRA2 does not receive test frames from lower priority manager MRA1 as these are not forwarded to non-ring ports, which excludes it from the voting process. Therefore MRA2 does not send negative test acknowledgements and MRA1 will stay in the MRM role. If MRA 1 would have a higher priority as MRA2, MRA 1 would send negative test acknowledgements but these would not reach MRA2 as these are not forwarded to non-ring ports either.

5.10 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 40 and Table 40, MRP_BLOCKED_SUPPORTED).

5.11 Interconnection port

The MIM and the MIC shall have one interconnection port.

The MIM and the MIC shall be able to detect the failure or recovery of a link on the interconnection port:

- By using link detection mechanisms based on ISO/IEC 8802-3 (IEEE 802.3)

In addition by applying one or both of the following mechanisms:

- a media link check protocol between interconnection ports. The media link check protocol shall be used at the MIM and MICs interconnection port if the MIM is configured to link check mode (LC-mode) and may be used if the MIM is configured to ring check mode (RC-mode).
- a periodic MRP_InTest frame which shall be sent and received by the MIM on its ring ports and interconnection port and shall be forwarded by the MICs on their ring ports and

10548 interconnection port. This mechanism shall be used for RC-mode and shall not be used for
10549 LC-mode.

10550 The MIM and the MIC shall not forward MRP_InTest frames, MRP_InTopologyChange frames,
10551 MRP_InLinkStatusPoll frames and MRP_InLinkChange frames to ports other than ring ports
10552 and other than the interconnection port.

10553 The interconnection port shall take one of the following port states:

10554 • DISABLED

10555 All frames shall be dropped.

10556 • BLOCKED

10557 All frames shall be dropped except the following:

10558 • MRP_InTest frames.

10559 • MRP_InLinkChange frames and MRP_InTopologyChange frames.

10560 • MRP_InLinkStatusPoll frames.

10561 • Media link check frames CFM-CCM according to IEEE 802.1Q-2011

10562 • Frames specified in IEEE 802.1D-2004 Table 7-10 to pass ports in “Discarding” state
10563 (e.g. LLDP, IEEE 1588-2008 PTP peer to peer frames).

10564 • Frames only produced or consumed by the higher layer entities of this node and never
10565 forwarded.

10566 • FORWARDING

10567 All frames shall be passed through according to the forwarding behavior of IEEE 802.1D.

10568 NOTE IEEE 802.1D refers to the port state corresponding to BLOCKED as “Discarding”.

10569

10570 5.12 Media redundancy Interconnection Manager (MIM)

10571 The interconnection port of the MIM shall be connected to the interconnection port of a MIC in
10572 another MRP ring, and the interconnection port of a MIC in the same ring shall be connected
10573 to the interconnection port of a MIC in this other MRP ring, thereby forming a MRP
10574 interconnection topology as shown in Figure 9.

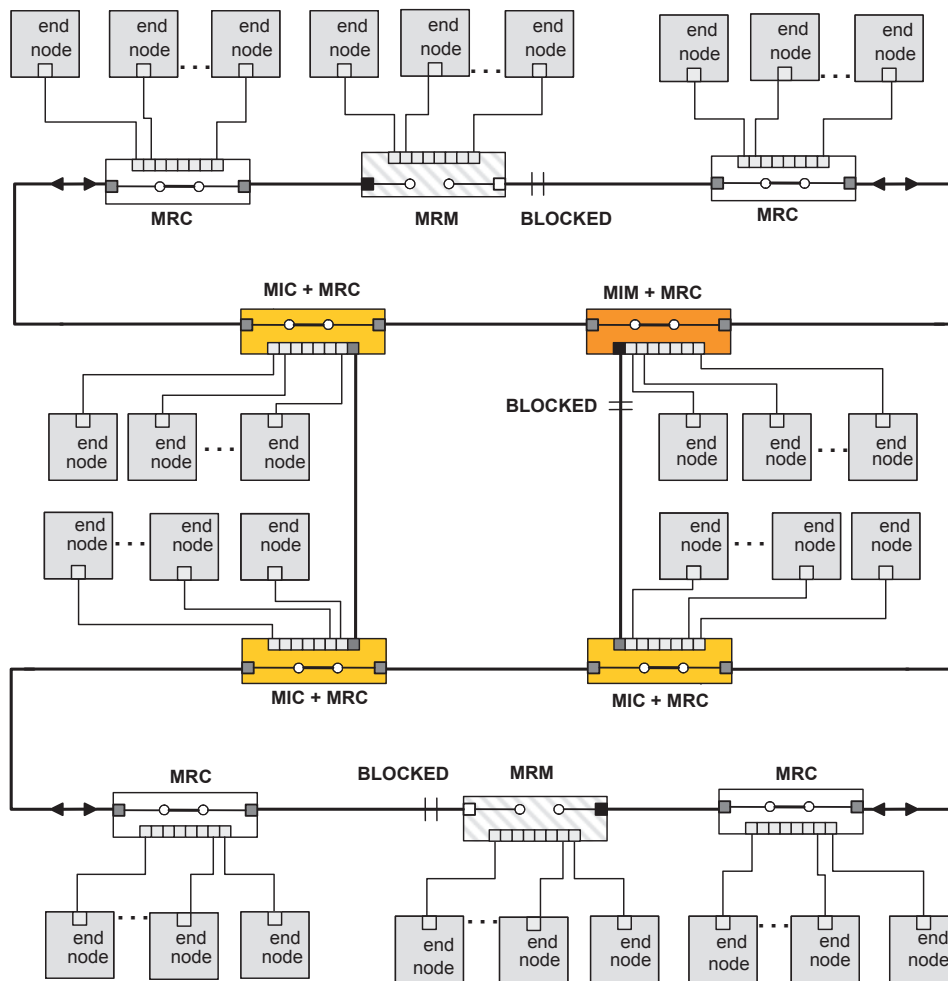


Figure 9 – MRP Interconnection topology

The MIM shall control its interconnection port state:

- by directly reacting only on interconnection port link change notifications from the MICs and from its own interconnection port (link check mode: LC-mode)
- or optionally by reacting on MRP_InTest frames (ring check mode: RC-mode).
- setting its interconnection port in BLOCKED state if:
 - it is in LC-mode and receives interconnection port link up notifications from its own interconnection port and from the MICs of the interlink connection (this means that the interconnection topology is closed, see Figure 9);
 - it is in RC-mode and receives its own MRP_InTest frames (this means that the interconnection topology is closed, see Figure 9).
- setting the interconnection port in FORWARDING state if:
 - it is in LC-mode and receives an interconnection port link down notification from at least one of the MICs of the interlink connection (this means that the interconnection topology is open, see Figure 10.)
 - it is in RC-mode and does not receive its own MRP_InTest frames within a configured time according to MRP_IN_TSTdefaultT and MRP_IN_TSTNRmax in Table 58 (this means that the interconnection topology is open, see Figure 10).

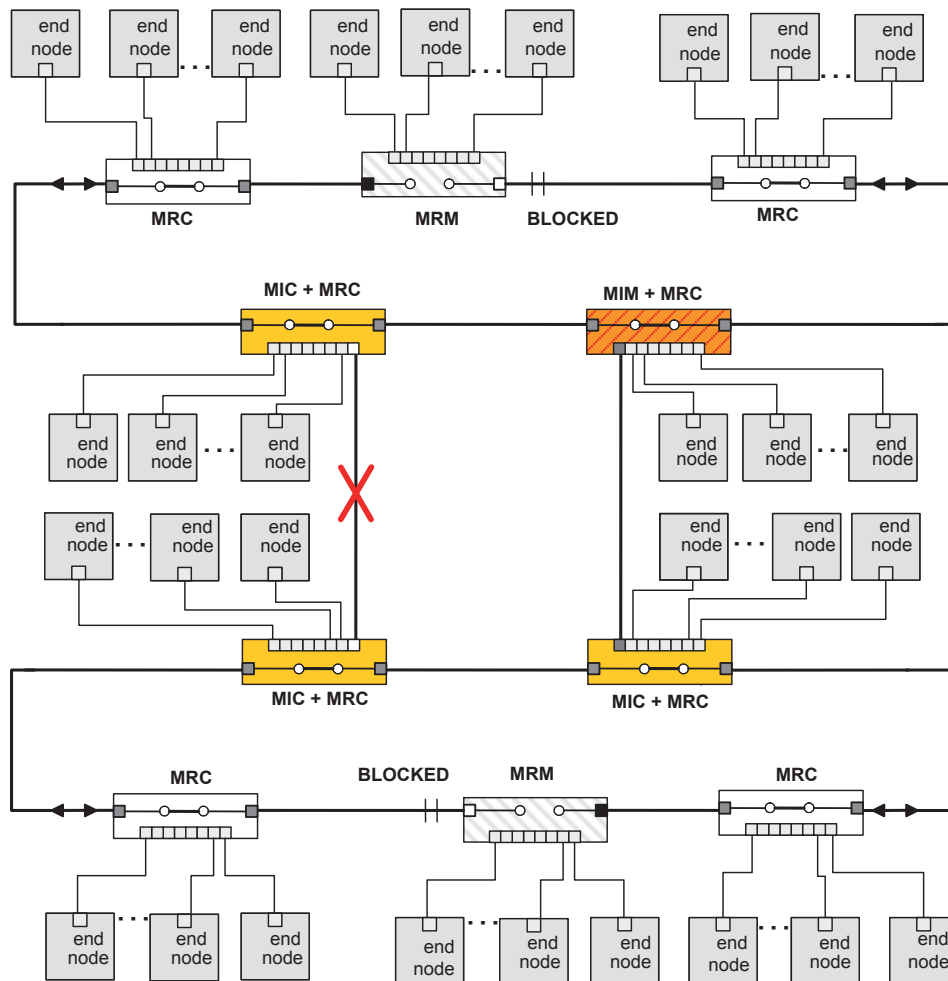


Figure 10 – MRP ring interconnection open

10594

10595 The following mechanism supports synchronization between MIM and MIC at interconnection
10596 topology changes.

10597 The MIM shall indicate changes in the interconnection topology state to the MICs, and to the
10598 MRMs in the connected MRP rings, by means of MRP_InTopologyChange frames.

10599 When being in LC-mode, the MIM shall, after startup and after recognition of a link up at its
10600 interconnection port, issue a MRP_InLinkStatusPoll frame at its ring ports, to poll the status of
10601 the redundant interlink connection from the MICs.

10602 When being in RC-mode, the MIM shall, after startup and after recognition of a link up at its
10603 interconnection port, cyclically send and receive MRP_InTest frames at its ring ports and at
10604 its interconnection port, to detect the status of the interconnection topology.

10605 When a transition to open or closed interconnection topology is detected, then the MIM shall
10606 send the MRP_InTopologyChange frames through both ring ports and through its
10607 interconnection port to the MICs and to the MRMs, to initiate the interconnection topology
10608 change.

10609 If the MIC receives a MRP_InTopologyChange frame, then the MIC shall, after recognition of
10610 a link up at its interconnection port, change the port state of its interconnection port to
10611 FORWARDING.

10612 If the MRMs receive a MRP_InTopologyChange frame, then the MRMs shall send
10613 MRP_TopologyChange frames at both ring ports, with the delay, after which all MRCs and
10614 MICs in the connected MRP rings will clear their filtering database (FDB).

10615 The MIM shall not forward its own MRP_InTest frames between the ring ports and its
10616 interconnection port.

10617 The MIM shall forward MRP_InLinkChange frames, MRP_InLinkStatusPoll frames and
10618 MRP_InTopologyChange frames received on one ring port to the other ring port and vice
10619 versa. The MIM shall process MRP_InLinkChange frames and MRP_InTopologyChange
10620 frames. The MIM shall not forward MRP_InLinkChange frames, MRP_InLinkStatusPoll frames
10621 and MRP_InTopologyChange frames, if the MIM received these frames at its interconnection
10622 port.

10623 Each MIC shall send the configured delay in MRP_Interval to the MIM in the MRP_InLinkUp
10624 and MRP_InLinkDown frames to tell the MIM after which time the MIC will change its
10625 interconnection port state from BLOCKED to FORWARDING (MRP_InLinkUp frame) or from
10626 FORWARDING to BLOCKED (MRP_InLinkDown frame).

10627 Each MIM shall support BLOCKED port state at the interconnection port.

10628 **5.13 Media redundancy Interconnection Client (MIC)**

10629 The interconnection port of the MIC shall be connected to the interconnection port of a MIM in
10630 another MRP ring, and the interconnection port of another MIC in the same ring shall be
10631 connected to the interconnection port of a MIC in this other MRP ring, thereby forming a MRP
10632 interconnection topology as shown in Figure 9.

10633 Each MIC shall forward MRP_InTest frames received on one ring port to the other ring port
10634 and to the interconnection port. Each MIC shall forward MRP_InTest frames received on the
10635 interconnection port to both ring ports. If the MIC detects a failure or recovery of the
10636 interconnection port link, the MIC shall notify the change by sending MRP_InLinkChange
10637 frames through both of its ring ports. Each MIC shall forward MRP_InLinkChange frames
10638 received on one ring port to the other ring port and vice versa. Each MIC shall forward
10639 MRP_InLinkChange frames received on one of the ring ports to the interconnection port.

10640 Each MIC shall forward MRP_InTopologyChange frames received on one ring port to the
10641 other ring port and vice versa. Each MIC shall process MRP_InTopologyChange frames. It
10642 shall, after recognition of a link up at its interconnection port, change the port state of its
10643 interconnection port to FORWARDING.

10644 After receiving a MRP_InLinkStatusPoll frame from the MIM, each MIC shall respond with a
10645 MRP_InLinkChange status frame informing about its current interconnection port link status.

10646 Each MIC shall support BLOCKED port state at the interconnection port.

10647 **5.14 Interconnection domain**

10648 The interconnection domain represents an interconnection topology. The MIM and the MICs of
10649 one interconnection topology belong to the same interconnection domain. A unique
10650 interconnection ID shall be allocated as a key attribute, especially if MIM and MICs are
10651 member of rings with multiple interconnections. A node shall assign exactly one unique
10652 interconnection port per interconnection domain.

10653 All interconnection topologies in the network shall have a unique interconnection ID.

10654 There shall be only one active MIM in an interconnection domain.

10655 NOTE Interconnection ports should behave as if STP, RSTP or MSTP is disabled.

10656 5.15 Interconnection diagnosis

10657 In an interconnection domain the following diagnosis events handling shall be implemented by
10658 each MIM.

- 10659 • If a device is configured as MIM, but not operating in this role, it shall signal a
10660 “MRP_INTERCONNECTION_MANAGER_ROLE_FAIL” diagnosis event and suspend
10661 reporting of all other media redundancy interconnection protocol diagnosis events while
10662 not in the manager role.
- 10663 • If a device is operating in MRP interconnection manager role (MIM) and detects or is
10664 informed about an open interconnection topology, it shall signal the
10665 “INTERCONNECTION_OPEN” event.

10666 These events shall be signaled by using the State Change service see 7.3.

10667 6 MRP Class specification

10668 6.1 General

10669 The MRP Application Service Element (ASE) defines two object types.

10670 6.2 Template

10671 6.2.1 Media redundancy template

10672 An MRP object is described by the following template:

10673	ASE:	Media redundancy ASE
10674	CLASS:	Media redundancy
10675	CLASS ID:	not used
10676	PARENT CLASS:	IEEE 802.3, IEEE 802.1D
10677	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 (AUTO), 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)

10678

10679 **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

10680 **6.2.2 Media redundancy Interconnection template**

10681 An MRP Interconnection object is described by the following template:

10682 **ASE: Media redundancy interconnection ASE**10683 **CLASS: Media redundancy interconnection**10684 **CLASS ID: not used**10685 **PARENT CLASS: IEEE 802.3, IEEE 802.1D**10686 **ATTRIBUTES:**

1.	(m)	Key Attribute:	Interconnection ID
2.	(m)	Attribute:	Interconnection Name
3.	(m)	Attribute:	Interconnection Port ID
4.	(o)	Attribute:	Interconnection Port State
5.	(o)	Attribute:	Interconnection VLAN ID
6.	(o)	Attribute:	Interconnection Mode
7.	(m)	Attribute:	Interconnection Role (MANAGER, CLIENT)
8.	(c)	Constraint:	Interconnection Role = MANAGER
8.1	(m)	Attribute:	Interconnection Topology Change Interval
8.2	(m)	Attribute:	Interconnection Topology Change Repeat Count
8.3	(o)	Attribute:	Interconnection Default Test Interval
8.4	(o)	Attribute:	Interconnection Test Monitoring Count
8.5	(o)	Attribute:	Interconnection Link Status Poll Interval
8.6	(o)	Attribute:	Interconnection Link Status Poll Repeat Count
8.7	(m)	Attribute:	Interconnection Topology State
9.	(c)	Constraint:	Interconnection Role = CLIENT
9.1	(m)	Attribute:	Interconnection Link Down Interval
9.2	(m)	Attribute:	Interconnection Link Up Interval
9.3	(m)	Attribute:	Interconnection Link Change Count

10687

10688 **SERVICES:**

1	(m)	OpsService:	Start MIM
2	(m)	OpsService:	Stop MIM
3	(o)	OpsService:	Interconnection State Change
4	(m)	OpsService:	Start MIC
5	(m)	OpsService:	Stop MIC
5	(o)	OpsService:	Read MIM
6	(o)	OpsService:	Read MIC

10689

10690 **6.3 Attributes**10691 **Domain ID**10692 This key attribute defines the redundancy domain representing the ring the MRP object
10693 belongs to. It is set to default Domain ID or provided as unique ID by engineering.

10694 Attribute Type: UUID

10695 **Domain Name**10696 This attribute defines the redundancy domain representing the ring the Media redundancy
10697 object belongs to. It is set to default Domain Name or provided as unique ID by
10698 engineering.

10699 Attribute Type: VisibleString[240]

- 10700 **Ring Port 1 ID**
10701 This attribute specifies one port of a switch which is assigned as ring port 1 in the
10702 redundancy domain referenced by the value of the attribute Domain ID.
10703 Attribute Type: Unsigned16
- 10704 **Ring Port 2 ID**
10705 This attribute specifies another port of a switch different from Ring Port 1 ID which is
10706 assigned as ring port 2 in the redundancy domain referenced by the value of the attribute
10707 Domain ID.
10708 Attribute Type: Unsigned16
- 10709 **VLAN ID**
10710 This optional attribute may be used by the MRP object and specifies its VLAN identifier in
10711 the redundancy domain.
10712 Attribute Type: Unsigned16
- 10713 **Expected Role**
10714 This attribute specifies the role of the MRP object in the redundancy domain.
10715 Attribute Type: Unsigned16
10716 Allowed values: MANAGER (Auto), MANAGER, CLIENT
- 10717 **Manager Priority**
10718 This attribute shall contain the priority of the MRM. A lower value indicates a higher
10719 priority, 0x0000 (highest priority) to 0xFFFF (lowest priority) in increments of 0x0001.
10720 Attribute Type: Unsigned16
- 10721 **Topology Change Interval**
10722 This attribute specifies the interval for sending MRP_TopologyChange frames.
10723 Attribute Type: Unsigned16
- 10724 **Topology Change Repeat Count**
10725 This attribute specifies the interval count which controls repeated transmissions of
10726 MRP_TopologyChange frames.
10727 Attribute Type: Unsigned16
- 10728 **Short Test Interval**
10729 This attribute specifies the short interval for sending MRP_Test frames on ring ports after
10730 link changes in the ring.
10731 Attribute Type: Unsigned16
- 10732 **Default Test Interval**
10733 This attribute specifies the default interval for sending MRP_Test frames on ring ports.
10734 Attribute Type: Unsigned16
- 10735 **Test Monitoring Count**
10736 This attribute specifies the interval count for monitoring the reception of MRP_Test
10737 frames.
10738 Attribute Type: Unsigned16
- 10739 **Non-blocking MRC supported**
10740 This attribute specifies the ability of the MRM to support MRCs without BLOCKED port
10741 state support in the ring.
10742 Attribute Type: Boolean
- 10743 **Test Monitoring Extended Count**
10744 This attribute specifies the extended interval count for monitoring the reception of
10745 MRP_Test frames.
10746 Attribute Type: Unsigned16
- 10747 **React On Link Change**
10748 This optional attribute specifies whether the MRM reacts on MRP_LinkChange frames or
10749 not.

10750 Attribute Type: Boolean

10751 **Check Media Redundancy**

10752 This attribute specifies whether monitoring of MRM state is enabled (TRUE) or disabled
10753 (FALSE) in the redundancy domain.

10754 Attribute Type: Boolean

10755 **Real Role State**

10756 This attribute specifies the actual role of the MRP object in the redundancy domain.

10757 Attribute Type: Unsigned16

10758 Allowed values: MANAGER (Auto), MANAGER, CLIENT, UNDEFINED

10759 **Real Ring State**

10760 This attribute specifies the actual ring state of the MRP object in the redundancy domain.

10761 The Ring State shall have one of the following values:

10762 OPEN: Ring is open due to link or MRC failure in ring.

10763 CLOSED: Ring is closed (normal operation, no error).

10764 UNDEFINED: Shall be set if the attribute Real Role State contains the value CLIENT
10765 (i.e. MRP object was reconfigured to client role).

10766 Attribute Type: Unsigned16

10767 Allowed values: OPEN, CLOSED, UNDEFINED

10768 **Ring Port 1 Port State**

10769 This optional attribute specifies the actual port state of Ring Port 1. The Ring Port 1 state
10770 shall be specified according to Ring port states in 5.1.

10771 Attribute Type: Unsigned16

10772 Allowed values: DISABLED, BLOCKED, FORWARDING

10773 **Ring Port 2 Port State**

10774 This optional attribute specifies the actual port state of Ring Port 2. The Ring Port 2 state
10775 shall be specified according to Ring port states in 5.1.

10776 Attribute Type: Unsigned16

10777 Allowed values: DISABLED, BLOCKED, FORWARDING

10778 **Link Down Interval**

10779 This attribute specifies the interval for sending MRP_LinkDown frames on ring ports.

10780 Attribute Type: Unsigned16

10781 **Link Up Interval**

10782 This attribute specifies the interval for sending MRP_LinkUp frames on ring ports.

10783 Attribute Type: Unsigned16

10784 **Link Change Count**

10785 This attribute specifies the MRP_LinkChange frame count which controls repeated
10786 transmission of MRP_LinkChange frames.

10787 Attribute Type: Unsigned16

10788 **BLOCKED state supported**

10789 This attribute specifies whether the MRC supports BLOCKED state at its ring ports or not.

10790 Attribute Type: Boolean

10791 **Interconnection ID**

10792 This key attribute defines the interconnection domain representing the interconnection
10793 topology the MRP interconnection object belongs to. It is provided as unique ID by
10794 engineering..

10795 Attribute Type: Unsigned16

- 10796 **Interconnection Name**
10797 This attribute specifies the name of the interconnection domain referenced by the value of
10798 the attribute Interconnection ID. It is set to default Interconnection Name or provided as
10799 Interconnection Name by engineering.
- 10800 Attribute Type: VisibleString[240]
- 10801 **Interconnection Port ID**
10802 This attribute specifies one port of a switch which is assigned as interconnection port in
10803 the interconnection domain referenced by the value of the attribute Interconnection ID.
- 10804 Attribute Type: Unsigned16
- 10805 **Interconnection Port State**
10806 This optional attribute specifies the actual port state of the interconnection port. The
10807 Interconnection Port state shall be specified according to Interconnection port states in
10808 5.1.
- 10809 Attribute Type: Unsigned16
10810 Allowed values: DISABLED, BLOCKED, FORWARDING
- 10811 **Interconnection VLAN ID**
10812 This optional attribute may be used by the MRP interconnection object and specifies its
10813 VLAN identifier in the interconnection domain.
- 10814 Attribute Type: Unsigned16
- 10815 **Interconnection Mode**
10816 This attribute specifies the mode of the MRP interconnection object in the interconnection
10817 domain.
- 10818 LC_MODE: Link check mode. The MIM analyses the ring interconnection state by
10819 using the link change notifications of the MICs. MRP_InTest frames are disabled.
- 10820 RC_MODE: Ring check mode. The MIM analyses the ring interconnection state by
10821 sending and receiving MRP_InTest frames. Link change notifications of the MICs
10822 may be used in addition to optimize the recovery timing.
- 10823 Attribute Type: Unsigned16
10824 Allowed values: UNDEFINED, LC_MODE, RC_MODE
- 10825 **Interconnection Role**
10826 This attribute specifies the role of the MRP interconnection object in the interconnection
10827 domain.
- 10828 Attribute Type: Unsigned16
10829 Allowed values: MANAGER, CLIENT
- 10830 **Interconnection Topology Change Interval**
10831 This attribute specifies the interval for sending MRP_InTopologyChange frames.
- 10832 Attribute Type: Unsigned16
- 10833 **Interconnection Topology Change Repeat Count**
10834 This attribute specifies the interval count which controls repeated transmissions of
10835 MRP_InTopologyChange frames.
- 10836 Attribute Type: Unsigned16
- 10837 **Interconnection Default Test Interval**
10838 This attribute specifies the default interval for sending MRP_InTest frames on ring ports
10839 and on the interconnection port.
- 10840 Attribute Type: Unsigned16
- 10841 **Interconnection Test Monitoring Count**
10842 This attribute specifies the interval count for monitoring the reception of MRP_InTest
10843 frames.
- 10844 Attribute Type: Unsigned16
- 10845 **Interconnection Link Status Poll Interval**
10846 This attribute specifies the interval for sending MRP_InLinkStatusPoll frames.

10847 Attribute Type: Unsigned16

10848 **Interconnection Link Status Poll Repeat Count**

10849 This attribute specifies the interval count which controls repeated transmissions of
10850 MRP_InLinkStatusPoll frames.

10851 Attribute Type: Unsigned16

10852 **Interconnection Topology State**

10853 This attribute specifies the actual interconnection topology state of the MRP
10854 interconnection object in the interconnection domain. The Interconnection Topology State
10855 shall have one of the following values:

10856 UNDEFINED: Device has no information (yet) about the Interconnection topology

10857 OPEN: Interconnection topology is open due to link or MIC failure in the
10858 interconnection topology.

10859 CLOSED: Interconnection topology is closed (normal operation, no error).

10860 Attribute Type: Unsigned16

10861 Allowed values: UNDEFINED, OPEN, CLOSED

10862 **Interconnection Link Down Interval**

10863 This attribute specifies the interval for sending MRP_InLinkDown frames on ring ports.

10864 Attribute Type: Unsigned16

10865 **Interconnection Link Up Interval**

10866 This attribute specifies the interval for sending MRP_InLinkUp frames on ring ports.

10867 Attribute Type: Unsigned16

10868 **Interconnection Link Change Count**

10869 This attribute specifies the MRP_InLinkChange frame count which controls repeated
10870 transmission of MRP_InLinkChange frames.

10871 Attribute Type: Unsigned16

10872 **7 MRP Service specification**

10873 **7.1 Start MRM**

10874 The Start MRM service creates a local instance of the MRM protocol machine.

10875 Table 2 shows the parameters of the service.

10876 **Table 2 – 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	

Parameter name	Req	Cnf
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
NOTE For the meaning of Req, Cnf, M, U and S refer to ISO/IEC 10164-1.		

10877

Argument

10878 The argument shall convey the service specific parameters of the service request.

Domain ID

10881 This is the key attribute to identify the instance of the protocol machine.

Ring Port 1 ID

10883 This parameter contains the ID of the port which serves as first ring port.

Ring Port 2 ID

10885 This parameter contains the ID of the port which serves as second ring port.

VLAN ID

10887 This optional parameter contains the value for the VLAN identifier.

Manager Priority

10889 This parameter contains the value for the manager priority.

Topology Change Interval

10891 This parameter contains the value of the interval for sending MRP_TopologyChange frames.

Topology Change Repeat Count

10894 This parameter contains the value of the interval count which controls repeated transmissions of MRP_TopologyChange frames.

Short Test Interval

10897 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

10900 This parameter contains the value of the default interval for sending MRP_Test frames on ring ports.

Test Monitoring Count

10903 This parameter contains the value of the interval count for monitoring the reception of MRP_Test frames.

Non-blocking MRC supported

10906 This parameter specifies the ability of the MRM to support MRCs without BLOCKED port state support in the ring.

Test Monitoring Extended Count

10909 This optional parameter contains the value of the extended interval count for monitoring the reception of MRP_Test frames.

React On Link Change

10912 This optional parameter specifies whether the MRM reacts on MRP_LinkChange frames or not.

10913

10914 **Check Media Redundancy**

10915 This parameter selects whether monitoring of MRM state is enabled or disabled.

10916 **Result(+)**

10917 This parameter indicates that the service request succeeded.

10918 **Domain ID**

10919 This is the key attribute to identify the instance of the protocol machine.

10920 **Result(-)**

10921 This parameter indicates that the service request failed.

10922 **Domain ID**

10923 This is the key attribute to identify the instance of the protocol machine.

10924 **Error Code**

10925 The parameter Result contains the error code of the specific error.

10926 Type: Unsigned16

10927 Allowed values: DOMAIN_ID_MISMATCH, ROLE_NOT_SUPPORTED, INVALID_RINGPORT

10928 **7.2 Stop MRM**10929 This service shall be used to stop the MRM protocol machine. Ring port states and switch
10930 functionality remain.

10931 Table 3 shows the parameters of the service.

10932 **Table 3 – 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.		

10933

10934 **Argument**

10935 The argument shall convey the service specific parameters of the service request.

10936 **Domain ID**

10937 This is the key attribute to identify the instance of the protocol machine.

10938 **Result(+)**

10939 This parameter indicates that the service request succeeded.

10940 **Domain ID**

10941 This is the key attribute to identify the instance of the protocol machine.

10942 **Result(-)**

10943 This parameter indicates that the service request failed.

10944 **Domain ID**

10945 This is the key attribute to identify the instance of the protocol machine.

10946 **Error Code**

10947 The parameter Result contains the error code of the specific error.

10948 Type: Unsigned16

10949 Allowed values: DOMAIN_ID_MISMATCH

10950 **7.3 State Change**

10951 This service shall be used to indicate a change of the MRP domain state.

10952 Table 4 shows the parameters of the service.

10953 **Table 4 – 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.	

10954

10955 **Argument**

10956 The argument shall convey the service specific parameters of the service request.

10957 **Domain ID**

10958 This is the key attribute to identify the instance of the protocol machine.

10959 **Error Type List**

10960 This attribute consists of the following elements:

10961 **Error Type**

10962 This attribute identifies a media redundancy error.

10963 Attribute Type: Unsigned16

10964 Allowed values: MANAGER_ROLE_FAIL, RING_OPEN, MULTIPLE_MANAGERS

10965 **Appear**

10966 This attribute identifies whether the error appears or disappears.

10967 Attribute Type: Boolean

10968 Allowed values: TRUE, FALSE

10969 **7.4 Start MRC**

10970 The Start MRC service creates an instance of the MRC protocol machine.

10971 Table 5 shows the parameters of the service.

10972 **Table 5 – 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	

Parameter name	Req	Cnf
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, M, U and S refer to ISO/IEC 10164-1.		

10973

Argument

10974 The argument shall convey the service specific parameters of the service request.

10975

Domain ID

10976 This is the key attribute to identify the instance of the protocol machine.

10977

Ring Port 1 ID

10978 This parameter contains the ID of the port which serves as first ring port.

10979

Ring Port 2 ID

10980 This parameter contains the ID of the port which serves as second ring port.

10981

VLAN ID

10982 This optional parameter contains the value for the VLAN identifier.

10983

Link Down Interval

10984 This parameter contains the value of the interval for sending MRP_LinkDown frames

10985 on ring ports.

10986

Link Up Interval

10987 This parameter contains the value of the interval for sending MRP_LinkUp frames on ring

10988 ports.

10989

Link Change Count

10990 This parameter contains the value of the MRP_LinkChange frame count which controls

10991 repeated transmissions of MRP_LinkUp or MRP_LinkDown frames.

10992

BLOCKED state supported

10993 This parameter specifies whether the MRC supports BLOCKED state at its ring ports or

10994 not.

10995

10996

Result(+)

10997 This parameter indicates that the service request succeeded.

10998

Domain ID

10999 This is the key attribute to identify the instance of the protocol machine.

11000

Result(-)

11001 This parameter indicates that the service request failed.

11002

Domain ID

11003 This is the key attribute to identify the instance of the protocol machine.

11004

Error Code

11005 The parameter Result contains the error code of the specific error.

11006

11007 Type: Unsigned16

11008 Allowed values: DOMAIN_ID_MISMATCH, ROLE_NOT_SUPPORTED, INVALID_RINGPORT

11009 **7.5 Stop MRC**

11010 This service shall be used to stop the MRC protocol machine. Ring port states and switch
11011 functionality remain. Table 6 shows the parameters of the service.

11012 **Table 6 – MRP Stop MRC**

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.		

11013

11014 **Argument**

11015 The argument shall convey the service specific parameters of the service request.

11016 **Domain ID**

11017 This is the key attribute to identify the instance of the protocol machine.

11018 **Result(+)**

11019 This parameter indicates that the service request succeeded.

11020 **Domain ID**

11021 This is the key attribute to identify the instance of the protocol machine.

11022 **Result(-)**

11023 This parameter indicates that the service request failed.

11024 **Domain ID**

11025 This is the key attribute to identify the instance of the protocol machine.

11026 **Error Code**

11027 The parameter Result contains the error code of the specific error.

11028 Type: Unsigned16

11029 Allowed values: DOMAIN_ID_MISMATCH

11030 **7.6 Read MRM**

11031 The optional Read MRM service reads the actual state of the MRM protocol machine.

11032 Table 7 shows the parameters of the service.

11033 **Table 7 – MRP Read MRM**

Parameter name	Req	Rsp
Argument	M	
Domain ID	M	
Result(+)		S
Domain ID		M

Parameter name	Req	Rsp
Ring Port 1 ID		M
Ring Port 2 ID		M
VLAN ID		U
Manager Priority		M
CheckMediaRedundancy		M
Real Role State		M
Real Ring State		M
Ring Port 1 Port State		U
Ring Port 2 Port State		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
Result(-)		S
Domain ID		M
Error Code		M
NOTE For the meaning of Req, Rsp, M, U and S refer to ISO/IEC 10164-1.		

11034

11035 **Argument**

11036 The argument shall convey the service specific parameters of the service request.

11037 **Domain ID**

11038 This is the key attribute to identify the instance of the protocol machine.

11039 **Result(+)**

11040 This parameter indicates that the service request succeeded.

11041 **Domain ID**

11042 This is the key attribute to identify the instance of the protocol machine.

11043 **Ring Port 1 ID**

11044 This parameter contains the ID of the port which serves as first ring port.

11045 **Ring Port 2 ID**

11046 This parameter contains the ID of the port which serves as second ring port.

11047 **VLAN ID**

11048 This optional parameter contains the value for the VLAN identifier.

11049 **Manager Priority**

11050 This parameter contains the value for the manager priority.

11051 **Check Media Redundancy**

11052 This parameter indicates whether monitoring of MRM is enabled or disabled

11053 **Topology Change Interval**11054 This parameter contains the value of the interval for sending MRP_TopologyChange frames.
1105511056 **Topology Change Repeat Count**11057 This parameter contains the value of the interval count which controls repeated
11058 transmission of MRP_TopologyChange frames.

- 11059 **Short Test Interval**
 11060 This parameter contains the value of the short interval for sending MRP_Test frames on
 11061 ring ports after link changes in the ring.
- 11062 **Default Test Interval**
 11063 This parameter contains the value of the default interval for sending MRP_Test frames on
 11064 ring ports.
- 11065 **Test Monitoring Count**
 11066 This parameter contains the value of the interval count for monitoring the reception of
 11067 MRP_Test frames.
- 11068 **Non-blocking MRC supported**
 11069 This parameter contains the ability of the MRM to support MRC without BLOCKED port
 11070 state support in the ring.
- 11071 **Test Monitoring Extended Count**
 11072 This optional parameter contains the value of the extended interval count for monitoring
 11073 the reception of MRP_Test frames.
- 11074 **Real Role State**
 11075 This attribute contains the actual role of the MRP object in the redundancy domain.
- 11076 **Real Ring State**
 11077 This attribute contains the actual ring state of the MRP object in the redundancy domain.
- 11078 **Ring Port 1 Port State**
 11079 This optional attribute contains the actual port state of Ring Port 1.
- 11080 **Ring Port 2 Port State**
 11081 This optional attribute contains the actual port state of Ring Port 2.
- 11082 **React On Link Change**
 11083 This optional parameter contains whether the MRM reacts on MRP_LinkChange frames or
 11084 not.
- 11085
- 11086 **Result(-)**
 11087 This parameter indicates that the service request failed.
- 11088 **Domain ID**
 11089 This is the key attribute to identify the instance of the protocol machine.
- 11090 **Error Code**
 11091 The parameter Result contains the error code of the specific error.
 11092 Type: Unsigned16
 11093 Allowed values: DOMAIN_ID_MISMATCH, MANAGER_READ_FAIL
- 11094 **7.7 Read MRC**
- 11095 The optional Read MRC service reads the actual state of the MRC protocol machine.
- 11096 Table 8 shows the parameters of the service.

Table 8 – MRP Read MRC

Parameter name	Req	Rsp
Argument	M	
Domain ID	M	
Result(+)		S
Domain ID		M
Ring Port 1 ID		M

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

11098

Argument

11099 The argument shall convey the service specific parameters of the service request.

Domain ID

11102 This is the key attribute to identify the instance of the protocol machine.

Result(+)

11104 This parameter indicates that the service request succeeded.

Domain ID

11106 This is the key attribute to identify the instance of the protocol machine.

Ring Port 1 ID

11108 This parameter contains the ID of the port which serves as first ring port.

Ring Port 2 ID

11110 This parameter contains the ID of the port which serves as second ring port.

VLAN ID

11112 This optional parameter contains the value for the VLAN identifier.

Link Down Interval

11114 This parameter contains the value of the interval for sending MRP_LinkDown frames on ring ports.

Link Up Interval

11117 This parameter contains the value of the interval for sending MRP_LinkUp frames on ring ports.

Link Change Count

11120 This parameter contains the value of the MRP_LinkChange frame count which controls repeated transmission of MRP_LinkUp or MRP_LinkDown frames.

Ring Port 1 Port State

11123 This optional attribute contains the actual port state of Ring Port 1.

Ring Port 2 Port State

11125 This optional attribute contains the actual port state of Ring Port 2.

BLOCKED state supported

11127 This parameter contains whether the MRC supports BLOCKED state at its ring ports or not.

11129

Result(-)

11131 This parameter indicates that the service request failed.

11132 **Domain ID**

11133 This is the key attribute to identify the instance of the protocol machine.

11134 **Error Code**

11135 The parameter Result contains the error code of the specific error.

11136 Type: Unsigned16

11137 Allowed values: DOMAIN_ID_MISMATCH, CLIENT_READ_FAIL

11138

11139 **7.8 Start MIM**

11140 The Start MIM service creates a local instance of the MIM protocol machine.

11141 Table 9 shows the parameters of the service.

11142 **Table 9 – MRP Start MIM**

Parameter name	Req	Cnf
Argument	M	
Interconnection ID	M	
Interconnection Name	M	
Interconnection Port ID	M	
Interconnection VLAN ID	U	
Interconnection Mode	M	
Interconnection Topology Change Interval	U	
Interconnection Topology Change Repeat Count	U	
Interconnection Default Test Interval	U	
Interconnection Test Monitoring Count	U	
Interconnection Link Status Poll Interval	U	
Interconnection Link Status Poll Repeat Count	U	
Result(+)		S
Interconnection ID		M
Result(-)		S
Interconnection ID		M
Error Code		M
NOTE For the meaning of Req, Cnf, M, U and S refer to ISO/IEC 10164-1.		

11143

11144 **Argument**

11145 The argument shall convey the service specific parameters of the service request.

11146 **Interconnection ID**11147 This is the key attribute to identify the instance of the interconnection protocol machine.
1114811149 **Interconnection Name**

11150 This parameter contains the name of the interconnection domain.

11151 **Interconnection Port ID**

11152 This parameter contains the ID of the port which serves as interconnection port.

11153 **Interconnection VLAN ID**

11154 This optional parameter contains the value for the VLAN identifier.