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TELECOMMUNICATION STANDARDIZATION SECTOR OF ITU

G.8132/Y.1383

Corrigendum 1

(08/2019)

SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

Packet over Transport aspects – MPLS over Transport aspects

SERIES Y: GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS, NEXT-GENERATION NETWORKS, INTERNET OF THINGS AND SMART CITIES

Internet protocol aspects – Transport

MPLS-TP shared ring protection

Corrigendum 1

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Recommendation ITU-T G.8132/Y.1383

MPLS-TP shared ring protection

Corrigendum 1

Summary

Recommendation ITU-T G.8132/Y.1383 provides architecture and mechanisms for shared ring protection for multi-protocol label switching-transport profile (MPLS-TP) networks. It describes the MPLS-TP shared ring protection (MSRP) mechanisms and the ring protection switch (RPS) protocol.

The mechanisms defined herein protect point-to-point MPLS-TP label switched paths (LSPs) against failures at the MPLS-TP section layer.

Corrigendum 1 provides updates to align with the changes made in Recommendation ITU-T G.808.2.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T G.8132/Y.1383	2017-08-13	15	11.1002/1000/13318
1.1	ITU-T G.8132/Y.1383 (2017) Cor. 1	2019-08-29	15	11.1002/1000/14021

Keywords

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FOREWORD

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MPLS-TP shared ring protection

Corrigendum 1

Editorial note: This is a complete-text publication. Modifications introduced by this corrigendum are shown in revision marks relative to Recommendation ITU-T G.8132/Y.1383 (2017).

1 Scope

This Recommendation provides architecture and mechanisms for shared ring protection for multi-protocol label switching-transport profile (MPLS-TP) networks.

It describes the MPLS-TP shared ring protection (MSRP) mechanisms and the ring protection switch (RPS) protocol defined in [IETF RFC 8227].

The mechanisms defined herein protect point-to-point MPLS-TP label switched paths (LSPs) against failures at the MPLS-TP section layer.

This Recommendation provides a representation of the MPLS-TP technology using the methodologies that have been used for other transport technologies [e.g., synchronous digital hierarchy (SDH), optical transport network (OTN) and Ethernet].[1]

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T G.805] Recommendation ITU-T G.805 (2000), *Generic functional architecture of transport networks*.

[ITU-T G.806] Recommendation ITU-T G.806 (2012), *Characteristics of transport equipment – Description methodology and generic functionality*.

[ITU-T G.808] Recommendation ITU-T G.808 (2016), *Terms and definitions for network protection and restoration*.

[ITU-T G.808.2] Recommendation ITU-T G.808.2 (2019), *Generic protection switching – Ring protection*.

[ITU-T G.8110.1] Recommendation ITU-T G.8110.1 (2011), *Architecture of the Multi-Protocol Label Switching transport profile layer network*.

[ITU-T G.8121] Recommendation ITU-T G.8121 (2016), *Characteristics of MPLS-TP equipment functional blocks*.

[IETF RFC 5654] IETF RFC 5654 (2009), *Requirements of an MPLS transport profile*.

[IETF RFC 6371] IETF RFC 6371 (2011), *Operations, administration, and maintenance framework for MPLS-based transport networks*.

[1] This ITU-T Recommendation is intended to be aligned with the IETF MPLS RFCs it cites as normative references.

[IETF RFC 6372] IETF RFC 6372 (2011), *MPLS transport profile (MPLS-TP) survivability framework.*

[IETF RFC 8227] IETF RFC 8227 (2017), *MPLS-TP shared-ring protection (MSRP) mechanism for ring topology*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 adaptation function (A): [ITU-T G.806]

3.1.2 atomic function: [ITU-T G.806]

3.1.3 clear: [ITU-T G.808]

3.1.4 connection function (C): [ITU-T G.806]

3.1.5 connection point (CP): [ITU-T G.806]

3.1.6 defect: [ITU-T G.806]

3.1.7 exercise signal: [ITU-T G.808]

3.1.8 extra traffic: [ITU-T G.808.2]

3.1.9 failure: [ITU-T G.806]

3.1.10 forced switch: [ITU-T G.808]

3.1.11 layer network: [ITU-T G.805]

3.1.12 manual switch: [ITU-T G.808]

3.1.13 non–pre-emptible unprotected traffic: [ITU-T G.808.2]

3.1.14 normal traffic: [ITU-T G.808.2]

3.1.15 revertive (protection) operation: [ITU-T G.808]

3.1.16 ring map: [IETF RFC 8227]:

NOTE – Ring map defined in [IETF RFC 8227] is slightly different in meaning from the one that [ITU-T G.808.2] uses. The ring map in [ITU-T G.808.2] includes only the ring topology map information, while the ring map in [IETF RFC 8227] also includes the ring connectivity status information.

3.1.17 section: [ITU-T G.806]

3.1.18 server signal fail (SSF): [ITU-T G.806]

3.1.19 steering: [ITU-T G.808]

3.1.20 termination connection point (TCP): [ITU-T G.806]

3.1.21 trail termination function (TT): [ITU-T G.806]

3.1.22 wrapping: [ITU-T G.808]

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

A	Adaptation function
C	Connection function
CIR	Committed Information Rate
CP	Connection Point
EIR	Excess Information Rate
LSP	Label Switched Path
LSR	Label Switched Router
MEP	Maintenance Entity Point
MPLS	Multi-Protocol Label Switching
MPLS-TP	Multi-Protocol Label Switching-Transport Profile
MSRP	MPLS-TP Shared Ring Protection
MT	MPLS-TP
NUT	Non-pre-emptible Unprotected Traffic
OAM	Operation, Administration and Maintenance
OTN	Optical Transport Network
PDU	Protocol Data Unit
PW	Pseudowire
RPS	Ring Protection Switch
SDH	Synchronous Digital Hierarchy
SF	Signal Fail
SSF	Server Signal Fail
Sk	Sink
So	Source
TCP	Termination Connection Point
TT	Trail Termination

5 Conventions

The naming and diagrammatic conventions for the atomic functions used in this Recommendation follow the rules specified in [ITU-T G.806].

The following syntax is used to describe the contents of the label stack:

1) The label stack is enclosed in square brackets ("[]").
2) Each level in the stack is separated by the '|' character. Note that the label stack can contain additional layers. However, the layers that are related to the protection mechanism are presented in this Recommendation.
3) If the label is assigned by node X, the node name is enclosed in parentheses ("(X)")

RaW_X and RcW_X denote anticlockwise working ring tunnel terminating on node X and clockwise working ring tunnel terminating on node X, respectively. Similarly, RaP_X and RcP_X denote anticlockwise protection ring tunnel terminating on node X and clockwise protection ring tunnel terminating on node X, respectively.

6 Overview

This Recommendation specifies MPLS-TP Shared Ring Protection (MSRP) switching mechanisms to be applied to MPLS-TP layer networks as described in [ITU-T G.8110.1].

Clause 4.1 of [IETF RFC 8227] provides an overview of MSRP.

7 Network objectives

Clause 2.5.6.1 of [IETF RFC 5654] describes the requirements for MPLS-TP ring protection as well as some optimization criteria.

Clause 3 of [IETF RFC 8227] describes how MSRP meets those optimization criteria.

This clause describes the network objectives that MSRP supports:

1) Operation in both a single ring topology and single rings of interconnected ring topology as stated in Requirement 92 of [IETF RFC 5654].
2) Identical protection mechanisms for both logical and physical rings as stated in Requirement 101 of [IETF RFC 5654].
3) Interconnection with other MPLS-TP domains without precluding the operations of other recovery mechanisms in the rest of the network as stated in Requirement 99 of [IETF RFC 5654].
4) Protection of unidirectional and bidirectional point-to-point LSPs as stated in Requirement 94 of [IETF RFC 5654].
5) Sharing of the reserved protection bandwidth as stated in Requirement 109 of [IETF RFC 5654].
6) Allowing the bandwidth of a physical link to be shared with best-effort traffic as stated in Requirement 108 of [IETF RFC 5654].
7) Transfer time <50 ms (T_t in [ITU-T ~~G.808.2~~G.808]) as specified in Requirement 96 of [IETF RFC 5654]. Note that transfer time in [ITU-T ~~G.808.2~~G.808] is considered to be the same as "switching time" in [IETF RFC 5646].
8) Hold-off time as specified in Requirement 61 of [IETF RFC 5654].
9) Wait-to-restore time as specified in Requirement 107 of [IETF RFC 5654].
10) Protection against a single failure and multiple failures when recovery is possible as per Requirement 106 of [IETF RFC 5654].
11) Revertive mode of operation as described in Requirement 103 of [IETF RFC 5654].
12) Bidirectional protection switching type as described in Requirement 102 of [IETF RFC 5654].
13) Interconnected rings as specified in Requirement 93 of [IETF RFC 5654].
14) MPLS-TP ring protection shall protect against the following events:
    a) MPLS-TP section layer failures.
    b) Node failures.
15) Traffic types:
    a) Normal traffic as defined in [ITU-T G.808.2] shall be supported.

   b) Non-pre-emptible unprotected traffic (NUT) as defined in [ITU-T G.808.2] shall not be supported, as described in Annex B.
   c) Extra traffic as defined in [ITU-T G.808.2] shall not be supported, as described in Annex B.

16) Ring protection switch (RPS) protocol and algorithm:
   a) The switching protocol shall be able to accommodate, as minimum, up to 127 nodes on a ring
   b) The RPS protocol and associated section operation, administration and maintenance (OAM) functions shall accommodate the capability to upgrade the ring (node insertion or removal), limiting the possible impact on existing traffic to protection switching hits only.
   c) All spans on a ring shall have equal priority in case of multiple failures.
   d) The RPS protocol shall allow coexistence of multiple ring switch requests as a result of combination of failures and a Manual/Forced Switch request resulting in the ring segmenting into separate segments.
   e) The RPS protocol shall be reliable and robust enough to avoid any cases of missing of a protection switch request as well as an incorrect interpretation of a request.

17) Protection switching actions shall not create any traffic misconnection.

18) The following externally initiated commands shall be supported (Requirement 76 of [IETF RFC 5654]): Lockout of Working, Lockout of Protection (Requirement 105 of [IETF RFC 5654]), Forced Switch, Manual Switch, Exercise and Clear.

19) The following automatically initiated commands shall be supported: Signal Fail – Working, Signal Fail – Protection, Wait-To-Restore, Reverse Request and No Request. The criteria for Signal Fail should be in harmony with definitions used in [ITU-T G.8121].

8 Functional model

When an MPLS-TP transport path, such as an LSP, enters the ring, the ingress node on the ring pushes the working ring tunnel label according to the egress node and sends the traffic to the next hop. The transit nodes on the working ring tunnel swap the ring tunnel labels and forward the packets to the next hop. When the packet arrives at the egress node, the egress node pops the ring tunnel label and forwards the packets based on the inner LSP label and pseudowire (PW) label.

An MSRP ring tunnel is modelled as a server sub-layer for the MPLS-TP (MT) LSP sub-layer. An MSRP sub-layer functional model is described in Figure 8-1, which is based on Figure ~~11-3~~11-1 of [ITU-T G.808.2].

An MSRP relies on an "MPLS-TP section layer OAM" for fault detection, as indicated in clause 4.2 of [IETF RFC 8227], and carriage of RPS protocol messages. Therefore, the server sub-layer for the MSRP is the MT section sub-layer that provides section OAM monitoring of the link.

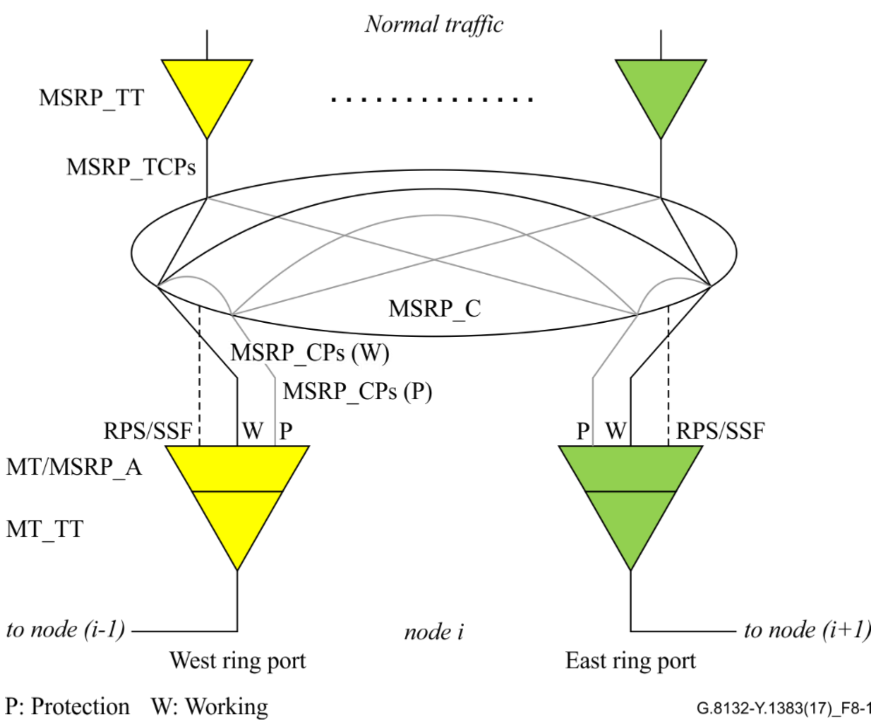

Figure 8-1 – MSRP functional model

The connectivity in the MSRP sub-layer, as shown in Figure 8-1, represents the forwarding rules for a group of MSRP ring tunnels:

– The MSRP_TCPs on the yellow (or green) MSRP_TT_So, on the West (or East) ring port, are associated with the RaW_X (or RcW_X) normal traffic that, under normal conditions, is forwarded through each RaW_X (or RcW_X) ring tunnel terminating on each remote node X.

– The MSRP_TCPs on the yellow (or green) MSRP_TT_Sk, on the West (or East) ring port, are associated with the RcW_X (or RaW_X) normal traffic that, under normal conditions, is received from each RcW_X (or RaW_X) ring tunnel terminating on the local node.

– The MSRP_CPs (W) on the yellow (or green) MT/MSRP_A_So, on the West (or East) ring port, are associated with the working traffic of each RaW_X (or RcW_X) ring tunnel terminating on a remote node X.

– The MSRP_CPs (W) on the yellow (or green) MT/MSRP_A_Sk, on the West (or East) ring port, are associated with the working traffic of each RcW_X (or RaW_X) ring tunnel terminating on a remote node X or on the local node.

– The MSRP_CPs (P) on the yellow (or green) MT/MSRP_A_So, on the West (or East) ring port, are associated with the protection traffic of each RaP_X (or RcP_X) ring tunnel terminating on a remote node X or, in the case of wrapping protection, on the local node.

– The MSRP_CPs (P) on the yellow (or green) MT/MSRP_A_Sk, on the West (or East) ring port, are associated with the protection traffic of each RcP_X (or RaP_X) ring tunnel terminating on a remote node X or on the local node.

The MSRP_C shows all the possible working and protection connections that can be setup in the MSRP sub-layer.

8.1 Label operations

This clause describes the forwarding operations for an example in clause 4.1.3 of [IETF RFC 8227] using the ITU-T functional model (complementing it with the description of how LSP1 traffic is forwarded outside of the ring). Figure 8-2 shows an example of label operations in the MSRP mechanisms.

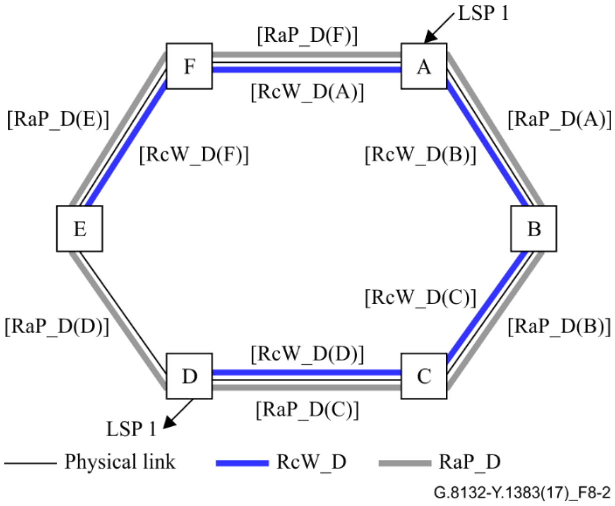

Figure 8-2 – Label operations of MSRP

8.1.1 Ingress node

Figure 8-3 depicts forwarding actions in the MT LSP and MSRP sub-layers for node A in Figure 8-2. Note that node B and node F are node A's adjacent nodes.

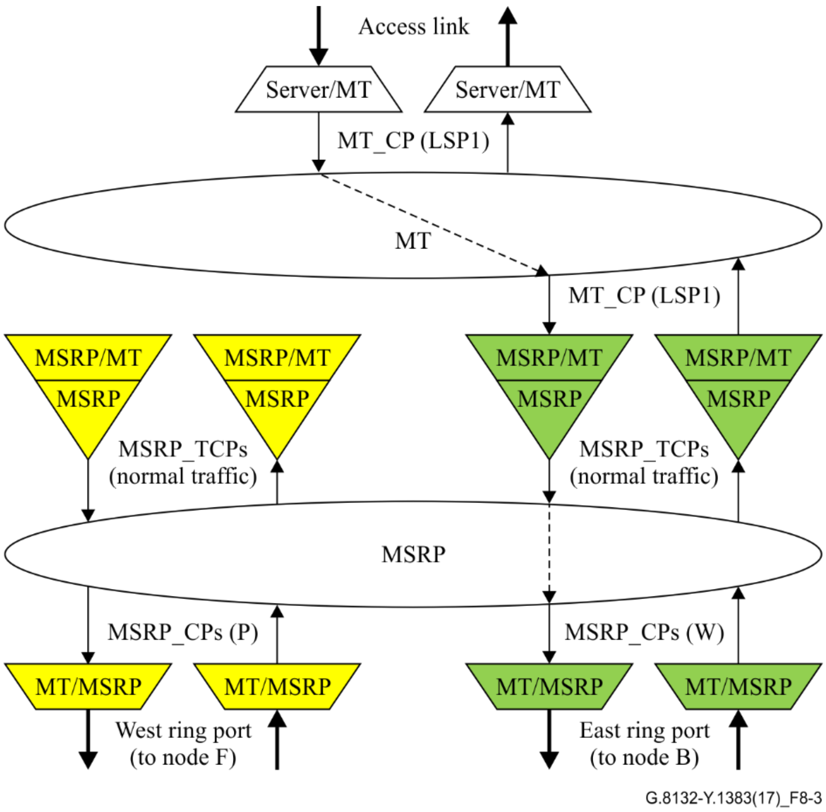

Figure 8-3 – Functional model of ingress node (node A)

Label operations performed up to the MPLS-TP LSP sub-layer on the traffic entering the ring at the ring ingress nodes depend on the role the ingress node plays at the MPLS-TP LSP sub-layer.

These label operations are modelled using the Server/MT_A, MT_TT, MT/MT_A and MT_C atomic functions modelling PW and LSP label operations, as defined in [ITU-T G.8110.1] and [ITU-T G.8121], together with the MSRP/MT_A atomic function modelling the adaptation between the MPLS-TP LSP and the MSRP ring tunnel.

In Figure 8-3, node A is a label switched router (LSR) for the LSP1 entering the ring: in this case MPLS packets of LSP1 arrive at node A from an access link with the [LSP1(A)] label stack and the received LSP1(A) label value is swapped to the LSP1(D) label value assigned by the ring egress node D:

– The Server/MT_A_Sk function is configured to send the traffic unit received from the access link with the LSP1(A) label value to the MT_CP associated with LSP1.
– The MT_C atomic function is configured to forward the traffic from the MT_CP associated to LSP1 on the Server/MT_A_Sk to the MT_CP associated with LSP1 on the green MSRP/MT_A_So (on the East ring port).
– The green MSRP/MT_A_So function is configured to assign the LSP1(D) label value to the traffic units received from the MT_CP associated with LSP1.

The ingress node should also push [RcW_D(B)] ring tunnel label; this operation is modelled using the green MSRP/MT_A, MSRP_TT, MSRP_C and MT/MSRP_A atomic functions, on the East ring port, shown in Figure 8-3.

– The green MSRP/MT_A_So is configured to send the traffic units received from the MT_CP associated with LSP1, through the green MSRP_TT_So, to the MSRP_TCP associated with the RcW_D normal traffic.
– In normal conditions, the MSRP_C atomic function is configured to forward the traffic units, from the MSRP_TCP associated with the RcW_D normal traffic to the MSRP_CP (W) associated with the RcW_D ring tunnel on the green MT/MSRP_A_So (East ring port).
– The green MT/MSRP_A_So, on the East ring port, is configured to assign the label value RcW_D(B) to the traffic units received from the MSRP_CP (W) associated with the RcW_D ring tunnel.

8.1.2 Transit node

The ring tunnel label swapping operations in the transit nodes is modelled by using the MSRP_C and MT/MSRP_A atomic functions shown in Figure 8-4.

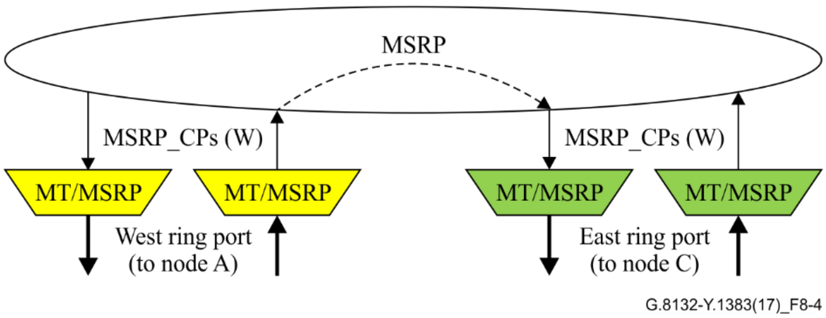

Figure 8-4 – Functional model of transit node (node B)

In node B, the ring tunnel label [RcW_D(B)] is swapped into [RcW_D(C)]:

– The yellow MT/MSRP_A_Sk, on the West ring port, is configured to send the packets received with the top label [RcW_D(B)] to the MSRP_CP (W) associated with the RcW_D ring tunnel.
– In normal conditions, the MSRP_C atomic function is configured to forward the traffic units, received from the MSRP_CP (W) associated with the RcW_D ring tunnel on the yellow MT/MSRP_A_Sk (West ring port) to the MSRP_CP (W) associated with the RcW_D ring tunnel on the green MT/MSRP_A_So (East ring port). The green MT/MSRP_A_So, on the East ring port, is configured to assign the label value RcW_D(C) to the traffic units received from MSRP_CP (W) associated with the RcW_D ring tunnel.

8.1.3 Egress node

The egress node D should also perform a ring tunnel label pop operation, which can be modelled using the MSRP/MT_A, MSRP_TT, MSRP_C and MT/MSRP_A atomic functions shown in Figure 8-5.

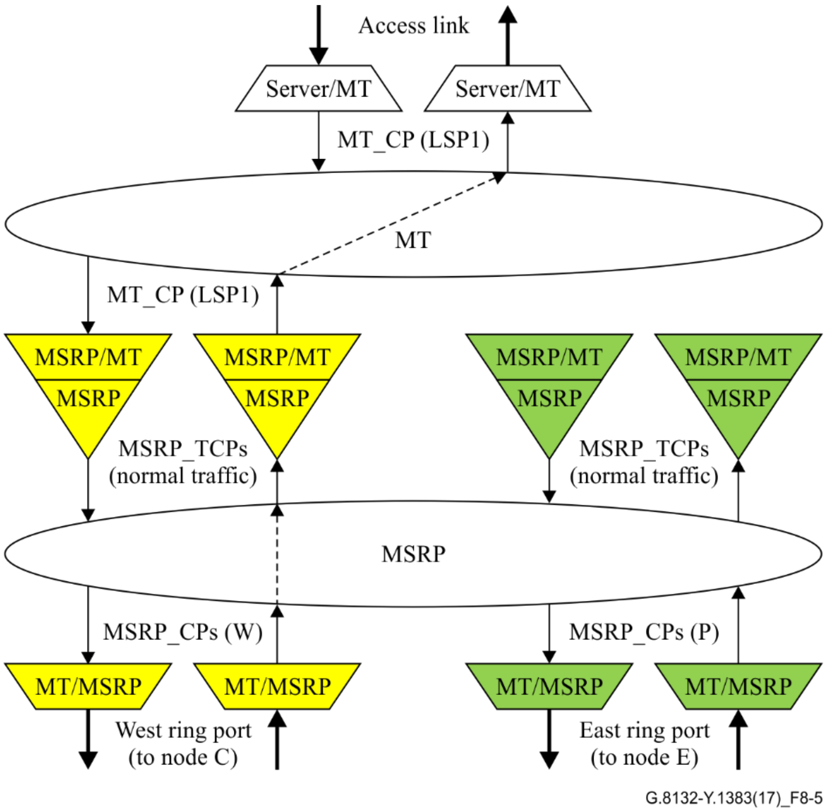

Figure 8-5 – Functional model of egress node (node D)

In node D, the ring tunnel label [RcW_D(D)] is popped:

– The yellow MT/MSRP_A_Sk, on the West ring port, is configured to send the packets received with the top label [RcW_D(D)] to the MSRP_CP (W) associated with the RcW_D ring tunnel.

– In normal conditions, the MSRP_C atomic function is configured to forward the traffic units, received from the MSRP_CP (W) associated with the RcW_D ring tunnel on the yellow MT/MSRP_A_Sk (West ring port) to the MSRP_TCP associated with the RcW_D normal traffic on the yellow MSRP_TT_Sk (West ring port).

Label operations performed up to the MPLS-TP LSP sub-layer on the traffic leaving the ring at the ring egress nodes depends on the role the egress node plays at the MPLS-TP LSP sub-layer.

These label operations can be modelled using the Server/MT_A, MT_TT, MT/MT_A and MT_C atomic functions modelling PW and LSP label operations, as defined in [ITU-T G.8110.1] and [ITU-T G.8121], together with the yellow MSRP/MT_A atomic function modelling the adaptation between the MPLS-TP LSP and the MSRP ring tunnel.

In Figure 8-5, the ring egress node (node D) is an LSR for the LSP1 leaving the ring: in this case MPLS packets of LSP1 arrive at node D with the [LSP1(D)] label at the top of the label stack and the received LSP1(D) label value is swapped to the value assigned by node D's next hop X with an LSP1(X) label value:

– The yellow MSRP/MT_A_Sk function, on the West ring port, is configured to send the traffic unit received from the yellow MSRP_TT_Sk (West ring port) with the LSP1(D) label value to the MT_CP associated with LSP1.
– The MT_C atomic function is configured to forward the traffic from the MT_CP associated to LSP1 on the yellow MSRP/MT_A_Sk to the MT_CP associated with LSP1 on Server/MT_A_So.
– The Server/MT_A_So function is configured to assign the LSP1(X) label value to the traffic units received from the MT_CP associated with LSP1.

9 Protection architecture types

Three types of ring protection mechanisms are specified: wrapping, short wrapping and steering.

The mechanisms of three types of ring protection can be found in clause 4.3 of [IETF RFC 8227].

10 Switching types

MSRP supports only the bi-directional protection switching type. This means that, in the case of unidirectional failures, all the traffic flowing in both directions, including the affected direction and the unaffected direction, is switched to protection.

11 Operation types

MSRP supports only the revertive protection operation type, which implies that the traffic will always return to (or remain on) the working entities if the switch requests are terminated.

If a local signal fail (SF) that has been active previously now becomes inactive, a local Wait-to-Restore state is entered. This state normally times out, becomes a No Request state and reverts back to the normal operation condition. The Wait-to-Restore timer is stopped if any local request of higher priority pre-empts this state.

12 Ring interconnection and its functional model

MSRP supports multi-ring scenario with intersecting rings as defined in clause 12 of [ITU-T G.808.2]. Both single node and dual node ring interconnections are supported.

The mechanisms for supporting interconnected ring protection can be found in clause 4.4 of [IETF RFC 8227].

This clause describes the forwarding operations of the dual-node interconnected rings in normal state for an example in clause 4.4 of [IETF RFC 8227] using the ITU-T functional model.

Figure 12-1 shows the example of ring tunnels provisioned for the normal traffic, i.e., LSP1 that enters Ring 1 at node D and leaves Ring 1 at node F through the clockwise working ring tunnel (R1cW_F&A) and continues to enter Ring 2 at node F and leaves at node I through the clockwise working ring tunnel (R2cW_I). Note that the direction of the working ring tunnels used in both rings should be same as specified in clause 4.4.2 of [IETF RFC 8227]. Short wrapping protection architecture type is assumed in Figure 12-1.

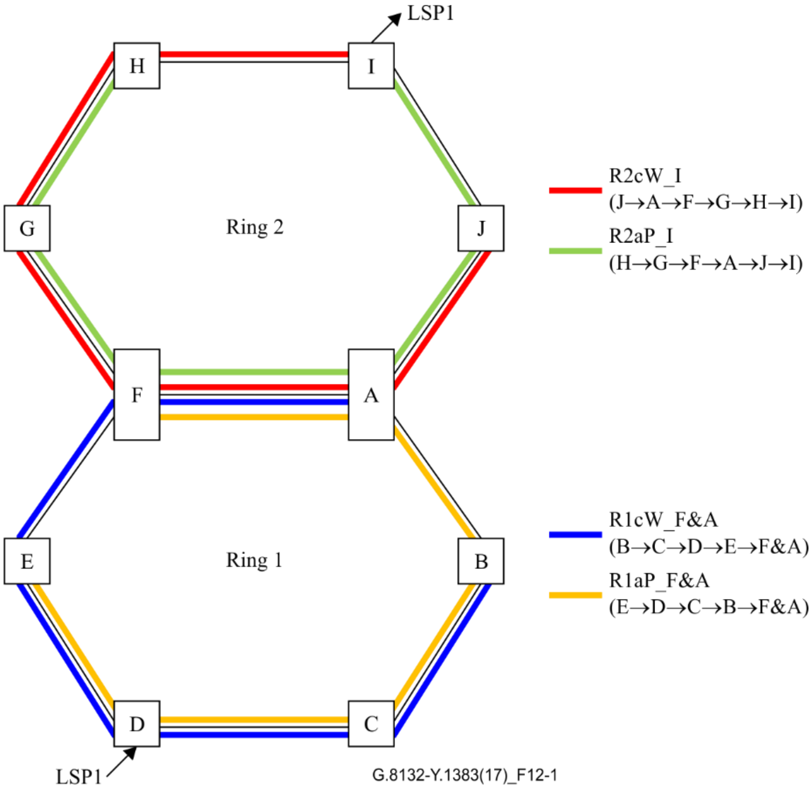

Figure 12-1 – Ring tunnels for dual-node interconnected rings (short wrapping)

12.1 Interconnection node

Forwarding actions in an interconnection node can be modelled as a concatenation of the functional model for the egress node and the functional model for the ingress node. The former is associated with forwarding actions in the ring through which normal traffic exits and the latter is associated with forwarding actions in the ring through which normal traffic enters. Figure 12-2 shows the functional model for the interconnection node F in Figure 12-1. Since two interconnection nodes F and A belong to both Ring 1 and Ring 2, the interconnection node A becomes an adjacent node for the interconnection node F in both rings.

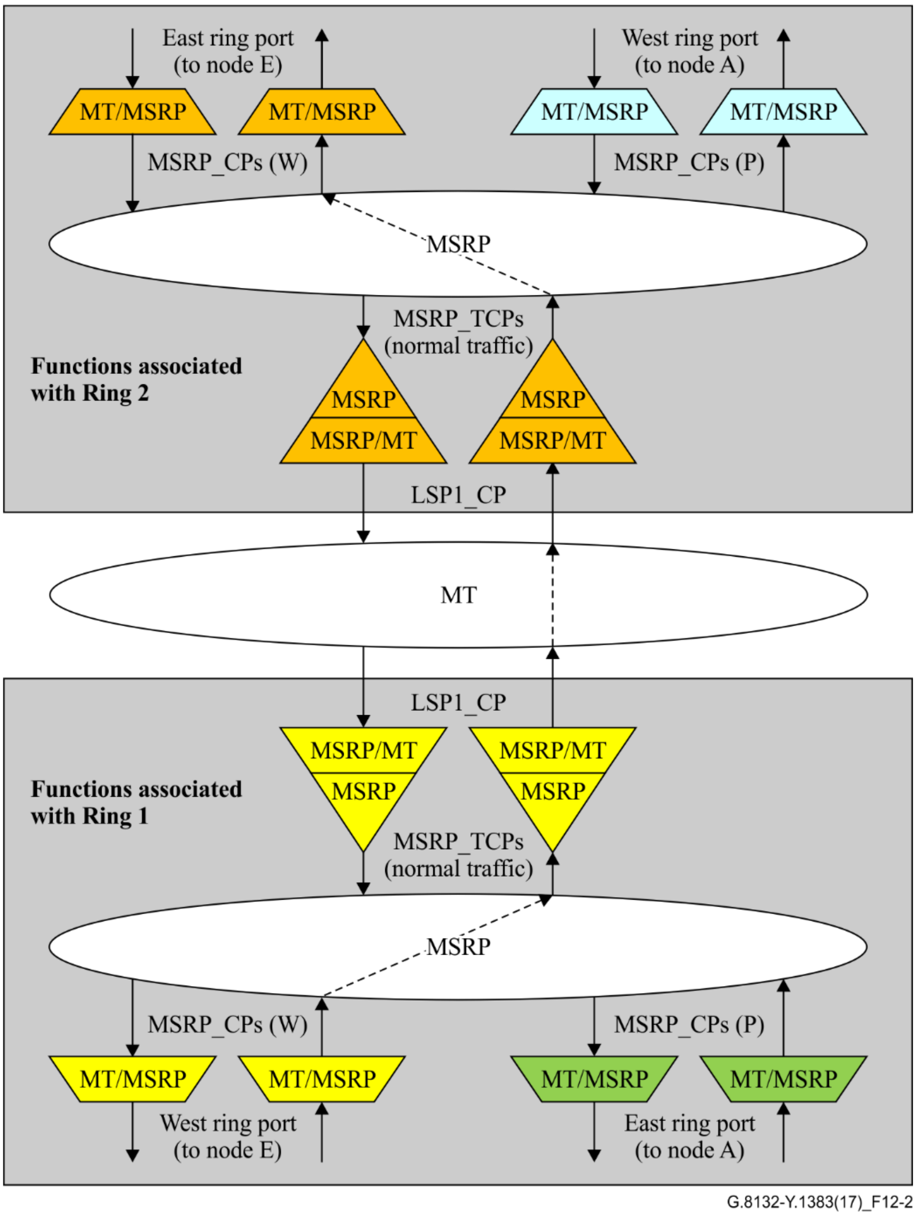

Figure 12-2 – Functional model of interconnection node (node F)

When the interconnection node F receives packets through the West ring port connected to node E in Ring 1, the ring tunnel label [R1cW_F&A(F)] is popped:

– The yellow MT/MSRP_A_Sk function, on the West ring port of Ring 1, is configured to send the packets received with the top label [R1cW_F&A(F)] to the MSRP_CP (W) associated with the R1cW_F&A ring tunnel.

– In normal conditions, the MSRP_C associated with Ring 1 is configured to forward the traffic units received from the MSRP_CP (W) associated with the R1cW_F&A ring tunnel on the yellow MT/MSRP_A_Sk (West ring port of Ring 1) to the MSRP_TCP associated with R1cW_F&A_W normal traffic on the yellow MSRP_TT_Sk (West ring port of Ring 1).

After the label pop operation, the label value of MPLS packets of LSP1 [LSP1(F&A)] is swapped to the label value [LSP1(I)] which is assigned by the next hop on Ring 2 from the MT LSP sub-layer's perspective, i.e., node I:

– The yellow MSRP/MT_A_Sk function on the West ring port of Ring 1 is configured to send the traffic unit received from the yellow MSRP_TT_Sk (West ring port of Ring 1) with the label value [LSP1(F&A)] to the MT_CP associated with LSP1.

– The MT_C atomic function is configured to forward the traffic from the MT_CP associated to LSP1 on the yellow MSRP/MT_A_Sk function (West ring port of Ring 1), to the MT_CP associated to LSP1 on the orange MSRP/MT_A_So (East ring port of Ring 2).
– The orange MSRP/MT_A_So function is configured to assign the label value [LSP1(I)] to the traffic units received from the MT_CP associated with LSP1.

After the label swap operation, the ring tunnel label [R2cW_I(G)] for Ring 2 is pushed:

– The orange MSRP/MT_A_So is configured to send the traffic units received from the MT_CP associated with LSP1, through the orange MSRP_TT_So, to the MSRP_TCP associated with the R2cW_I normal traffic.
– In normal conditions, the MSRP_C associated with Ring 2 is configured to forward the traffic units from the MSRP_TCP associated with the R2cW_I normal traffic to the MSRP_CP (W) associated with the R2cW_I ring tunnel on the orange MT/MSRP_A_So (East ring port of Ring 2).
– The orange MT/MSRP_A_So function, on the East ring port of Ring 2, is configured to assign the label value [R2cW_I(G)] to the traffic units received from the MSRP_CP (W) associated with the RcW_D ring tunnel.

13 Failure detection

The MPLS-TP section layer OAM is used to monitor the connectivity between two adjacent nodes on the ring using the mechanisms defined in [IETF RFC 6371].

How defect conditions on each MPLS-TP section are detected is the subject of [ITU-T G.8121]. For the purpose of the MSRP switching process, a span within the ring has a condition of OK or failed (SF).

SF is declared when the MPLS-TP trail termination sink (MT_TT_Sk) function of an MPLS-TP section maintenance entity point (MEP) detects a trail signal fail as defined in [ITU-T G.8121].

A node failure is regarded as the failure of two links attached to that node. The two nodes adjacent to the failed node detect the failure in the links that are connected to the failed node.

Hold-off timers, as defined in clause 14 of [ITU-T G.808.2] and in clause 4.9 of [IETF RFC 6372], are used to coordinate protection switching actions in the case of nested protection.

The hold-off timer is provisionable. The suggested range of the hold-off timer is 0 s to 10 s in steps of 100 ms.

14 Ring protection switch protocol

The MSRP protection operations are controlled by the RPS protocol as described in clause 5.2 of [IETF RFC 8227].

14.1 Transmission and acceptance of ring protection switch requests

RPS request messages are transmitted as described in clause 5.2.1 of [IETF RFC 8227].

14.2 RPS PDU format

The format of RPS PDU is as described in clause 5.2.2 of [IETF RFC 8227].

14.3 Ring node ring protection switch state

The definition and detailed specification of the RPS states a ring node can enter are as described in clause 5.2.3 of [IETF RFC 8227].

14.4 Ring protection switch state transition

The rules of RPS state transition are as described in clause 5.2.4 of [IETF RFC 8227].

15 Misconnection avoidance

MSRP requires that the "label distribution policy" assigns a unique label value per path, in such a way that it avoids different LSPs and Ring Tunnels to access the protection resource (even in transient phases) with the same label. A unique label per path is sufficient to prevent misconnections without the need to other mechanisms like squelching described in clause 22.1 of [ITU-T G.808.2].

16 Ring protection switch initiation criteria

16.1 Administrative commands

Administrative commands, which can be initiated by the network operator, are described in clause 5.3.1.1 of [IETF RFC 8227].

16.2 Automatically initiated commands

Automatically initiated commands, which can be initiated based on the MPLS-TP section layer OAM indication and the received switch requests, are described in clause 5.3.1.2 of [IETF RFC 8227].

Annex A

State transition tables of protection switching

(This annex forms an integral part of this Recommendation.)

RPS state machines are defined in clause 5.3 of [IETF RFC 8227]: clause 5.3.3 defines the state transitions triggered by local requests; clause 5.3.4 defines the state transitions triggered by remote RPS requests addressed to the node; and clause 5.3.5 defines the state transitions triggered by remote RPS requests addressed to a different node.

In order to avoid potential mistakes in duplicating the state transition tables from [IETF RFC 8227], the tables are omitted in this Recommendation.

Annex B

Bandwidth sharing

(This annex forms an integral part of this Recommendation.)

The bandwidth on each physical link along the ring of a given MSRP instance can be shared with other MSRP instances as well as with non-MSRP traffic (i.e., traffic that does not belong to any MSRP instance). For a given MSRP instance, part of the physical link capacity is used by the working traffic and part is used by the protection traffic, in the case of protection switching requests on that MSRP instance.

Both committed information rate (CIR) and excess information rate (EIR) traffic types can share the bandwidth using normal MPLS-TP quality of service techniques. In order to guarantee CIR traffic types on each physical link along the ring of a given MSRP instance, part of the physical link capacity is allocated to the working traffic, part is allocated to the protection traffic and part is allocated to the other traffic that does not belong to that MSRP instance.

NUT, as defined in [ITU-T G.808.2], is not required for MSRP. The traffic sharing the bandwidth on each physical link along the ring of a given MSRP instance, not belonging to that MSRP instance, will neither be pre-empted nor protected by that MSRP instance. Such traffic can be either unprotected or protected by other MSRP instances, or other survivability mechanisms. Therefore, there is no need to increase the complexity of the MPLS-TP ring protection mechanism to support NUT.

Extra traffic, as defined in [ITU-T G.808.2], is not required for MSRP. The link capacity allocated, but not used, by protection traffic can be used by the EIR traffic type. Therefore, there is no need to increase the complexity of the MPLS-TP ring protection mechanism. Further considerations concerning extra traffic for MPLS-TP are also provided in clause 4.3.3 of [IETF RFC 6372].

Appendix I

Wrapping and steering examples

(This appendix does not form an integral part of this Recommendation.)

I.1 Wrapping

Operational examples of the wrapping mechanism are shown in clause 4.3.1 of [IETF RFC 8227].

I.2 Short wrapping

Operational examples of the short wrapping mechanism are shown in clause 4.3.2 of [IETF RFC 8227].

I.3 Steering

Operational examples of the steering mechanism are shown in clause 4.3.3 of [IETF RFC 8227].

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