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Stitching Dynamically and Statically Provisioned Segments To Construct End-To-End Multi-Segment Pseudowires
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Abstract

The MPLS Transport Profile (MPLS-TP) transport paths can be statically provisioned via a Network Management System (NMS) or dynamically provisioned via a control plane. The transport paths provided by MPLS-TP are used as a server layer for pseudowires carrying client signals other than IP or MPLS. It may be necessary to support MPLS-TP pseudowires, to extend across multiple domains.

This document outlines the requirements and solution for coordinating MPLS-TP transport paths and a multi-segment PWs that will traverse multiple domains, where some domains are statically provisioned, and other domains that are dynamically provisioned.

This document is a product of a joint Internet Engineering Task Force (IETF) / International Telecommunication Union Telecommunication Standardization Sector (ITU-T) effort to include an MPLS Transport Profile within the IETF MPLS and Pseudowire Emulation Edge-to-Edge (PWE3) architectures to support the capabilities and functionalities of a packet transport network as defined by the ITU-T.

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1. Introduction

The MPLS Transport Profile (MPLS-TP) is being defined in a joint effort between the International Telecommunications Union (ITU) and the IETF. The requirements for MPLS-TP are defined in the requirements document [RFC5654]. A general framework for MPLS-TP has been defined in [RFC5921].

An MPLS-TP network can be operated via static provisioning of transport paths, or the elective use of GMPLS control plane to support dynamic provisioning of transport paths. The MPLS-TP LSP control plane is based on GMPLS. The framework for MPLS-TP dynamic provisioning and is described in [MPLS-TP-CP].

The LSPs provided by MPLS-TP are used as a server layer for Pseudowires (PWs). The PWs are essential Communication Service Providers (CSP) as they are used to carry client signals other than IP or MPLS.

It may be necessary to extend the reach of an MPLS-TP transport path, and PWs, across multiple domains. A domain can be defined as a separate administrative, geographic, or switching environment within the CSP network. Additionally a domain can also be categorized as a separate AS or IGP area.

The MPLS-TP transport path would consist of two or more contiguous MPLS-TP and PW segments, each segment would traverse a single domain. The segments are concatenated so that they behave and function as a single MPLS-TP transport and PW path.

For these multi-segment transport and PW paths the intermediate segments, or domains, may be statically or dynamically provisioned. There may be a requirement to automatically set up transport path that will traverse multiple domains that are managed both statically and dynamically. There must therefore be some coordination between domains that are managed statically and dynamically to ensure the end-to-end MPLS-TP transport path and PW are successfully setup.

This document outlines the requirements and solution for coordinating MPLS-TP transport paths and PWs and that will traverse multiple domains, where some domains are statically provisioned, and other domains are dynamically provisioned.

This document is a product of a joint Internet Engineering Task Force (IETF) / International Telecommunications Union Telecommunications Standardization Sector (ITU-T) effort to include an MPLS Transport Profile within the IETF MPLS and PWE3 architectures to support the capabilities and functions of a packet transport network as defined by the ITU-T.

1.1 Statically Provisioned PWs across MPLS-TP

A PW is a mechanism that carries a native service over an emulated service from one PE to one or more other PEs over a PSN. [RFC3985], defines the signaling and encapsulation techniques for establishing Single-segment PW (SS-PWs) between a pair of terminating PEs.

1.2 Dynamically Provisioned PWs across MPLS-TP

[MS-PW-DYN] describes the procedure and extensions to dynamically place the segments of the Multi-segment Pseudowire (MS-PW) among a set of PE routers. The dynamic PW capability is based on the existing PW control plane [RFC4447], and the PW architecture [RFC3985].

1.3 Multi-Segment Pseudowire (MS-PW)

A set of two or more contiguous PW segments that behave and function as a single point-to-point PW, can be considered a MS-PW. The architecture for MS-PWs across multi-domain environments is described in [RFC5659].

The switching points (S-PEs), in addition to the terminating (T-PEs), are manually provisioned for each segment. They are configured to direct the MPLS packets from one PW into the other. There is no control protocol involved in this case.

Dynamic end-to-end signaling of MS-PWs is achieved by using information present in S-PEs to support the determination of the next PW signaling hop. This selection information is disseminated via inter-domain routing protocols (e.g. BGP).

[RFC6073] describes a procedure for connecting multiple pseudowires together where each domain is dynamically provisioned. This procedure requires each S-PE to be manually configured with the information required to terminate and initiate the Single-segment Pseudowire (SS-PW) part of the Multi-segment Pseudowire (MS-PW).

The issue exists when an end-to-end PW is requested across domains that are comprised of both statically and dynamically configured.

1.4 Multi-segment Pseudowire Path Selection

An important feature of the establishment of a multi-domain multi-segment pseudowires is the determination of the path of the pseudowire. That is, the selection of the LSP tunnels and PW switching points that the end-to-end PW will traverse.

Selecting this path can be an off-line management task using information gathered from a number of sources or pre-known by the management tools. Alternatively, the path can be selected dynamically using policy-based tools that operate on information gathered from the network in a manner similar to existing MPLS traffic engineering mechanisms, and using routing protocols.

However, in multi-domain environments there may be issues of confidentiality of network topology information. For example, one service provider may not wish to fully reveal the extent to which it supports cross-domain LSP tunnels, or where its internal PW stitching points are. These issues significantly complicate the mechanisms available for selecting end-to-end multi-segment pseudowire paths.

The Path Computation Element (PCE) [RFC4655] was developed to facilitate inter-domain path computation. The PCE uses topology and resource availability information to compute paths inside a domain. To support inter-domain path computation, PCEs responsible for different coordinate with each other to calculate end-to-end multi-domain paths.

Cooperating PCEs could be used to compute end-to-end MPLS-TP transport paths and the stitching points of PW segments. This document concentrates on the issues of signalling and not path determination. The method and procedure of how this may be achieved is not in scope of this document.

2. Terminology

MS-PW	Multi-segment Pseudowire
PW	Pseudowire
S-PE	Pseudowire Switching Provider Edge
SS-PW	Single-segment Pseudowire
T-PE	Pseudowire Terminating Provider Edge

Additional definitions and terminology can be found in [RFC5921] and [ROSETTA].

2.1 Requirements Language

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. Reference Model

The control plane reference model is based on the general MPLS-TP reference model as defined in the MPLS-TP framework [RFC5921]. Per the MPLS-TP framework [RFC5921], where relevant the MPLS-TP control plane is based on GMPLS with RSVP-TE for LSP signaling and targeted LDP for PW signaling [RFC6073].

```
           PSN1       PSN2       PSN3       PSN4
        +--------+ +--------+ +--------+ +--------+
        |        | |        | |        | |        |
        |        | |        | |        | |        |
    +-+ | +-+    +-+  +-+   +-+   +-+  +-+    +-+ | +-+
    |A|...|B|====|C|==|D|===|E|===|F|==|G|====|H|...|I|
    +-+ | +-+    +-+  +-+   +-+   +-+  +-+    +-+ | +-+
        | | |    | |        | |        | |    | | |
        | | |    | |        | |        | |    | | |
        +--------+ +--------+ +--------+ +--------+
          | |<PW>| |<--PW-->| |<--PW-->| |<PW>| |
          |                                     |
          |<-----Multi-Segment Pseudowire------>|
```

Figure 1: ABRs Acting as Pseudowire Switching Provider Edges

```
            PSN1         PSN2            PSN3
         +-------+    +---------+    +----------+
         |       |    |         |    |          |
         |       |    |         |    |          |
    +-+  | +-+  +-+  +-+  +-+  +-+  +-+     +-+ |  +-+
    |A|....|B|==|C|==|D|==|E|==|F|==|G|=====|H|....|I|
    +-+  | +-+  +-+  +-+  +-+  +-+  +-+     +-+ |  +-+
         | ||    |    |         |    |       || |
         | ||    |    |         |    |       || |
         +-------+    +---------+    +----------+
           ||<PW>|<PW>|<--PW--->|<PW>|<--PW->||
           |                                  |
           |<----Multi-Segment Pseudowire---->|
```

Figure 2: ASBRs Acting as Pseudowire Switching Provider Edges

A: Customer Edge
B: Pseudowire Terminating Provider Edge
C: Pseudowire Switching Provider Edge
D: Provider Router
E: Pseudowire Switching Provider Edge
F: Provider Router
G: Pseudowire Switching Provider Edge
H: Pseudowire Terminating Provider Edge
I: Customer Edge

In the reference models described above any of the domains (PSNs) may support static or dynamic PW establishment, for instance:

PSN1: Static Provisioning
PSN2: Dynamic Provisioning
PSN3: Static Provisioning

PSN4: Dynamic Provisioning

4. Problem Statement

The requirements and mechanisms for the establishment of MS-PWs are given in [RFC6073]. This includes all of the signaling extensions to describe PW capabilities, the S-PEs and T-PEs to be navigated (i.e., the PW path), and the identities of the ACs that the PW connects.

However, when some of the segments are statically provisioned, there is a requirement to carry this PW information across the statically provisioned domains to make the information available in subsequent dynamically provisioned domains.

For example, consider that in Figure 3, domains 1 and 2 are dynamically provisioned, domain 3 is statically provisioned and domain 4 is dynamically provisioned:

```
            Dyn       Dyn       Static       Dyn
        +---------+ +---------+ +---------+ +---------+
        |         | |         | |         | |         |
        |         | |         | |         | |         |
    +-+ | +-+    +-+  +-+    +-+   +-+   +-+    +-+ | +-+
    |A|...|B|====|C|==|D|===|E|===|F|==|G|====|H|...|I|
    +-+ | +-+    +-+  +-+    +-+   +-+   +-+    +-+ | +-+
        | | |     | |         | |         | |     | | |
        | | |     | |         | |         | |     | | |
        +---------+ +---------+ +---------+ +---------+
          | |<PW>| |<--PW-->| |<--PW-->| |<PW>| |
          |                                     |
          |<-----Multi-Segment Pseudowire------>|
```

Figure 3: Dynamic and Static Domain Topology

The normal techniques of [RFC6073] can be used to request an end-to-end MS-PW from B to H, and this can be signaled from B to E.

Furthermore, S-PE E can select a statically pre-provisioned PW segment from E to G to use as the next segment in the MS-PW. Node E can set up the necessary switching mechanisms for this connectivity.

However, [RFC6073] does not describe how node G is informed about the end-to-end MS-PW or how G is triggered to resume dynamic signalling toward T-PE H. It is not just a simple trigger that is required, because all of the PW configuration parameters signaled by T-PE B must be conveyed in the signaling from G to H.

This simple scenario can be further complicated by the existence of multiple domains (static or dynamic in any sequence) along the path.

4.1 Requirements

The requirements for setting up end-to-end PWs across MPLS-TP transport paths, across statically and dynamically provisioned domains, are document in [RFC5659], specific attention should be given to:

- o End-to-end PW setup across the MPLS-TP LSP: the destination and BW requirements MUST be met.

- o Traffic engineering and QoS consistency: the PW traffic engineering and QoS requirements MUST be met.

- o Resiliency: when requested, the maintaining of mechanisms to protect a MS-PW when an element on the existing path of a MS-PW fails SHOULD be maintained.

PW resiliency is provided using end-to-end protection techniques. That is, two path-diverse PWs are established to serve as working and protected PWs.

In a MS-PW environment, these two PWs must be kept path diverse across the whole of their paths. Where the path of the PWs is pre-planned, this can be archived within the scope of the management tool, and where both PWs are fully dynamic they can be established sequentially with the second PW having the awareness of the route of the first PW.

However, where there is a mix of static and dynamic segments, care will be required to ensure that the end-to-end working and protection MS-PWs follow diverse paths.

5. Procedures

The following section describe the procedures to satisfy the problem and requirements specified in the previous section.

6. Protocol Extensions

Where possible existing control protocol and procedures will be reused. However, to meet the setup and control of PWs over MPLS-TP transport paths, that traverse statically and dynamically provisioned domains, a set of new extensions of the existing control plane mechanisms are required.

This section will clarify the areas where PW control plane extensions are required.

7. Security Considerations

The MPLS-TP data plane does not provide any specific security mechanisms. MS-PW connections that wish to secure data carried over MPLS-TP transport entities are REQUIRED to apply their own security mechanisms.

Where control plane protocols are used to dynamically install label switching operations necessary to establish MPLS-TP transport paths, those protocols are equipped with security features that network operators may use to securely create the transport paths.

The use of static configuration exposes the CSP to another set of security risks, compared to dynamic configuration. If an MPLS-TP transport path is misconfigured in a statically configured network, it may result traffic looping and lack of end-to-end connectivity.

Further details of MPLS and MPLS-TP security can be found in [RFC5921] and [RFC5920]. The PWE3 security considerations are described in [RFC3985].

8. Operations and Maintenance (OAM)

To be discussed in future revisions of this document.

9. IANA Considerations

To be discussed in future revisions of this document.

10. References

10.1 Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC4447] "Pseudowire Setup and Maintenance Using the Label Distribution Protocol (LDP)", Martini L.,et al, RFC 4447, June 2005.

[RFC5654] Niven-Jenkins, B., Ed., Brungard, D., Ed., Betts, M., Ed., Sprecher, N., and S. Ueno, "Requirements of an MPLS Transport Profile", RFC 5654, September 2009.

10.2 Informative References

[RFC3985] Bryant, S. and P. Pate, "Pseudowire Emulation Edge-to-Edge (PWE3) Architecture", RFC 3985, March 2005.

[RFC4655] Farrel, A., Vasseur, J.-P., and J. Ash, "A Path Computation Element (PCE)-Based Architecture", RFC 4655, August 2006.

[RFC5659] Bocci, M. and S. Bryant, "An Architecture for Multi-Segment Pseudo Wire Emulation Edge-to-Edge", RFC 5659, October 2009.

[RFC5920] Fang, L., "Security Framework for MPLS and GMPLS Networks", RFC 5920, July 2010.

[RFC5921] Bocci, M., Bryant, S., Frost, D., Levrau, L., and L. Berger, "A Framework for MPLS in Transport Networks", RFC 5921, July 2010.

[RFC6073] Martini, L., Metz, C., Nadeau, T., Bocci, M., and M. Aissaoui, "Segmented Pseudowire", RFC 6073, January 2011.

[MS-PW-DYN] Martini, L., Bocci, M., Bitar, N., Shah, H., Aissaoui, M., and F. Balus, et al. "Dynamic Placement of Multi Segment Pseudo Wires", draft-ietf-pwe3-dynamic-ms-pw-14 (work in progress), July 2011.

[MPLS-TP-CP] Andersson, L., Berger, L., Fang, L., Bitar, N., Takacs, A., Vigoureux, M., and E. Bellagamba, "MPLS-TP Control Plane Framework", draft-abfb-mpls-tp-control-plane-framework-02 (work inprogress), January 2011.

[ROSETTA] Van Helvoort, H., Ed., Andersson, L., and N. Sprecher, "A Thesaurus for the Terminology used in Multiprotocol Label Switching Transport Profile (MPLS-TP) drafts/RFCs and ITU-T's Transport Network Recommendations", draft-ietf-mpls-tp-rosetta-stone, Work in Progress.

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