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Pseudo Wire (PW) Virtual Circuit Connection Verification (VCCV)
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Status of this Memo

Abstract

This document describes Virtual Circuit Connection Verification (VCCV) procedures for use with psuedowire connections. VCCV supports connection verification applications for pseudowire VCs regardless of the underlying MPLS or IP tunnel technology. VCCV makes use of IP based protocols such as Ping and MPLS-Ping to perform operations and maintenance functions. A network operator may use the VCCV procedures to test the network's forwarding plane liveliness.

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2. Introduction

As network operators deploy pseudowire services, fault detection and diagnostic mechanisms particularly for the PSN portion of the network are pivotal. Specifically, the ability to provide end-to-end fault detection and diagnostics for an emulated pseudowire service is critical for the network operator. Operators have indicated in [MPLSOAMREQS] that such a tool is required for pseudowire deployments. This document describes procedures for PSN-agnostic fault detection and diagnostics called virtual circuit connection verification (VCCV).

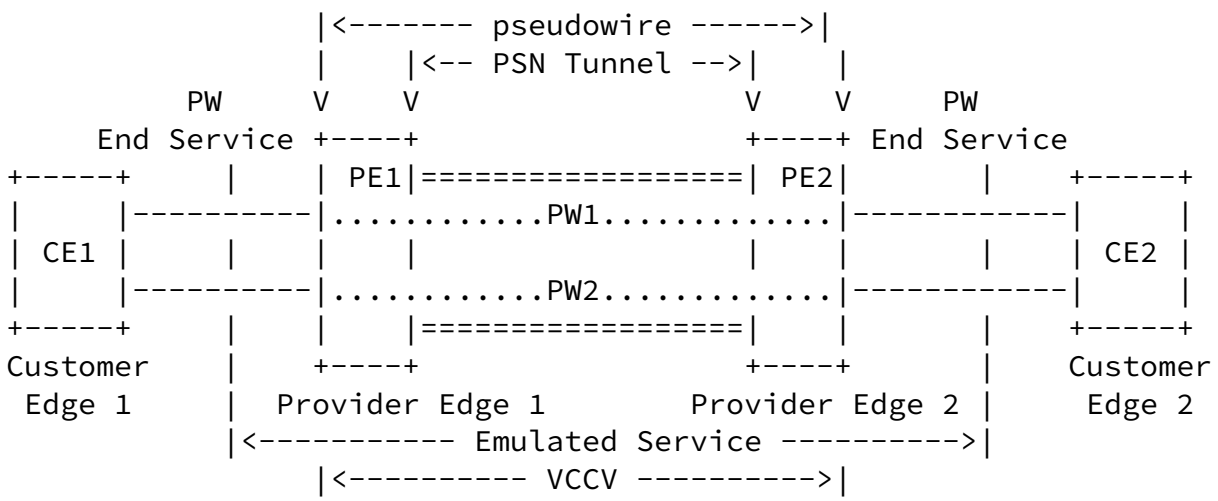
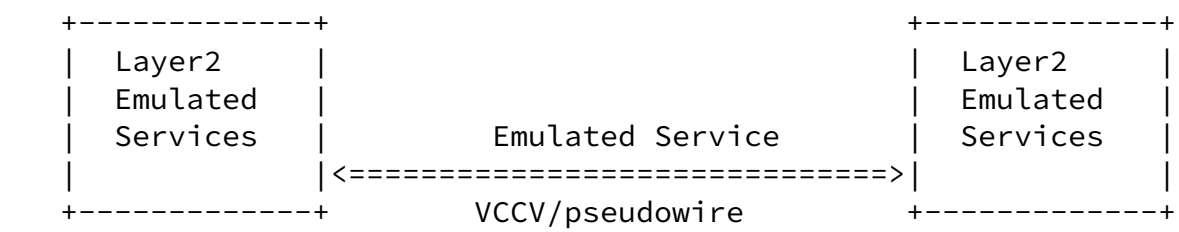


Figure 1: PWE3 VCCV Operation Reference Model

Figure 1 depicts the basic functionality of VCCV. VCCV provides several means of creating a control channel between PEs that

attaches the VC under test.



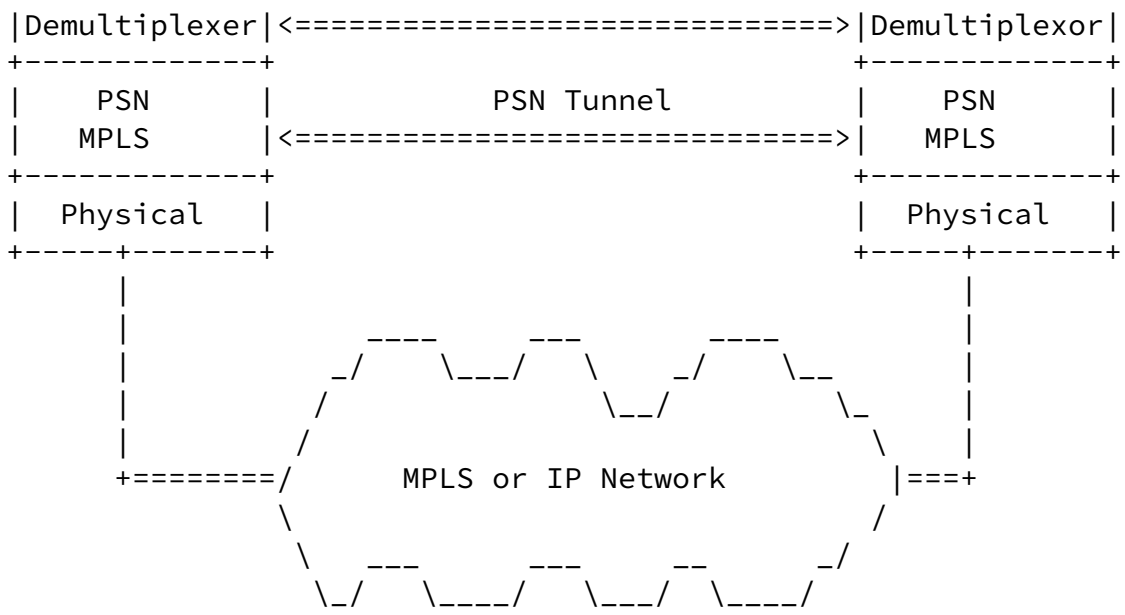


Figure 2: PWE3 Protocol Stack Reference Model
including the VCCV control channel.

Figure 2 depicts how the VCCV control channel is run along with the pseudowire to verify specific VCs. Ping and other IP messages are encapsulated using the PWE3 encapsulation as described below in sections 5 and 6. These messages, referred to as VCCV messages, are exchanged only after the desire to exchange such traffic has been negotiated between the PEs (see section 8).

3. MPLS as PSN

In order to apply IP monitoring tools to PWE3 circuits, VCCV creates a control channel between PWE3 PEs[PWEARCH]. Packets sent across this channel are IP packets, allowing maximum flexibility.

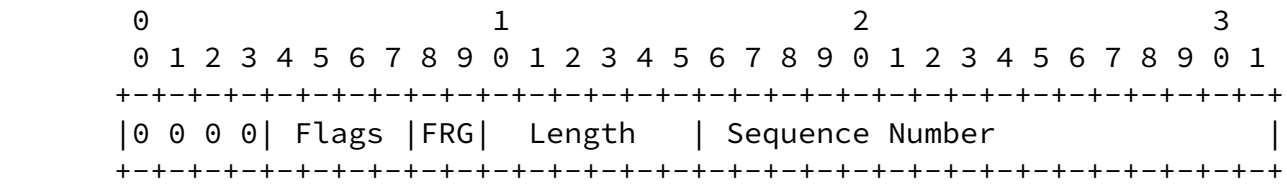
Ideally such a control channel would be completely in band. When a control word is present on virtual circuit, it is possible to indicate the control channel by setting a bit in the control header. This method is described in section 7.1 and is referred to as inband MPLS VCCV.

However in order to address the case when the control header is not in use as well as to deal with a number of existent hardware devices, use of the MPLS Router Alert Label to indicate the IP control channel is also proposed. This is described in section 7.2.

The actual channel type is agreed through signaling as described in section 8.

3.1. Inband MPLS VCCV

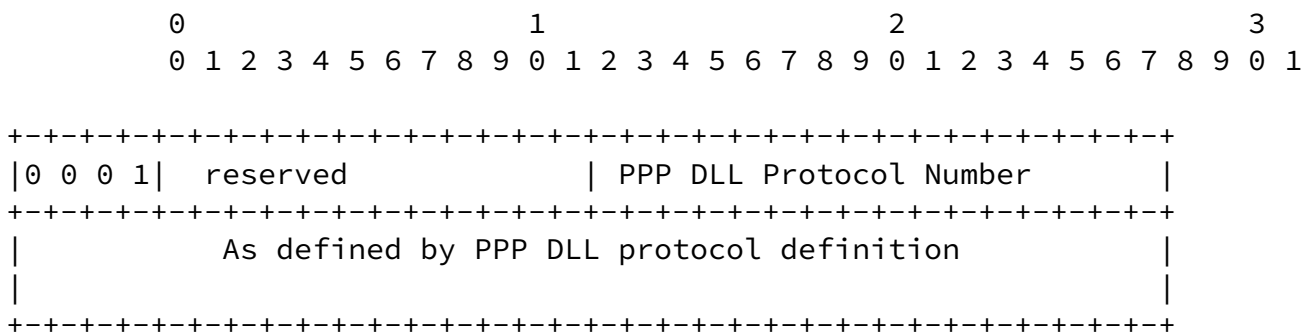
The PW set-up protocol determines whether a PW uses a control word. When a control word is used, it SHOULD have the following preferred form:



for the purpose of indicating VCCV control channel messages.

Note that for data, one uses the control word defined just above the MPLS payload [PWEARCH] .

The MPLS payload type is defined as follows:



The first nibble 0000 indicates data. When the first nibble is 0001, the protocol of the frame is indicated by the Protocol Number. IP OAM flows are identified by either an IPv4 or IPv6 codepoint.

3.2. Router Alert Label Approach

When the control word is not used, or the receiving hardware

cannot divert control traffic, an IP control channel can be created by including the MPLS router alert label immediately above the VC label. If the control word is in use on this VC it is also included in the IP control flow.

0x1 OAM Flag in PWE header
0x2 Include the control channel label in stack above VC label

4. IP Probe Traffic

For connectivity verification, both ICMP Ping and LSP-Ping packets may be used on the control channel. The type of packets used is agreed in signaling as described in section 9.

4.1. ICMP Ping

When ICMP packets are used, the source address should be set to the source address of the LDP session and the destination address to the destination of the LDP session. The Identifier and Sequence Number fields of the ICMP Echo Request / Echo Reply messages are used to track what VCs are being tested.

These fields are only interpreted by the sending PE. Specific use of these fields is an implementation matter.

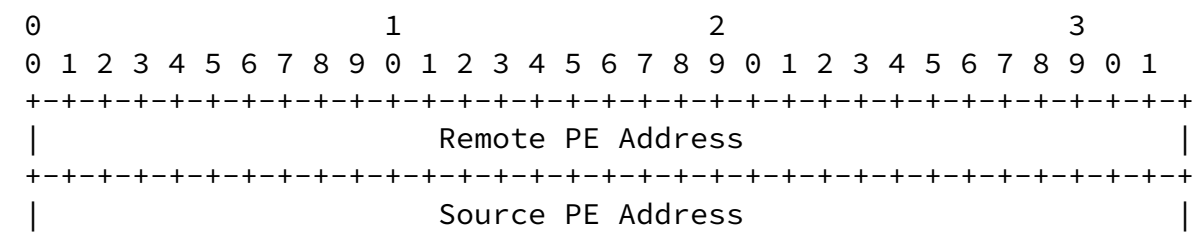
4.2. MPLS Ping Packet

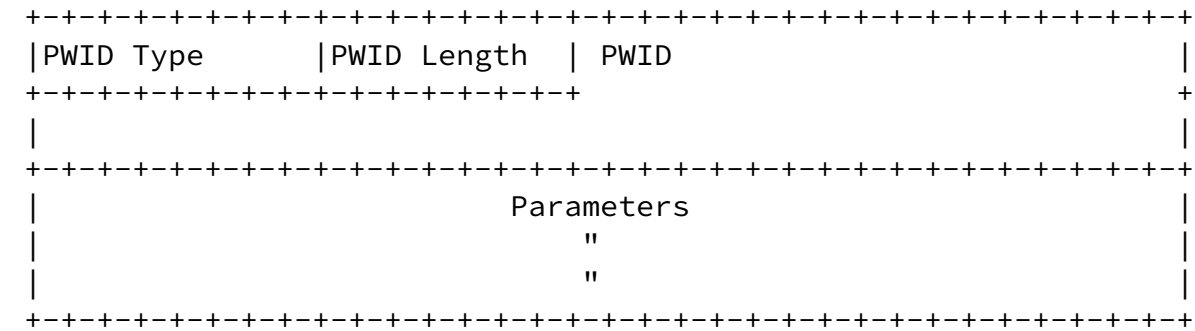
The LSP Ping header must be used as described [LSP-PING] and must also contain the sub-TLV of 8 for PW circuits. This sub-TLV must be sent containing the circuit to be verified as the "VC ID" field:

4.2.1 L2 Circuit ID TLV for MPLS LSP Ping

The value field consists of a remote PE address (the address

of the targeted LDP session), the source address of the PE that originated this request, a VC ID and an encapsulation type, as follows.





Two PWID types are defined:

1. A FEC 128 VCID as defined in [MARTINISIG].
2. A FEC 129 Attachment Identifier, as defined [L2SIG].

The PWID length field contains the length of the PWID field in bytes. Zero to three bytes of padding will follow the PWID field, so that the parameters field starts on a 64-bit boundary.

Parameters are:

- Interface parameters, as defined in [MARTINISIG].

***Note that we propose that this field be removed from the LSP Ping draft [LSPPING] and defined here instead.

5. OAM Capability Indication

To permit negotiation of the use and type of OAM for Connectivity Verification, a VCCV parameter is defined below. When a PE signals a PWE3 VC and desires OAM for that VC, it MUST indicate this during VC establishment using the messages defined below. Specifically for LDP it MUST include the VCCV parameter in the VC setup message.

As the overall method of PWE3 signaling is downstream, unsolicited, this leaves the decision of the type of IP control channel completely to the receiving control entity. OAM capability MUST be signaled BEFORE a PE may send OAM messages. If a PE receives OAM messages prior to sending a VCCV parameter, it MUST discard these messages and not reply to them. In this case, the LSR SHOULD increment an error counter and optionally issues a system and/or SNMP notification to indicate to the system administrator that a mis-configuration exists.

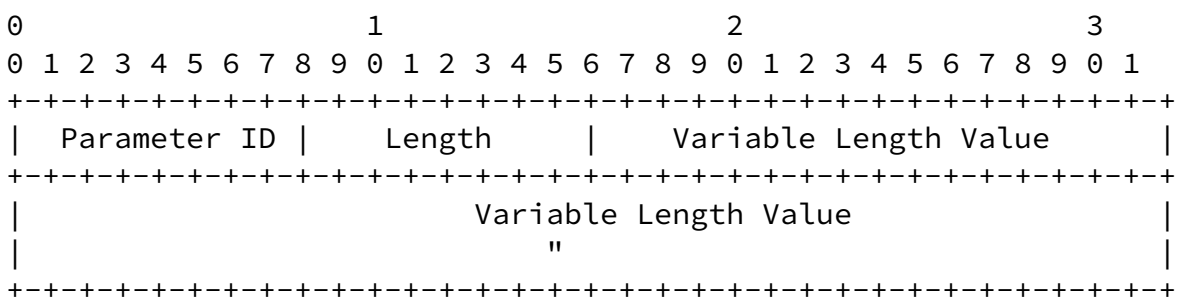
The requesting PE indicates its desire for the remote PE to support OAM capability by including the VCCV parameter with appropriate options set to indicate which methods of OAM are

acceptable. The requesting PE MAY indicate multiple IP control IP control channel options. The absence of the VCCV FEC TLV indicates that no OAM functions are supported or desired by the requesting PE. This last method MUST be supported by all PEs in order to handle backward-compatibility with older PEs. The receiving PE agrees to accept any of the indicated OAM types and options by virtue of establishing the VC. If it does not or cannot support at least one of the options specified, it MUST not establish the VC. If the requesting PE wishes to continue, it may choose different options and try to signal the PE again.

5.1. Optional VCCV Parameter

[PWE3CONTROL] defines a VC FEC TLV for LDP. Parameters can be carried within that TLV to signal different capabilities for specific PWs. We propose an optional parameter to be used to indicate the desire to use a control channel for VCCV as follows.

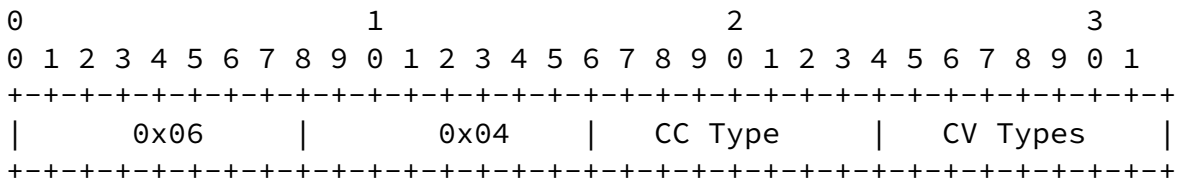
The TLV field structure is defined in [PWE3CONTROL] as follows:



The VCCV parameter ID is defined as follows:

Parameter ID	Length	Description
0x06	4	VCCV

The format of the VCCV parameter TLV is as follows:



The CC type field defines the type of IP control channel. The defined values are:

0x1 OAM Flag set in PWE header
0x2 MPLS Router Alert Label

The CV Types field defines the types of IP control packets that may be sent on the control channel. The defined values are:

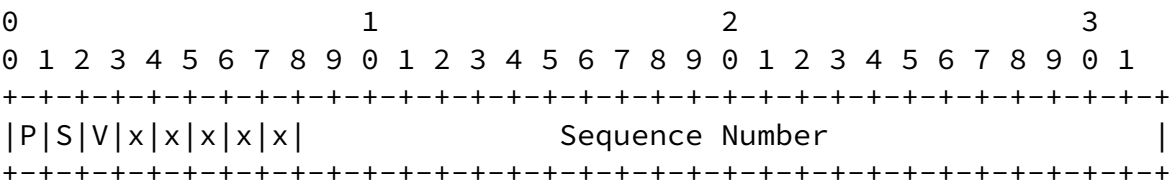
0x1 ICMP Ping
0x2 LSP Ping

6. L2TPV3 as PSN

When L2TPv3 is used as the underlying PSN, a VCCV mechanism is needed for the L2TPv3 session. The L2TPv3 control connection does employ a keepalive mechanism. However this mechanism isn't sufficent for fault detection and diagnostic of the L2TPv3 session i.e. data plane. In L2TPv3 a session is analogous to a PW. A L2TPv3 VCCV mechanism is needed in particular for verifying the session forwarding state at the egress router.

When a PE verifies the connection status of a L2TPv3 session it must transmit a L2TPv3 VCCV message encoded in the L2TPv3 session packet.

The presence of a VCCV message in a L2TPv3 session packet can be indicated by reserving a bit in the default L2-specific sublayer format.



Default L2-Specific Sublayer Format with V bit.

The 'V' bit indicates that this is a VCCV session packet. If the PW has not been signaled to include a L2-specific sublayer format, other

mechanisms are needed to indicate the VCCV message. Such mechanisms are for further study.

6.1. L2TPv3 VCCV Message

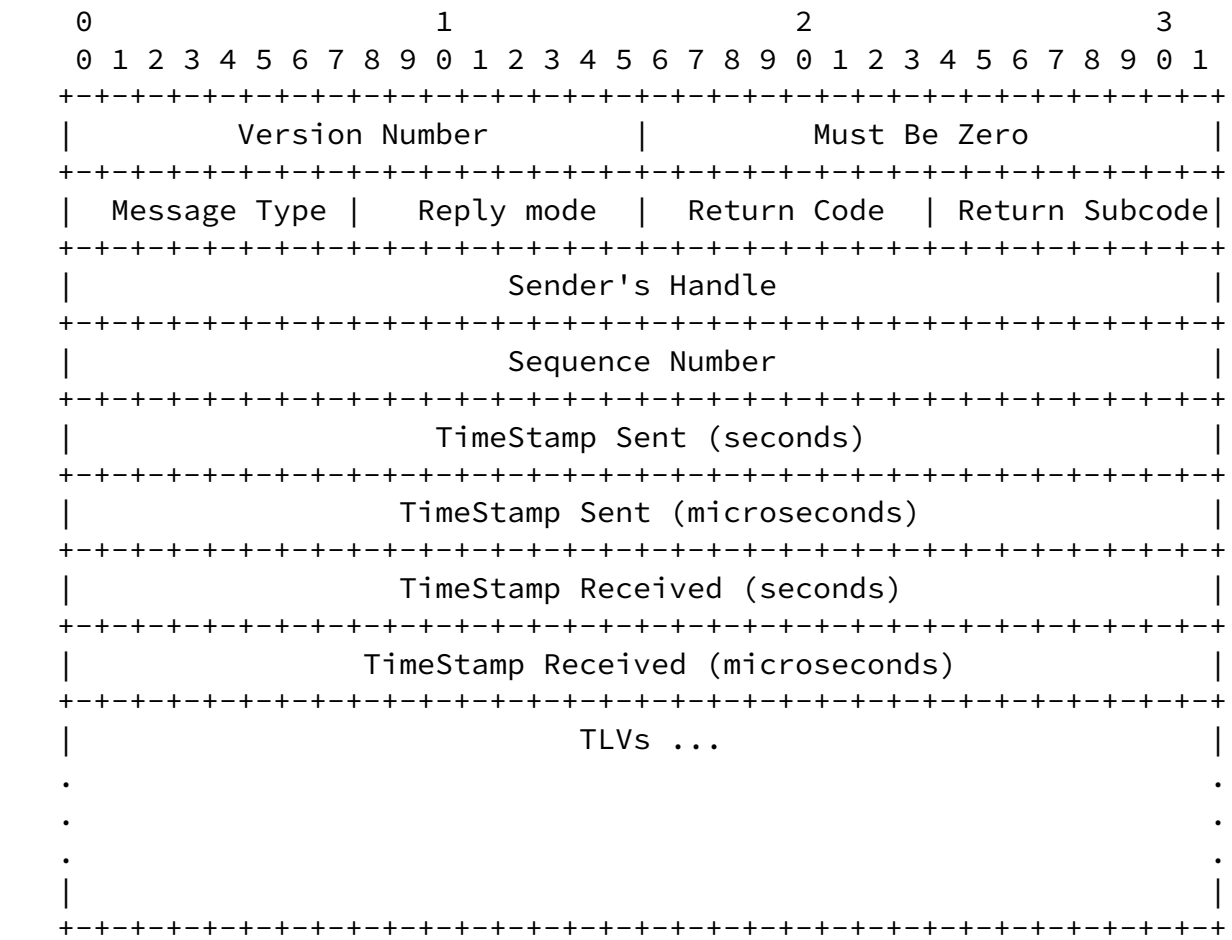
The VCCV message MUST contain a VCCV AVP. It does not contain a message header. A new AVP, called the VCCV AVP is defined. The usage of the L2TPv3 AVP format leaves room for adding further AVPs to this message

in the future as needed.

6.1.1. L2TPv3 VCCV AVP

This AVP encodes the LSP Ping header as defined in [LSP-PING]. M and H

bits must not be set. The attribute type is TBD. The LSP Ping header is not encapsulated in UDP. The modifications to the semantics of the fields of this header are specified here. Unless otherwise specified the semantics of the fields as explained in [LSP-PING] are to be followed. For reference the format of the LSP Ping header is shown below.



The version number is currently 1. The message type is one of the following:

1 - L2TPv3 VCCV Echo Request
2 - L2TPv3 VCCV Echo Reply

The Reply Mode is:

1 - Do not reply
2 - Reply using the L2TPv3 session

As explained in [LSP-PING] a reply mode of "do not reply" can be used

for one way connectivity tests. The VCCV message will normally contain a reply mode of "reply using the L2TPv3 session".

The return code can be set to the following by the receiver:

1 - Malformed echo request received
2 - One or more of the TLVs was not understood
3 - Replying router has a session mapping for the verified pseudo wire
4 - Replying router does not have a mapping for the verified pseudo wire

The LSP Ping header must contain the L2 Circuit ID TLV as defined in section 8.2. This TLV identifies the pseudo wire associated with the session, that is being verified. For L2TPv3 the remote PE address is the address of the session's remote end. A new PWID type is defined for L2TPv3, in addition to the ones defined in section 8.2:

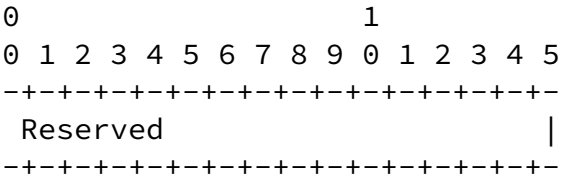
3. L2TPv3 Remote End Identifier AVP

6.2. L2TPv3 VCCV Capability Negotiation

A LCCE or a LAC should be able to indicate whether the session is capable of processing VCCV packets. This is done by including the optional VCCV capability AVP in an ICRQ, ICRP, OCRQ or OCRP.

6.2.1. L2TPv3 VCCV Capability AVP

This AVP specifies the VCCV capability. Its attribute type is TBD. The value field has the following format:



6.3. L2TPv3 VCCV Operation

A PE sends VCCV echo requests on a L2TPv3 signaled pseudo wire for fault detection and diagnostic of the L2TPv3 session. The destination

IP address in the echo request is set to the remote PE's IP address,

while the source IP address is set to the local PE's IP address. The egress of the L2TPv3 session verifies the signaling and forwarding state of the pseudo wire, on reception of the VCCV message. Any faults detected can be signaled in the VCCV echo response. Its to be noted that the VCCV mechanism for L2TPv3 is primarily targeted at verifying

the pseudo wire forwarding and signaling state at the egress PE. It also helps when L2TPv3 control and session paths are not identical.

A PE must send VCCV packets on a L2TPv3 session only if it has signaled VCCV capability to the remote end and received VCCV capability from the remote end. If a PE receives VCCV packets and its not VCCV capable or

it has not received VCCV capability indication from the remote end, it must discard these messages. In addition if a PE receives VCCV messages and it has not received VCCV capability from the remote end, it should

increment an error counter. In this case the PE can optionally issue a system and/or SNMP notification.

7. Acknowledgments

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9. Security Considerations

TBD.

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