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Enhanced path segment monitoring
draft-ietf-mpls-tp-temporal-hitless-psm-09.txt

Abstract

The MPLS transport profile (MPLS-TP) has been standardized to enable carrier-grade packet transport and to complement converged packet network deployments. The most attractive features of MPLS-TP are the OAM functions. These functions enable maintenance tools that may be exploited by network operators and service providers for fault location, survivability, performance monitoring, in-service and out-of-service measurements.

One of the most important mechanisms that is common for transport network operation is fault localisation. A segment monitoring function of a transport path is effective in terms of extension of the maintenance work and indispensable, particularly when the OAM function is activated only between end points. However, the current approach defined for MPLS-TP of segment monitoring has some drawbacks. This document elaborates on the problem statement for the Sub-path Maintenance Elements (SPMEs) which provide monitoring of a segment of a set of transport paths (LSPs or MS-PWs). Based on the identified problems, this document provides considerations for the specification of new requirements to consider a new improved mechanism for hitless transport path segment monitoring to be named Enhanced Path Segment Monitoring (EPSM).

Status of This Memo

Table of Contents

1. Introduction

A packet transport network enables carriers and service providers to use network resources efficiently. It reduces operational complexity and provides carrier-grade network operation. Appropriate maintenance functions that support fault location, survivability, pro-active performance monitoring, pre-service and in-service measurements, are essential to ensure the quality of service and the reliability of a network. They are essential in transport networks and have evolved along with PDH, ATM, SDH and OTN.

Similar to legacy technologies, MPLS-TP also does not scale when an arbitrary number of OAM functions is enabled.

According to the MPLS-TP OAM requirements RFC 5860 [RFC5860], mechanisms MUST be available for alerting a service provider of a fault or defect that affects their services. In addition, to ensure that faults or service degradation can be localized, operators need a function to diagnose the detected problem. Using end-to-end monitoring for this purpose is insufficient. In fact by using end-to-end OAM monitoring, an operator will not be able to localize a fault or service degradation accurately.

Thus, a dedicated segment monitoring function that can focus on a specific segment of a transport path and can provide a detailed analysis is indispensable to promptly and accurately localize the fault.

For MPLS-TP, a path segment monitoring function has been defined to perform this task. However, as noted in the MPLS-TP OAM Framework RFC 6371 [RFC6371], the current method for segment monitoring of a transport path has implications that hinder the usage in an operator network.

This document elaborates on the problem statement for the path segment monitoring function and proposes to consider a new improved method for segment monitoring, following up the description in RFC 6371 [RFC6371]. This document also provides additional detailed requirements for a new temporary and hitless segment monitoring function which is not covered in RFC 6371 [RFC6371].

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].

2.1. Terminology

ATM - Asynchronous Transfer Mode

EPSM - Enhanced Path Segment Monitoring

LSP - Label Switched Path

LSR - Label Switching Router

ME - Maintenance Entity

MEG - Maintenance Entity Group

MEP - Maintenance Entity Group End Point

MIP - Maintenance Entity Group Intermediate Point

OTN - Optical Transport Network

PDH - Plesiochronous Digital Hierarchy

PST - Path Segment Tunnel

TCM - Tandem connection monitoring

SDH - Synchronous Digital Hierarchy

SPME - Sub-path Maintenance Element

2.2. Definitions

None.

3. Network objectives for segment monitoring

There are two network objectives for MPLS-TP segment monitoring described in section 3.8 of RFC 6371 [RFC6371]:

1. The monitoring and maintenance of current transport paths has to be conducted in-service without traffic disruption.

2. Segment monitoring must not modify the forwarding of the segment portion of the transport path.

4. Problem Statement

The Sub-Path Maintenance Element (SPME) function is defined in RFC 5921 [RFC5921]. It is used to monitor, protect, and/or manage segments of transport paths, such as LSPs in MPLS-TP networks. The SPME is defined between the edges of the segment of a transport path that needs to be monitored, protected, or managed. This SPME is created by stacking the shim header (MPLS header) according to RFC 3031 [RFC3031] and is defined as the segment where the header is stacked. OAM messages can be initiated at the edge of the SPME and sent to the peer edge of the SPME or to a MIP along the SPME by setting the TTL value of the label stack entry (LSE) and interface identifier value at the corresponding hierarchical LSP level in case of a per-node model.

This method has the following drawbacks that impact the operation costs:

(P-1) It lowers the bandwidth efficiency.

(P-2) It increases network management complexity, because a new sublayer and new MEPs and MIPs have to be configured for the SPME.

Problem (P-1) is caused by the shim headers stacking that increases the overhead.

Problem (P-2) is related to an identifier management issue. In the case of label stacking the identification of each sub-layer is required for segment monitoring in a MPLS-TP network. When SPME is applied for on-demand OAM functions in MPLS-TP networks ~~in a similar manner as Tandem Connection Monitoring (TCM) in the Optical Transport Networks (OTN) and Ethernet transport networks~~, a rule for operationally differentiating those SPME~~/TCMs~~ will be required; at least within an administrative domain. This forces operators to create an additional permanent layer identification policy that will only be used for temporary path segment monitoring. Additionally, from the perspective of operation, increasing the number of managed addresses and managed layers is not desirable in view of keeping the transport networks as simple as possible. Reducing the number of managed identifiers and managed sub-layers should be the fundamental objective in designing the architecture.

The analogy for SPME in legacy transport networks is TCM, which is on-demand and does not affect the transport path.

Also, using the currently defined methods, temporary setting of SPMEs causes the following problems due to additional label stacking:

6-1

(P-3) The original condition of the transport path is affected by changing the length of MPLS frames and changing the value of exposed label.

(P-4) The client traffic over a transport path is disrupted when the SPME is configured on-demand.

Problem (P-3) impacts network objective (2) in Section 3. The monitoring function should monitor the status without changing any conditions of the targeted, to be monitored, segment or transport path. Changing the settings of the original shim header should not be allowed because this change corresponds to creating a new segment of the original transport path. And this differs from the original data plane conditions. When the conditions of the transport path change, the measured values or observed data will also change and this may make the monitoring meaningless because the result of the measurement would no longer reflect the performance of the connection where the original fault or degradation occurred.

Figure 1 shows an example of SPME settings. In the figure, "X" is the label value of the original transport path expected at the tail-end of node D. "210" and "220" are label values allocated for SPME. The label values of the original path are modified as well as the values of the stacked labels. As shown in Figure 1, SPME changes both the length of MPLS frames and the label value(s). This means that it is no longer monitoring the original transport path but it is monitoring a different path. In particular, performance monitoring measurements (e.g. Delay Measurement and Packet Loss Measurement) are sensitive to these changes.

6-2

```
      (Before SPME settings)
       ---     ---     ---     ---     ---
      |   |   |   |   |   |   |   |   |   |
      |   |   |   |   |   |   |   |   |   |
       ---     ---     ---     ---     ---
        A--100--B--110--C--120--D--130--E  <= transport path
       MEP                             MEP

      (After SPME settings)
       ---     ---     ---     ---     ---
      |   |   |   |   |   |   |   |   |   |
      |   |   |   |   |   |   |   |   |   |
       ---     ---     ---     ---     ---
        A--100--B-----------X---D--130--E  <= transport path
       MEP     \                  /    MEP
                --210--C--220--            <= SPME
               MEP'          MEP'
```

Figure 1: An Example of a SPME settings

Problem (P-4) can be avoided if the operator sets SPMEs in advance and maintains it until the end of life of a transport path, which is neither temporary nor on-demand. Furthermore SMPEs cannot be set arbitrarily because overlapping of path segments is limited to nesting relationships. As a result, possible SPME configurations of segments of an original transport path are limited due to the characteristic of SPME shown in Figure 1, even if SPMEs are pre-configured.

Although the make-before-break procedure in the survivability document RFC 6372 [RFC6372] seemingly supports the hitless configuration for monitoring according to the framework document RFC 5921 [RFC5921], the reality is that configuration of an SPME is impossible without violating network objective (2) in Section 3. These concerns are described in section 3.8 of RFC 6371 [RFC6371].

Additionally, the make-before-break approach might not be usable in the static model without a control plane. This is because the make-before-break is a restoration function based on a control plane. Consequently the management systems should support SPME creation and coordinated traffic switching from original transport path to the SPME.

Other potential risks are also envisaged. Setting up a temporary SPME will result in the LSRs within the monitoring segment only looking at the added (stacked) labels and not at the labels of the original LSP. This means that problems stemming from incorrect (or unexpected) treatment of labels of the original LSP by the nodes within the monitored segment can not be identified when setting up SPME. This might include hardware problems during label look-up, mis-configuration, etc. Therefore operators have to pay extra attention to correctly setting and checking the label values of the original LSP in the configuration. Of course, the reverse of this situation is also possible, e.g., an incorrect or unexpected treatment of SPME labels can result in false detection of a fault where no problem existed originally.

The utilisation of SPMEs is basically limited to inter-carrier or inter-domain segment monitoring where they are typically pre-configured or pre-instantiated. SPME instantiates a hierarchical transport path (introducing MPLS label stacking) through which OAM packets can be sent. The SPME monitoring function is mainly important for protecting bundles of transport paths and carriers' carrier solutions within one administrative domain.

To summarize: the problem statement is that the current sub-path maintenance based on a hierarchical LSP (SPME) is problematic for pre-configuration in terms of increasing the bandwidth by label stacking and increasing the number of managing objects by layer stacking and address management. An on-demand/temporary configuration of SPME is one of the possible approaches for minimizing the impact of these issues. However, the current procedure is unfavorable because the temporary configuration for monitoring can change the condition of the original monitored transport path. To avoid or minimize the impact of the drawbacks discussed above, a more efficient approach is required for the operation of an MPLS-TP transport network. A monitoring mechanism, named on-demand Enhanced Path Segment Monitoring (EPSM), supporting temporary and hitless path segment monitoring is proposed.

5. OAM functions supported in segment monitoring

OAM functions that may usefully be exploited across on-demand EPSM are basically the on-demand performance monitoring functions which are defined in OAM framework document RFC 6371 [RFC6371]. Segment performance monitoring is used to verify the performance and hence the status of transport path segments. The "on-demand" attribute is generally temporary for maintenance operation.

Packet Loss and Packet Delay measurement are OAM functions strongly required in hitless and temporary segment monitoring because these functions are normally only supported at the end points of a transport path. If a defect occurs, it might be quite hard to locate the defect or degradation point without using the segment monitoring function. If an operator cannot locate or narrow down the cause of the fault, it is quite difficult to take prompt actions to solve the problem.

Other on-demand monitoring functions, (e.g. Delay Variation measurement) are desirable but not as necessary as the functions mentioned above.

Regarding out-of-service on-demand performance management functions (e.g. Throughput measurement) there seems no need for EPSM. However, OAM functions specifically designed for segment monitoring should be developed to satisfy network objective (2) described in Section 3.

Finally, the solution for EPSM has to cover both the per-node model and the per-interface model as specified in RFC 6371 [RFC6371].

6. Requirements for enhanced segment monitoring

In the following sections, mandatory (M) and optional (O) requirements for the enhanced segment monitoring function are listed.

6.1. Non-intrusive segment monitoring

One of the major problems of legacy SPME highlighted in section 4 is that it may not monitor the original transport path and it could distrupt service traffic when set-up on demand.

(M1) EPSM must not change the original condition of transport path (e.g. must not change the length of MPLS frames, the exposed label values, etc.)

(M2) EPSM must be provisioned on-demand without traffic disruption.

6.2. Single and multiple level monitoring

The new enhanced segment monitoring function is supposed to be applied mainly for on-demand diagnostic purposes. We can differentiate this monitoring from the existing proactive segment monitoring by referring to ~~is~~ as on-demand multi-level monitoring. Currently the most serious problem is that there is no way to locate the degraded segment of a path without changing the conditions of the original path. Therefore, as a first step, single layer segment monitoring, not affecting the monitored path, is required for a new on-demand and hitless segment monitoring function. A combination of multi-level and simultaneous segment monitoring is the most powerful tool for accurately diagnosing the performance of a transport path. However, in the field, a single level approach may be enough.

(M3) Single-level segment monitoring is required

(O1) Multi-level segment monitoring is desirable

Figure 2 shows an example of multi-level on-demand segment monitoring.

```
      ---     ---     ---     ---     ---
     |   |   |   |   |   |   |   |   |   |
     | A |   | B |   | C |   | D |   | E |
      ---     ---     ---     ---     ---
      MEP                             MEP <= ME of a transport path
              *-----------------*         <=On-demand segm. mon. level 1
                *-------------*           <=On-demand segm. mon. level 2
                      *-*                 <=On-demand segm. mon. level 3
```

Figure 2: Example of multi-level on-demand segment monitoring

6.3. EPSM and end-to-end proactive monitoring independence

The need for simultaneously using existing end-to-end proactive monitoring and the enhanced on-demand path segment monitoring is considered. Normally, the on-demand path segment monitoring is configured on a segment of a maintenance entity of a transport path. In such an environment, on-demand single-level monitoring should be performed without disrupting the pro-active monitoring of the targeted end-to-end transport path to avoid affecting user traffic performance monitoring.

Therefore:

(M4) EPSM shall be configured without changing or interfering with the already in place end-to-end pro-active monitoring of the transport path.

```
      ---     ---     ---     ---     ---
     |   |   |   |   |   |   |   |   |   |
     | A |   | B |   | C |   | D |   | E |
      ---     ---     ---     ---     ---
      MEP                             MEP <= ME of a transport path
        +-----------------------------+   <= Pro-active end-to-end mon.
              *------------------*        <= On-demand segment mon.
```

Figure 3: Independency between proactive end-to-end monitoring and on-demand segment monitoring

6.4. Arbitrary segment monitoring

The main objective for enhanced on-demand segment monitoring is to diagnose the fault locations. A possible realistic diagnostic procedure is to fix one end point of a segment at the MEP of the transport path under observation and change progressively the length of the segments. This example is shown in Figure 4.

```
        ---     ---     ---     ---     ---
       |   |   |   |   |   |   |   |   |   |
       | A |   | B |   | C |   | D |   | E |
        ---     ---     ---     ---     ---
        MEP                             MEP <= ME of a transport path
          +-----------------------------+   <= Pro-active end-to-end mon.
          *-----*                           <= 1st on-demand segment mon.
          *-------*                         <= 2nd on-demand segment mon.
          *------------*                    <= 3rd on-demand segment mon.
               |                               |
               |                               |
          *-----------------------*         <= 6th on-demand segment mon.
          *-----------------------------*   <= 7th on-demand segment mon.
```

Figure 4: A procedure to localize a defect by consecutive on-demand segment monitoring

Another possible scenario is depicted in Figure 5. In this case, the operator wants to diagnose a transport path starting at a transit node, because the end nodes(A and E) are located at customer sites and consist of cost effective small boxes supporting only a subset of OAM functions. In this case, where the source entities of the diagnostic packets are limited to the position of MEPs, on-demand segment monitoring will be ineffective because not all the segments can be diagnosed (e.g. segment monitoring 3 in Figure 5 is not available and it is not possible to determine the fault location exactly).

Therefore:

(M5) it shall be possible to provision EPSM on an arbitrary segment of a transport path and diagnostic packets should be inserted/terminated at any of intermediate maintenance points of the original ME.

```
             ---     ---     ---
      ---    |   |   |   |   |   |    ---
     | A |   | B |   | C |   | D |   | E |
      ---     ---     ---     ---     ---
      MEP                             MEP <= ME of a transport path
        +----------------------------+   <= Pro-active end-to-end mon.
        *-----*                          <= On-demand segment mon. 1
              *-----------------------*  <= On-demand segment mon. 2
              *---------*                <= On-demand segment mon. 3
```

Figure 5: ESPM configured at arbitrary segments

6.5. Fault while EPSM is operational

Node or link failures may occur while EPSM is active. In this case, if no resiliency mechanism is set-up on the subtended transport path, there is no particular requirement for the EPSM function. If the transport path is protected, the EPSM function should be terminated to avoid monitoring a new segment when a protection or restoration path is active.

Therefore:

(M6) the EPSM function should avoid monitoring an unintended segment when one or more failures occur

The following examples are provided for clarification only and they are not intended to restrict any solution for meeting the requirements of EPSM.

Protection scenario A is shown in figure 6. In this scenario a working LSP and a protection LSP are set-up. EPSM is activated between nodes A and E. When a fault occurs between nodes B and C, the operation of EPSM is not affected by the protection switch and continues on the active LSP path. As a result requirement (M6) is satisfied.

```
      A - B - C - D - E - F
        \               /
          G - H - I - L

      Where:
      - end-to-end LSP: A-B-C-D-E-F
      - working LSP:    A-B-C-D-E-F
      - protection LSP: A-B-G-H-I-L-F
      - EPSM:           A-E
```

Figure 6: Protection scenario A

Protection scenario B is shown in figure 7. The difference with scenario A is that only a portion of the transport path is protected. In this case, when a fault occurs between nodes B and C on the working sub-path B-C-D, traffic will be switched to protection sub-path B-G-H-D. Assuming that OAM packet termination depends only on the TTL value of the MPLS label header, the target node of the EPSM changes from E to D due to the difference of hop counts between the working path route (A-B-C-D-E: 4 hops) and protection path route (A-B-G-H-D-E: 5 hops). As a result requirement (M6) is not satisfied.

```
          A - B - C - D - E - F
                \     /
                 G - H

      - end-to-end LSP:      A-B-C-D-E-F
      - working sub-path:    B-C-D
      - protection sub-path: B-G-H-D
      - EPSM:                A-E
```

Figure 7: Protection scenario B

6.6. EPSM maintenance points

An intermediate maintenance point supporting the EPSM function has to be able to generate and inject OAM packets. However, maintenance points for the EPSM do not necessarily have to coincide with MIPs or MEPs defined in the architecture.

Therefore:

(M7) The same identifiers for MIPs and/or MEPs should be applied to EPSM maintenance points

7. Summary

An enhanced path segment monitoring (EPSM) mechanism is required to provide temporary and hitless segment monitoring. It shall meet the two network objectives described in section 3.8 of RFC 6371 [RFC6371] and repeated in Section 3 of this document.

The enhancements should minimize the problems described in Section 4, i.e., (P-1), (P-2), (P-3) and (P-4).

The solution for the temporary and hitless segment monitoring has to cover both the per-node model and the per-interface model specified in RFC 6371 [RFC6371].

The temporary and hitless segment monitoring solutions shall support on-demand Packet Loss Measurement and Packet Delay Measurement functions and optionally other performance monitoring and fault management functions (e.g. Throughput measurement, Delay variation measurement, Diagnostic test, etc.).

8. Security Considerations

The security considerations defined for RFC 6378 apply to this document as well. As this is simply a re-use of RFC 6378, there are no new security considerations.

9. IANA Considerations

There are no requests for IANA actions in this document.

Note to the RFC Editor - this section can be removed before publication.

10. Acknowledgements

The author would like to thank all members (including MPLS-TP steering committee, the Joint Working Team, the MPLS-TP Ad Hoc Group in ITU-T) involved in the definition and specification of MPLS Transport Profile.

The authors would also like to thank Alexander Vainshtein, Dave Allan, Fei Zhang, Huub van Helvoort, Malcolm Betts, Italo Busi, Maarten Vissers, Jia He and Nurit Sprecher for their comments and enhancements to the text.

11. References

11.1. Normative References

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11.2. Informative References

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[RFC6372] Sprecher, N., Ed. and A. Farrel, Ed., "MPLS Transport Profile (MPLS-TP) Survivability Framework", RFC 6372, DOI 10.17487/RFC6372, September 2011, <http://www.rfc-editor.org/info/rfc6372>.

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1-1 Feb 27, 2016, 06:13, Dave Sinicrope

Abstract, P1: "The most attractive"... This is a subjective statement. The rationalization for MPLS-TP was to provide a simplified profile if MPLS with less IP dependency for packet transport use. Change "the most attractive" to "Key".

Tag G1 - In general tone down an/or drop the subjective and promotional language. This will also shorten the abstract and document. This comment applies to several places thought the text.

1-2 Feb 27, 2016, 06:04, Dave Sinicrope

Abstract P2: this document provides... - in providing this these are new requirements for MPLS-TP. The original requirements were done in concert with the ITU-T. Changes to those requirements should also involved the ITU-T.

1-3 Feb 27, 2016, 06:04, Dave Sinicrope

Abstract, P2: MS-PW -to the best of my knowledge MS-PWs are not part of MPLS-TP.

1-4 Feb 27, 2016, 06:04, Dave Sinicrope

Abstract, P2, last sentence: This sentence, which highlights the purpose of the document, is unclear. It talks about providing "... considerations for the specification of new requirements to consider a new improved mechanism ..." I suspect the document is providing new requirements but hard to tell with the considerations. .Please clarify in the document body what the purpose of this document is and briefly summarize the purpose Int the abstract.

1-5 Mar 6, 2016, 19:45, Dave Sinicrope

Gen: I have read the AD comments sent on Feb 26. I agree with all comments. I will not repeat them here for the sake of clarity and expediency.

Gen: in one with the AD comments the term temporal or temporary is causing confusion. On-demand seems a better choice.

Gen: same issue with "hitless". I'm assuming you mean no traffic impact or performance degradation. If not please clarify. If so please consider a term change.

Gen: I'm note sure what this doc is trying to do. It's self described as considerations for specification of new requirements. So is it a requirements spec? Or a start to a requirements spec? It makes reference to the MPLS-TP OAM requirements but indicates they are faulty or insufficient. It seems that this would better be framed as a proposed update to the existing requirements pointing out deficiencies.

Gen: the document asserts tree are issues with the existing MPLS-TP requirements. Those requirements were developed jointly with the ITU-T SG15. I would assume any shortcomings and/or alternative requirements should be conveyed to SG15 for comment and input.

3-1 Feb 27, 2016, 06:13, Dave Sinicrope

Introduction, first 2 paragraphs: These paragraphs don't introduce any more than the 3rd and distract from the point of the document. You can start with P3 and remove these two.

3-2 Mar 6, 2016, 17:03, Dave Sinicrope

Sec 1., Para 2, "Similar to ...": This statement needs clarification. I believe is that it is meant to convey that MPLS-TP OAM does scale when invoked a priori at each possible use point in the network. Let's leave the legacy tech out of the discussions.

3-3 Mar 6, 2016, 17:03, Dave Sinicrope

Sect 1, 3rd Para., 3rd sentence: change "in fact" to "in that" and make part of precious sentence.

3-4 Mar 6, 2016, 17:03, Dave Sinicrope
Sect 1, para 4: the existing, while not dedicated, can do this, why is another needed?

3-5 Mar 6, 2016, 17:03, Dave Sinicrope
Sect 1, para 6: need to find better terms than temporary and gutless and define them

4-1 Mar 6, 2016, 18:35, Dave Sinicrope
Sec 3: could be incorporated to section 4

5-1 Mar 6, 2016, 19:45, Dave Sinicrope
Sec 4, P-1: more explanation is needed here. A single extra label is negligible in bandwidth efficiency. However if these labels are added such that several segments are monitored at once or nested in their monitoring, this may impact bandwidth efficiency. If this is the case it should be spelled out. If not how is label stacking a significant impact?

RfC 5860 notes that an arbitrary label stack must be dealt with, implying label depth is not an issue.

5-2 Mar 6, 2016, 17:03, Dave Sinicrope
Sec 4, P-2: more explanation is needed here. Configuration of the MEPs, MIPs and sub layer is required regardless of mechanism. How is this a "problem" vs a necessary fact of implementing a network?

P-2 Nit: place this problem statement above its explanation.

5-3 Mar 6, 2016, 17:03, Dave Sinicrope
,

5-4 Mar 6, 2016, 17:03, Dave Sinicrope
an

5-5 Mar 6, 2016, 17:03, Dave Sinicrope
to administer

5-6 Mar 6, 2016, 17:03, Dave Sinicrope
<move to after point is made>

5-7 Mar 6, 2016, 17:03, Dave Sinicrope
Sec 4, para 6: I was under the impression that having the identification and addressing of the management/maintenance entities established a priori allowed:
1. Faster diagnosis of network problems in that establishing identification of monitoring and localization points was already done when a problem arose,
2. Allowed consistent reference points for predictable, repeated diagnostics and comparison.

5-8 Mar 6, 2016, 17:03, Dave Sinicrope
Sec 4, para 7: this pint is not clear and seemingly contradicts the statement in the paragraph above. Please elaborate on the comparison to TCM

5-9 Mar 6, 2016, 17:03, Dave Sinicrope
Sec 4, para 8: this contradicts the point in paragraph 6 noting problems setting them up permanently. If one doesn't want to establish them permanently or temporarily what is left?

6-1 Mar 6, 2016, 18:43, Dave Sinicrope
Sec 4, P-3: Nit: move description under problem statements

Sec 4 P-3 and P-4:

6-2 Mar 6, 2016, 19:45, Dave Sinicrope

Sec 4, para 12: refer to AD comments of Feb 26

7-1 Mar 6, 2016, 19:45, Dave Sinicrope

Sec 4, para 15: how is make before break limited to control plane? The observation concerning the management system contradicts this statement and could not be the case if the function was based on control plane.

8-1 Mar 6, 2016, 19:45, Dave Sinicrope

Sec 4, para 16: this point has already been made in P-4

8-2 Mar 6, 2016, 19:45, Dave Sinicrope

Sec 4, para 16: issues described here always need to be considered and aren't unique to OAM or these requirements. How is this relevant to these requirements?

8-3 Mar 6, 2016, 19:45, Dave Sinicrope

Sec 4, para 17: the assertion that SPMEs are limited to inter carrier is not supported. This may be an opinion of their practical value vs the asserted overhead of their a priori configuration, but it is not stated in this way. Consider restating this as an opinion.

8-4 Mar 6, 2016, 19:45, Dave Sinicrope

Sec 4, para 18: this alludes to a solution. Not appropriate in a Req document

9-1 Mar 6, 2016, 19:45, Dave Sinicrope

it

9-2 Mar 6, 2016, 19:45, Dave Sinicrope

Sec 6.2: multilevel is a req that has no aforementioned problem to be solved. Levels haven't entered into the discussion at all to this point. It should be removed from the text.

9-3 Mar 6, 2016, 19:45, Dave Sinicrope

Sec 6.1, M-2: why would the provisioning of ESPM change the traffic. Wouldn't it be the invocation of the function that needs to leave the traffic as is?

9-4 Mar 6, 2016, 19:45, Dave Sinicrope

Sc 6.1