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LDP Extensions for Pseudo Wire (PW) Transfer in an MPLS-TP Network
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Abstract

As defined in [RFC5654] MPLS-TP transport path includes LSP and PW. And the possibility of transferring the ownership and control of an existing and in-use path between the management plane and the control plane, without actually affecting data plane traffic being carried over it, is a valuable option for carrier. [RFC5493] and [RFC5852] describe the LSP transfer. This memo gives the requirement and LDP extensions for PW transfer in an MPLS-TP network.

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1. Introduction

As defined in [RFC5654], MPLS-TP transport path corresponds to an LSP or a PW which is beared in an LSP. And LSP includes unidirectional LSP, co-routed bidirectional LSP and associated bidirectional LSP, while PW includes Single-Segment Pseudowire (SS-PW) and Multi-Segment Pseudowire (MS-PW).

For MPLS-TP LSP, it can be created/deleted via GMPLS signaling, see [RFC3945]. However, the creation/deletion of PW can be completed by LDP, and [RFC4447] gives these procedures of SS-PW while [SEG-PW] and [DYNAMIC-MS-PW] decribes the ones of MS-PW.

Nowdays, some service providers have deployed MPLS-TP network for mobile backhaul. But, most of the MPLS-TP paths are statically configured by management plane in the first stage. So, it is desirable for provider to transfer the control of paths from the management plane (MP) to control plane (CP) in future. In addition, the control transfer in the opposite direction, from CP to MP should be possible as well.

Both the requirement 55 in [RFC5654] and requirement 47 in [MPLS-TP-CP-FWK] state that an MPLS-TP control plane MUST provide a mechanism for dynamic ownership transfer of the control of MPLS-TP transport paths from the management plane to the control plane and vice versa. Furthermore, section 5.3.3 of [MPLS-TP-CP-FWK] describes the requirement for PW transfer. So, this memo considers the detailed requirements for PW transfer, and the corresponding LDP extensions is also described.

1.1. Comparison with Make-before-Break

The Make-Before-Break (MBB) technology is an alternative method for PW transfer which has three steps. Firstly, a new PW (has the same parameters with the one to be transferred) will be created; then the PW will be switched from old PW to the new one; and after the PW switching completed successfully the old PW will be deleted. From this process, we can find there're many drawbacks with MBB.

The creation and swithing steps of MBB will lead to instant interruption;. Although, it is acceptable if the instant interruption can be controlled within 50ms, but this has a strict requirement for equipment. Furthermore, extra resource is need, in the circumstance that the network is almost saturate, there maybe not enough resource for the new PWs, so MBB will be unavailable. Otherwise, MBB will lead to label modification which will make the bundling relationship between PW and LSP must modified at the same time. This will triggre many problems, and a new detection mechanism

needs to be defined which may be very complex. In addition, since control plane is used to create the new PW while management plane is responsible for the deletion of the old PW. Thus batch operation cann't be used for this process. If there're a large number PWs needed to be transfered, the operator's time will be engaged by this tedious operation which is inefficiency. However, the PW transfer method described in this document will not affect the data plane, the traffic and it's configuration. So it's preference for PW transfer. However, the PW transfer method described in this document will not affect the data plane, the traffic and it's configuration. So it's preference for PW transfer.

1.2. 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 [RFC2119].

2. Terminology

- Transport Path: A network connection as defined in G.805 [ITU.G805.2000]. In an MPLS-TP environment, a transport path corresponds to an LSP or a PW (see [RFC5654]).

- Single-Segment Pseudowire (SS-PW): A PW setup directly between two T-PE devices. Each PW in one direction of a SS-PW traverses one PSN tunnel that connects the two T-PEs.

- Multi-Segment Pseudowire (MS-PW): A static or dynamically configured set of two or more contiguous PW segments that behave and function as a single point-to-point PW. Each end of a MS-PW by definition MUST terminate on a T-PE.

- PW Segment: A part of a single-segment or multi-segment PW, which traverses one PSN tunnel in each direction between two PE devices, T-PEs and/or S-PEs.

- Resource Ownership: A resource used by an MPLS-TP path is said to be 'owned' by the plane that was used to set up the MPLS-TP path through that part of the network. So, a resource owned by the management/control plane means the resource was used to set up the MPLS-TP path through the management/control plane. See [RFC5493] for detailed description.

3. Overview of the PW Transfer

The PW transfer includes two reverse procedures. One is the MP to CP (MP2CP) transfer procedure, another is the CP to MP (CP2MP) transfer procedure.

For MP2CP transfer procedure, a PW set up and owned by MP needs to be transferred to CP control. To conduct this transfer, the T-LDP session will be created in CP for PW. After this transfer procedure, the resource ownership must be transferred, that is the resource owned by MP will be transferred to CP.

The CP2MP transfer procedure is the reverse one compared to MP2CP procedure. However, since a LDP session may be shared by multi PWs, the T-LDP session may be retained after one PW transferring from CP to MP, if there're still another PWs remain untransferred. So, the CP2MP procedure needs to check whether this signaling session should be retained or not.

As an requirement listed in [RFC5493], during both MP2P and CP2MP transfer procedures, if PW is carrying traffic, its control transfer has to be done without any disruption to the data plane traffic.

Furthermore, both MP2CP and CP2MP transfer procedures can be conducted in a batch manner, that is, multiple LSPs or PWs can be transferred all at one time. For example, all PWs on a node can be transferred at one time. However, this transfer manner is out of this document.

4. Requirements for PW Transfer

[RFC5493] describes the requirements for the conversion between permanent connection (PC) and switched connection (SC) in a GMPLS network. The terminologies "PC" and "SPC" come from ITU-T standard [G.8081], Because associated bidirectional LSP isn't defined in ITU-T standard. So, both PC and SPC can only be considered as unidirectional LSP and co-routed bidirectional LSP. Therefore, these requirements fully apply to unidirectional LSP and co-routed bidirectional LSP in a MPLS-TP network. Although, some requirements defined in [RFC5493] apply to PW, but other new requirements also need to be explored.

This section lists the special requirements for PW transfer.

1) PW attributes MUST not be changed

   The PW attributes, such as bandwith, PWid , PW type, Control Word, VCCV, Interface Parameter, MUST not be changed during and after the PW transfer.

2) PW transfer MUST be independent of LSP

   The PW transfer SHOULD not depend on whether the LSP (bearing this PW) is controlled by MP or CP. Since PW transfer procedure will not impact the data plane path, so PW transfer MUST leave LSP alone. The relationship between PW and LSP MUST NOT be changed.

3) Support partial MS-PW segments transfer

   Since a MS-PW transit multi domains and these domains may belong to different providers. In this scenario, if some providers have deployed control plane while others not, the PW segments in these domains that control plane are deployed SHOULD be allowed to transfer between MP and CP while other PW segments keep their original states.

5. LDP Extension for PW Transfer

5.1. LDP Extension

5.1.1. Support PW Transfer with LDP

A new Capability Parameter TLV is defined, the PW Transfer Capability. Following is the format of the PW Transfer Capability Parameter.

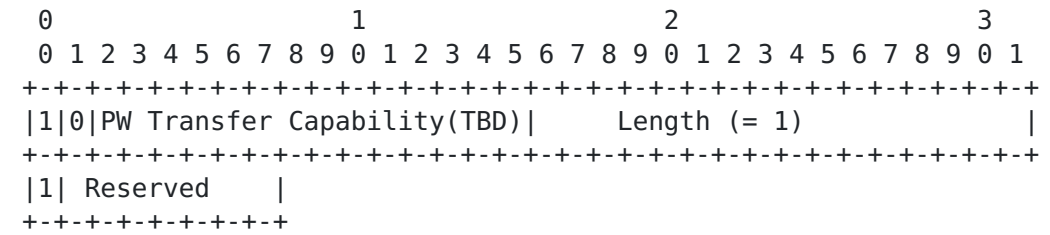

Figure 1: PW Transfer Capability

The PW Transfer Capability TLV MUST be supported in the LDP Initialization Message([RFC5561]). Advertisement of the PW Transfer Capability indicates support of the procedures for PW transfer between MP and CP detailed in this document. If the peer has not

advertised the corresponding capability, then no PW transfer label messages should be sent to the peer.

5.1.2. PW Ownership Transfer TLV

To ensure the PW ownership transfer between MP and CP automatically, T-PE/S-PE SHOULD has the knowledge of the PW transfer signaling message. So, the PW path and PW transfer indication MUST be carried in the LDP Label Mapping message.

Since [SEG-PW] has defined PW switching point TLV (S-PE TLV) and Sub-TLV to the switching points that the PW traverses, so these TLV and Sub-TLV can be used to carry the PW path. Therefore, this section only defines a new LDP TLV - Transfer TLV - which can be used to indicate a PW transfer signaling procedure.

The PW Ownership Transfer TLV (PW-OH TLV), is defined as follows (TLV type needs to be assigned by IANA):

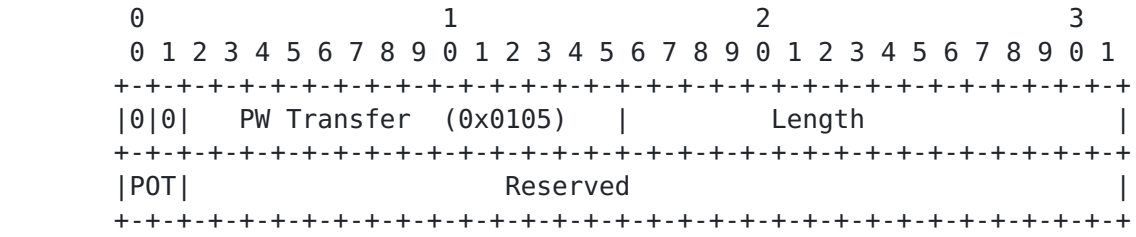

Figure 2: PW Ownership Transfer TLV

POT (2 bits): PW Ownership Transfer. PE MUST carry this TLV in LDP Label Mapping and Notification message defined in [RFC5036] when transferring from MP to CP, or CP to MP. The value of POT is following:

1 - PW ownership transfer from management plane to control plane

2 - PW ownership transfer from control plane to management plane

Reserved(30 bits): This field MUST be set to zero on transmission and MUST be ignored on receipt.

5.2. Procedures

5.2.1. PW Ownership Transfer from MP to CP

Before transferring from MP to CP, there MUST be a T-LDP session between two T-PE for SS-PW, or T-PE and S-PE for MS-PW. During the LDP initialization stage, the LDP speaker MUST announce it's PW

transfer capability according to [RFC5561] by sending the peer a Capability message carrying the PW transfer capability TLV.

To conduct the MP2CP PW transfer, operator sends the MP2CP PW transfer command to the source and destination T-PEs which will inform MP and CP to initiate the MP2CP PW transfer process. When CP gets all the information of the PW to be transferred , the CP of source and destination nodes will build the LDP mapping message based on the procedures described in [RFC4447], and send the mapping message to its peer T-PE or S-PE.

The differences between the normal and the MP2CP PW transfer Label Mapping message are:

1. PW-OH TLV with POT value equals 1 will be encoded into the "Optional Parameters" of the Mapping message for both SS-PW and MS-PW MP2CP transfer.

2. For MS-PW, the PW path will be encoded into S-PE TLVs and Sub-TLVs with local S-PE address according to [SEG-PW].

When the Label Mapping message is build up, it will be send to source/destination T-PE for SS-PW and to S-PE for MS-PW.

For SS-PW, when the source/destination T-PE receives the MP2CP PW transfer Label Mapping message, and also send MP2CP PW transfer Label Mapping message to its peer, it will transfer the PW control from MP to CP.

For MS-PW, when the S-PE receives the MP2CP PW transfer Label Mapping message, it will decode the next hop S-PE from local IP address Sub-TLVs in S-PE TLVs then forward this Label Mapping message to the next hop S-PE. Only when S-PE receive the MP2CP PW transfer label mapping message from the reverse direction of PW, it will transfer the PW control from MP to CP. When the source/destination T-PE receives the MP2CP PW transfer Label Mapping message, it will deal with it in the same way as SS-PW described above.

5.2.1.1. MP2CP PW Transfer Failure

If T-PEs or S-PE fail to PW transfer capability negotiation, the procedures in [RFC5561] SHOULD be performed.

Since T-LDP runs over TCP, and there is only one hop between T-PEs in SS-PW, if the T-LDP sesseion is created successfully, the PW transfer Label Mapping can be sent and received reliably.

For MS-PW, if one of the PW segment fails to transfer from MP to CP,

a Notification message SHOULD be sent to source/destionation T-PE to report the failure. And the PW segments successfully transferred SHOULD be remained.

5.2.2. PW Ownership Transfer from CP to MP

Since multiple PWs can share a single T-LDP session, when a PW transferred from CP to MP, the LDP session may be retained for other PWs. So when a PW transfers from CP to MP, a Notification message carring the corresponding PW FEC and PW-OH TLV with the POT value equals 2 SHOULD be send out. All the other S-PEs along the PW received this Notification message, SHOULD send the notification message to next hop S-PE. Only when S-PE receives notification message from reverse direction of PW, it will transfer the PW control from CP to MP and remain the corresponding LDP session. When there is no PW, the session MAY be still remained for the future use. Thus, whether to delete the LDP session depends on the provider's policy. If the provider want to delete the LDP session in which there is no PW, the procedures in [RFC5036] can be conducted.

5.2.2.1. CP2MP PW Transfer Failure

Since the PW transfer capability is negotiated before T-LDP session set up, and the T-LDP runs over TCP, CP2MP PW transfer can be performed reliably.

For MS-PW, if one PW segment fails to transfer from CP to MP, a Notification message SHOULD be sent to source/destionation T-PE to report the failure.

6. Security Considerations

[RFC5036] and [RFC4447] describe the security considerations that apply to the T-LDP specification. The same security framework and considerations apply to the capability mechanism described in this document.

7. IANA considerations

TBD.

8. Acknowledgements

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