       **Updates to MPLS Transport Profile (MPLS-TP) Linear Protection in
                Automatic Protection Switching (APS) Mode
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Abstract

   This document contains updates to MPLS Transport Profile (MPLS-TP)
   linear protection in Automatic Protection Switching (APS) mode
   defined in RFC 7271. The updates provide rules related to the
   initialization of the Protection State Coordination (PSC) Control
   Logic, in which the state machine resides, when operating in APS
   mode.

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1. Introduction

MPLS Transport Profile (MPLS-TP) linear protection in Automatic
Protection Switching (APS) mode is defined in RFC 7271 [RFC7271]. It
defines a set of alternate and additional mechanisms to perform some
of the functions of linear protection described in RFC 6378
[RFC6378]. The actions performed at initialization of the Protection
State Coordination (PSC) Control Logic are not described in either
[RFC7271] or [RFC6378]. Although it is a common perception that the
state machine starts at the Normal state, this is not explicitly
specified in any of the documents and various questions have been
raised by implementers and in discussions on the MPLS working group
mailing list concerning the detailed actions that the PSC Control
Logic should take.

The state machine described in [RFC7271] operates under the
assumption that both end nodes of a linear protection domain start in
the Normal state. In the case that one node reboots while the other
node is still in operation, various scenarios may arise resulting in
problematic situations. This document resolves all the problematic
cases and minimizes traffic disruptions related to initialization
including both cold and warm reboots that require re-initialization
of the PSC Control Logic.

This document contains updates to the MPLS-TP linear protection in
APS mode defined in [RFC7271]. The updates provide rules related to
initialization of the PSC Control Logic, in which the state machine
resides, when operating in APS mode. The updates also include
modifications to the state transition table defined in Section 11.2
of [RFC7271]. The changes in the state transition table have been
examined to make sure that they do not introduce any new problems.

This document does not introduce backward compatibility issues with
implementations of [RFC7271]. In case a node implementing this
document restarts, the new state changes will not cause problems at
the remote node implementing [RFC7271] and the two ends will converge
to the same local and remote states. In case a node implementing
[RFC7271] restarts, the two ends behave as today.

The reader of this document is assumed to be familiar with [RFC7271].

2. Conventions Used in This Document

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
"SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this
document are to be interpreted as described in RFC 2119 [RFC2119].

3. Acronyms

This document uses the following acronyms:

```
APS      Automatic Protection Switching
DNR      Do-not-Revert
E::R     Exercise state due to remote EXER message
EXER     Exercise
MS-P     Manual Switch to Protection path
MS-W     Manual Switch to Working path
MPLS-TP  MPLS Transport Profile
N        Normal state
NR       No Request
PF:DW:R  Protecting Failure state due to remote SD-W message
PF:W:L   Protecting Failure state due to local SF-W
PF:W:R   Protecting Failure state due to remote SF-W message
PSC      Protection State Coordination
RR       Reverse Request
SD       Signal Degrade
SF-P     Signal Fail on Protection path
SF-W     Signal Fail on Working path
UA:P:L   Unavailable state due to local SF-P
WTR      Wait-to-Restore
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4. Updates

This document updates [RFC7271] by specifying the actions that will
be performed at the initialization of the PSC Control Logic and
modifies the state transition table defined in Section 11.2 of
[RFC7271].

4.1. Initialization Behavior

This section defines initialization behavior that is not described in
[RFC7271].

When the PSC Control Logic is initialized, the following actions MUST
be performed:

o Stop the WTR timer if it is running.

o Clear any operator command in the Local Request Logic.

o If an SF-W or SF-P exists as the highest local request, the node
   being initialized starts at the PF:W:L or UA:P:L state,
   respectively.

o If the node being initialized has no local request:

   * If the node being initialized does not remember the active path
      or if the node being initialized remembers the working path as
      the active path, the node starts at the Normal state.

   * Else (the node being initialized remembers the protection path
      as the active path), the node starts at the WTR state sending
      NR(0,1) or at the DNR state sending DNR(0,1) depending on the
      configuration that allows or prevents automatic reversion to
      the Normal state.

o In case any local SD exists, the local SD MUST be considered as an
   input to the Local Request Logic only after the local node has
   received the first protocol message from the remote node and
   completed the processing (i.e., updated the PSC Control Logic and
   decided which action, if any, to be sent to the PSC Message
   Generator).

o If the local node receives an EXER message as the first protocol
   message after initialization and the remote EXER becomes the top-
   priority global request, the local node MUST set the position of
   the bridge and selector according to the Path value in the EXER
   message and transit to the E::R state.

Remembering the active path in case of no local request minimizes
traffic switchovers in cases where the remote node is still in
operation. This approach does not cause a problem even if the
remembered active path is no longer valid due to any local input that
occurred at the remote node while the initializing node was out of
operation.

It is worth noting that in some restart scenarios (e.g., cold
rebooting) no valid SF/SD indications may be present at the input of
the Local Request logic. In this case, the PSC Control Logic would
restart as if no local requests are present. If a valid SF/SD
indication is detected later, this would be notified to the PSC
Control Logic and trigger state change.

4.2. State Transition Modification

In addition to the initialization behavior described in Section 4.1,
four cells of the remote state transition table need to be changed to
make two end nodes converge after initialization. State transition
by remote message defined in Section 11.2 of [RFC7271] is modified as
follows (only modified cells are shown):

	MS-W	MS-P	WTR	EXER	RR	DNR	NR
N			(13)			DNR	
PF:W:R						DNR	
PF:DW:R						DNR	

The changes in two rows of remote protecting failure states lead to
the replacement of note (10) with DNR, therefore note (10) is no
longer needed. The resultant three rows read:

	MS-W	MS-P	WTR	EXER	RR	DNR	NR
N	SA:MW:R	SA:MP:R	(13)	E::R	i	DNR	i
PF:W:R	SA:MW:R	SA:MP:R	(9)	E::R	i	DNR	(11)
PF:DW:R	SA:MW:R	SA:MP:R	(9)	E::R	i	DNR	(11)

5. Security Considerations

No specific security issue is raised in addition to those ones
already documented in [RFC7271]. It may be noted that tightening the
description of initializing behavior may help to protect networks
from re-start attacks.

6. IANA Considerations

This document makes no request of IANA.

Note to RFC Editor: this section may be removed on publication as an RFC.

7. Acknowledgements

The authors would like to thank Joaquim Serra for bringing up the issue related to initialization of the PSC Control Logic at the very beginning. The authors would also like to thank Adrian Farrel for his valuable comments and suggestions on this document.

8. References

8.1. Normative References

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