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S. Sivabalan
S. Boutros
Cisco Systems, Inc.
H. Shah
Ciena Corp.
S. Aldrin
Huawei Technologies.
M. Venkatesan
Comcast.

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MAC Address Withdrawal over Static Pseudowire
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Abstract

This document specifies a mechanism to signal MAC address withdrawal notification using PW Associated Channel (ACH). Such notification is useful when statically provisioned PWs are deployed in VPLS/H-VPLS environment.

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 [RFC2119].

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on September 10, 2015.

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1. Introduction

An LDP-based MAC Address Withdrawal Mechanism is specified in [RFC4762] to remove dynamically learned MAC addresses when the source of those addresses can no longer forward traffic. This is accomplished by sending an LDP Address Withdraw Message with a MAC List TLV containing the MAC addresses to be removed, to all other PEs over the LDP sessions. When the number of MAC addresses to be removed is large, the empty MAC List TLV may be used. [RFC7361] describes an optimized MAC withdrawal mechanism which can be used to remove only the set of MAC addresses that need to be re-learned in H-VPLS networks. The solution also provides optimized MAC Withdrawal operations in PBB-VPLS networks.

A PW can be signaled via the LDP or can be statically provisioned. In the case of static PW, LDP based MAC withdrawal mechanism cannot be used. This is analogous to the problem and solution described in [RFC4762] where PW OAM message has been introduced to carry PW

status TLV using in-band PW Associated Channel. In this document, we propose to use PW OAM message to withdraw MAC address(es) learned via static PW.

Thus, MAC withdraw signaling for static PW re-uses concepts of -

- in-band signaling mechanisms used by static PW status signaling and

- MAC withdraw mechanisms described by [RFC4762] and [RFC7361]

The MAC withdraw signaling is a best effort scheme. It is an attempt to optimize the network convergence by reducing blackholes caused by PW failover for protected PWs. The protocol defined in this document addresses possible loss of MAC withdraw signal due to network congestion, but does not assure the guarenteed delivery, as is the case for the LDP based MAC withdraw signaling. In the event that MAC withdraw signaling does not reach the intended target, the fallback to MAC re-learning due to bi-directional traffic or as a last resort to user configured MAC entries age out, will resume the traffic via new PW path. Such fallbacks would cause temporary blackout but does not render network permanently unusable.

2. Terminology

The following terminologies are used in this document:

ACK: Acknowledgement for MAC withdraw message.

LDP: Label Distribution Protocol.

MAC: Media Access Control.

PE: Provide Edge Node.

MPLS: Multi Protocol Label Switching.

PW: PseudoWire.

PW OAM: PW Operations, Administration and Maintenance.

TLV: Type, Length, and Value.

VPLS: Virtual Private LAN Services.

3. MAC Withdraw OAM Message

LDP provides a reliable packet transport for control plackets for dynamic PWs. This can be contrasted with static PWs which rely on re-transmission and acknowledgments (ACK) for reliable OAM packet delivery as described in [RFC6478]. The proposed solution for MAC withdrawal over static PW also relies on re-transmissions and ACKs. However, ACK is mandatory. A given MAC withdrawal notification is sent as a PW OAM message, and the sender re-transmits the message for a configured number of times in the absence of an ACK response for the sequence numbered message. The receiver removes the MAC address(es) for a given sequence number MAC withdraw signaling and sends the ACK response. The receipt of same or lower sequence number message is responded with ACK but does not cause removal of MAC addresses. A new TLV to carry the sequence number has been defined.

The format of the MAC address withdraw OAM message is shown in Figure 1. The PW OAM message header is exactly the same as what is defined in [RFC6478]. Since the MAC withdrawal PW OAM message is not refreshed forever, a MAC address withdraw OAM message MUST contain a "Sequence Number TLV" otherwise the entire message is dropped. It MAY contain MAC Flush Parameter TLVs defined in [RFC7361] when static PWs are deployed in H-VPLS and PBB-VPLS scenarios. The first 2 bits of the sequence number TLV are reserved and MUST be set to 0 on transmit and ignored on receipt.

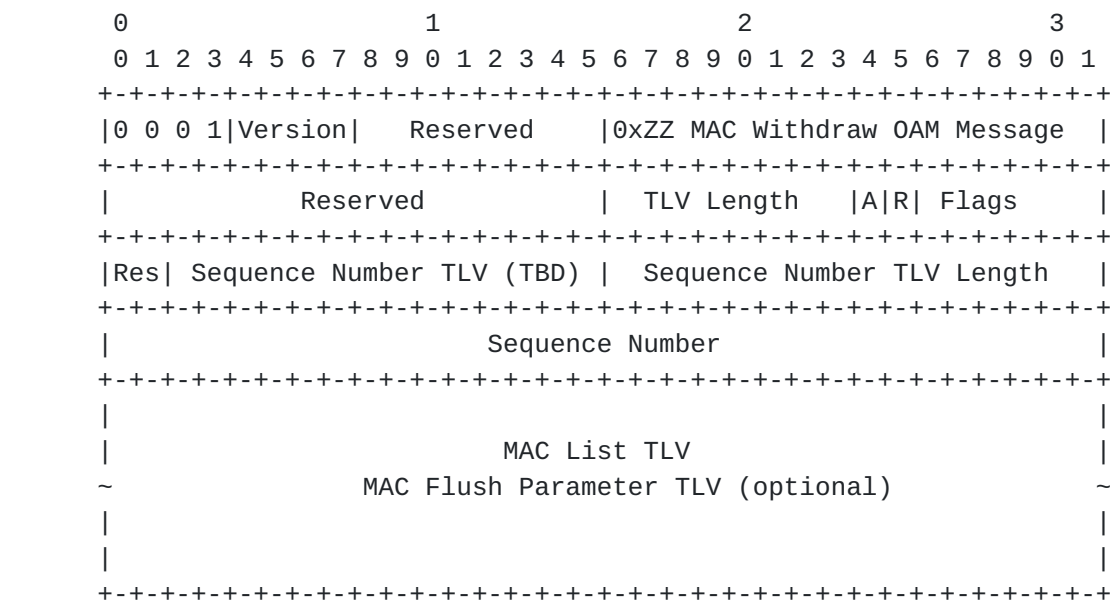

Figure 1: MAC Address Withdraw PW OAM Packet Format

In this section, MAC List TLV and MAC Flush Parameter TLV are collectively referred to as "MAC TLV(s)". The definition and processing rules of MAC List TLV are described by [RFC4762], and the corresponding rules of MAC Flush Parameter TLV are governed by [RFC7361].

"TLV Length" is the total length of all TLVs in the message, and "Sequence Number TLV Length" is the length of the sequence number field.

A single bit (called A-bit) is set to indicate if a MAC withdraw message is for ACK. Also, ACK does not include MAC TLV(s).

Only half of the sequence number space is used. Modular arithmetic is used to detect wrapping of sequence number. When sequence number wraps, all MAC addresses are flushed and the sequence number is reset. The sequence number handling is described in [RFC4385] with the exception that sequence number in this case is 32-bits and hence sequence number in half the number space (~2billion) is considered in the valid receive range.

A single bit (called R-bit) is set to indicate if the sender is requesting reset of the sequence numbers. The sender sets this bit when the Pseudowire is restarted and has no local record of send and expected receive sequence number.

4. Operation

This section describes how the initial MAC withdraw OAM messages are sent and retransmitted, as well as how the messages are processed and retransmitted messages are identified.

4.1. Operation of Sender

Each PW is associated with a counter to keep track of the sequence number of the transmitted MAC withdrawal messages. Whenever a node sends a new set of MAC TLVs, it increments the transmitted sequence number counter, and include the new sequence number in the message. The transmit sequence number is initialized to 1 at the onset.

The sender expects an ACK from the receiver within a time interval which we call "Retransmit Time" which can be either a default (1 second) or configured value. If the ACK does not arrive within the Retransmit Time, the sender retransmits the message with the same sequence number as the original message. The retransmission MUST be ceased anytime when ACK is received or after three retries. This avoids unended retransmissions in the absence of acknowledgements. Since retransmission time interval and the maximum number of retries is local configuration of the sender node,it is up to the implementor to pick a discipline. For instance, 1 second retransmission with three retries in absence of ACK response is suggested in this document. However, incremental backoff with higher number of retries is also feasible and may be worth consideration to address the scale issues. This document does not mandate a strict guideline since there are no interoperability implications. However, implementer must consider the decaying value of delayed MAC withdraw signaling against possible relearning due to bidirectional traffic or MAC age timeout.

During the period of retransmission, if a need to send a new MAC withdraw message with updated sequence number arises then retransmission of the older unacknowledged withdraw message MUST be suspended and retransmit time for the new sequence number MUST be initiated. In essence, sender engages in retrasmission logic only for the latest send withdraw message for a given PW.

In the event that a Pseudowire was deleted and re-added or the router is restarted with configuration, the local node may lose information about the send sequence number of previous incarnation. This becomes problematic for the remote peer as it will continue to ignore the received MAC withdraw messages with lower sequence numbers. In such cases, it is desirable to reset the sequence numbers at both ends of the Pseudowire. The 'R' reset bit is set in the first MAC withdraw to notify the remote peer to reset the send and receive sequence

numbers. The 'R' bit must be cleared in subsequent MAC withdraw messages after the acknowledgement is received

4.2. Operation of Receiver

Each PW is associated with a register to keep track of the expected sequence number of the MAC withdrawal message and is initialized to 1. Whenever a MAC withdrawal message is received, and if the sequence number on the message is greater than the value in the register, the MAC address(es) contained in the MAC TLV(s) is/are removed, and the register is updated with the received sequence number plus 1. The receiver sends an ACK whose sequence number is the same as that in the received message.

If the sequence number in the received message is smaller than or equal to the value in the register, the MAC TLV(s) is/are not processed. However, an ACK with the received sequence number MUST be sent as a response. The receiver processes the ACK message as an acknowledgement for all the MAC withdraw messages sent up to the sequence number present in the ACK message and terminates retransmission.

As mentioned above, since only half of the sequence number space is used, the receiver MUST use modular arithmetic to detect wrapping of the sequence number. The exact processing on how to handle the sequence number overflow is described in [RFC4385]

A MAC withdraw message with 'R' bit set MUST be processed by resetting the send and receive sequence number first. The rest of MAC withdraw message processing is performed as described above. The acknowledgement is sent with 'R' bit cleared.

5. Security Consideration

The security measures described in [RFC4447], [RFC5085], and [RFC6073] are adequate for the proposed mechanism.

6. IANA Considerations

The proposed mechanism requests IANA to a assign new channel type (recommended value 0x0028) from the registry named "Pseudowire Associated Channel Types". The description of the new channel type is "Pseudowire MAC Withdraw OAM Channel".

A new registry for the "Sequence Number TLV" is governed by the static PW MAC withdraw signaling described in this document. The value is 0x0001. A value other than 1 should be considered an error and result in discarding of the packet.

7. References

7.1. Normative References

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[RFC7361] Dutta, P., Balus, F., Stokes, O., Calvignac, G., and D. Fedyk, "LDP Extensions for Optimized MAC Address Withdrawal in a Hierarchical Virtual Private LAN Service (H-VPLS)", RFC 7361, September 2014.

7.2. Informative References

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

Authors' Addresses

Siva Sivabalan
Cisco Systems, Inc.
2000 Innovation Drive
Kanata, Ontario K2K 3E8
Canada

Email: msiva@cisco.com

Sami Boutros
Cisco Systems, Inc.
170 West Tasman Dr.
San Jose, CA 95134
US

Email: sboutros@cisco.com

Himanshu Shah
Ciena Corp.
3939 North First Street
San Jose, CA 95134
US

Email: hshah@ciena.com

Sam Aldrin
Huawei Technologies.
2330 Central Express Way
Santa Clara, CA 95051
US

Email: aldrin.ietf@gmail.com

Mannan Venkatesan
Comcast.
1800 Bishop Gate Blvd
Mount Laurel, NJ 08075
US

Email: mannan_venkatesan@cable.comcast.com