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IGMP and MLD Snooping Yang Module Extension for L2VPN
draft-ietf-pim-igmp-mld-snooping-yang-l2vpn-ext-07

Abstract

Internet Group Management Protocol (IGMP) and Multicast Listener Discovery (MLD) Snooping could be used in both bridge service and L2VPN service. The old ietf-igmp-mld-snooping yang module just describes the bridge service. In this document we extend the existing ietf-igmp-mld-snooping yang module and make it could be used in L2VPN service.

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1. Introduction

The Internet Group Management Protocol (IGMP) and Multicast Listener Discovery (MLD) Snooping [RFC4541] could be used in both bridge and L2VPN. This document extends the existing ietf-igmp-mld-snooping yang module and introduces l2vpn as a new l2-service-type [RFC9166]. The YANG module in this document conforms to the Network Management Datastore Architecture defined in [RFC8342].

1.1. Terminology

The terminology for describing YANG data models is found in [RFC6020]

and [RFC7950], including:

* augment
* data model
* data node
* identity
* module

The following terminologies are used in this document:

* mrouter: The multicast router, which is a router that has multicast routing enabled [RFC4286].
* mrouter interface: The snooping switch ports where multicast routers are attached [RFC4541]. Either Attachment Circuit (AC) or Pseudo Wire (PW) could be mrouter interface in L2VPN.

The following abbreviations are used in this document and defined model:

IGMP: Internet Group Management Protocol [RFC3376].

MLD: Multicast Listener Discovery [RFC3810].

AC: Attachment Circuit [RFC3916].

PW: Pseudo Wire [RFC3916].

1.2. Tree Diagrams

Tree diagrams used in this document follow the notation defined in

[RFC8340].

1.3. Prefixes in Data Node Names

In this document, names of data nodes, actions, and other data model objects are often used without a prefix, as long as it is clear from the context in which YANG module each name is defined. Otherwise, names are prefixed using the standard prefix associated with the corresponding YANG module, as shown in Table 1.

Prefix	YANG module	Reference
if	ietf-interfaces	[RFC8343]
rt	ietf-routing	[RFC8349]
ni	ietf-network-instance	[RFC8529]
ims	ietf-igmp-mld-snooping	[RFC9166]
pw	ietf-pseudowires	[draft-ietf-bess-l2vpn-yang]
l2vpn	ietf-l2vpn	[draft-ietf-bess-l2vpn-yang]

Table 1: Prefixes and Corresponding YANG Modules

2. Design of Data Model

Besides bridge, IGMP & MLD snooping also provides a way to constrain multicast traffic for L2VPN. By monitoring the IGMP & MLD membership reports sent by hosts within the L2VPN domain, IGMP & MLD snooping can set up Layer 2 multicast forwarding tables to deliver traffic only to ports with at least one interested member within the L2VPN domain. Thereby significantly reduce the volume of multicast traffic that would otherwise flood an entire L2VPN domain. The IGMP & MLD snooping operation applies to both access circuits and pseudowires within a L2VPN domain. A network-instance [RFC8529] whose type is vpls-instance-type [draft-ietf-bess-l2vpn-yang] could be treated as a L2VPN domain.

The YANG module in this document includes all the common building blocks for IGMP & MLD snooping used in L2VPN. It defines a new L2 service type which is L2VPN [draft-ietf-bess-l2vpn-yang]. When value of l2-service-type is l2vpn, the IGMP & MLD Snooping instance will be used in the L2VPN service. One instance corresponds to one L2VPN [draft-ietf-bess-l2vpn-yang] instance. It also defines mrouter interface and outgoing interface including statically configured and dynamically learned.

3. Module Structure

This module augments ietf-igmp-mld-snooping data model specified in [RFC9166]. It adds mrouter interface, outgoing AC and outgoing PW which could be used in both igmp-snooping-instance and mld-snooping-instance.

This module also defines how to use the igmp-snooping-instance and mld-snooping-instance in L2VPN service.

This module conforms to the Network Management Datastore Architecture (NMDA) [RFC8342]. The operational state data is combined with the associated configuration data in the same hierarchy [RFC8407].

3.1. Mrouter interface for L2VPN

This module augments /rt:routing/rt:control-plane-protocols/rt:control-plane-protocol/ims:igmp-snooping-instance to add mrouter interface for L2VPN in IGMP Snooping.

The static-l2vpn-mrouter-interface-ac and static-l2vpn-mrouter-interface-pw represent mrouter interfaces which are manually configured.

The l2vpn-mrouter-interface-ac and l2vpn-mrouter-interface-pw represent mrouter interfaces learned by the snooping device dynamically.

```
  augment /rt:routing/rt:control-plane-protocols
            /rt:control-plane-protocol/ims:igmp-snooping-instance:
    +--rw static-l2vpn-mrouter-interface-ac*   if:interface-ref
    +--rw static-l2vpn-mrouter-interface-pw*   pw:pseudowire-ref
    +--ro l2vpn-mrouter-interface-ac*          if:interface-ref
   +--ro l2vpn-mrouter-interface-pw*          pw:pseudowire-ref
```

Similarly this module also augments /rt:routing/rt:control-plane-protocols/rt:control-plane-protocol/ims:mld-snooping-instance to add mrouter interface for L2VPN in MLD Snooping.

```
  augment /rt:routing/rt:control-plane-protocols
            /rt:control-plane-protocol/ims:mld-snooping-instance:
    +--rw static-l2vpn-mrouter-interface-ac*   if:interface-ref
    +--rw static-l2vpn-mrouter-interface-pw*   pw:pseudowire-ref
    +--ro l2vpn-mrouter-interface-ac*          if:interface-ref
    +--ro l2vpn-mrouter-interface-pw*          pw:pseudowire-ref
```

3.2. Outgoing interface for L2VPN

IGMP & MLD snooping can set up Layer 2 multicast forwarding tables to deliver multicast traffic, so each packet should have at least one corresponding outgoing interface. The outgoing interfaces might be Attachment Circuit (AC) or Pseudo Wire (PW) in L2VPN. They could be manually configured or dynamically learned by the snooping device.

This module augments /rt:routing/rt:control-plane-protocols/rt:control-plane-protocol/ims:igmp-snooping-instance/ims:static-l2-multicast-group to add l2vpn-outgoing-ac and l2vpn-outgoing-pw for L2VPN in IGMP Snooping. They should be configured manually.

```
  augment /rt:routing/rt:control-plane-protocols
            /rt:control-plane-protocol/ims:igmp-snooping-instance
            /ims:static-l2-multicast-group:
    +--rw l2vpn-outgoing-ac*   if:interface-ref
   +--rw l2vpn-outgoing-pw*   pw:pseudowire-ref
```

Similarly it also augments /rt:routing/rt:control-plane-protocols/rt:control-plane-protocol/ims:mld-snooping-instance/ims:static-l2-multicast-group to add l2vpn-outgoing-ac and l2vpn-outgoing-pw for L2VPN in MLD Snooping. They should be configured manually.

```
  augment /rt:routing/rt:control-plane-protocols
            /rt:control-plane-protocol/ims:mld-snooping-instance
            /ims:static-l2-multicast-group:
    +--rw l2vpn-outgoing-ac*   if:interface-ref
   +--rw l2vpn-outgoing-pw*   pw:pseudowire-ref
```

This module augments /rt:routing/rt:control-plane-protocols/rt:control-plane-protocol/ims:igmp-snooping-instance/ims:group/ims:source to add l2vpn-outgoing-ac and l2vpn-outgoing-pw for L2VPN in IGMP Snooping. They are read only and should be filled dynamically.

```
  augment /rt:routing/rt:control-plane-protocols
            /rt:control-plane-protocol/ims:igmp-snooping-instance
            /ims:group/ims:source:
    +--ro l2vpn-outgoing-ac*   if:interface-ref
    +--ro l2vpn-outgoing-pw*   pw:pseudowire-ref
```

Similarly it also augments /rt:routing/rt:control-plane-protocols/rt:control-plane-protocol/ims:mld-snooping-instance/ims:group/ims:source to add l2vpn-outgoing-ac and l2vpn-outgoing-pw for L2VPN in MLD Snooping. They are read only and should be filled dynamically.

```
  augment /rt:routing/rt:control-plane-protocols
            /rt:control-plane-protocol/ims:mld-snooping-instance
            /ims:group/ims:source:
    +--ro l2vpn-outgoing-ac*   if:interface-ref
    +--ro l2vpn-outgoing-pw*   pw:pseudowire-ref
```

3.3. Using IGMP and MLD Snooping Instances in L2VPN service

This module augments /ni:network-instances/ni:network-instance/ni:ni-type/l2vpn:l2vpn [draft-ietf-bess-l2vpn-yang] to use igmp-snooping-

instance. It means IGMP Snooping is enabled in the specified L2VPN instance.

```
  augment /ni:network-instances/ni:network-instance/ni:ni-type
            /l2vpn:l2vpn:
    +--rw igmp-snooping-instance?
    |       ims:igmp-mld-snooping-instance-ref
    +--rw mld-snooping-instance?
            ims:igmp-mld-snooping-instance-ref
```

The mld-snooping-instance could be used in concurrence with igmp-snooping-instance to configure the MLD Snooping.

4. IGMP and MLD Snooping Yang Module Extension

This module references [RFC1112],[RFC2236],[RFC2710],[RFC3376], [RFC3810],[RFC4541],[RFC5790],[RFC6991],[RFC7761],[RFC8343],[RFC8529],[RFC9166] and [draft-ietf-bess-l2vpn-yang].

<CODE BEGINS> file ietf-igmp-mld-snooping-l2vpn@2022-10-11.yang

```
module ietf-igmp-mld-snooping-l2vpn {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-igmp-mld-snooping-l2vpn";

  prefix l2vpn-ims;

  import ietf-interfaces {
    prefix "if";
    reference
      "RFC 8343: A YANG Data Model for Interface Management";
  }

  import ietf-routing {
    prefix "rt";
    reference
      "RFC 8349: A YANG Data Model for Routing Management (NMDA
       Version)";
  }

  import ietf-network-instance {
    prefix "ni";
    reference
      "RFC 8529: YANG Data Model for Network Instances";
  }

  import ietf-igmp-mld-snooping {
    prefix "ims";
    reference
      "RFC 9166: A YANG Data Model for Internet Group Management
       Protocol (IGMP) and
       Multicast Listener Discovery (MLD) Snooping";
```

```
  }

  import ietf-l2vpn {
    prefix "l2vpn";
    reference
      "draft-ietf-bess-l2vpn-yang: YANG Data Model for MPLS-based
L2VPN";
  }

  import ietf-pseudowires {
    prefix "pw";
    reference
      "draft-ietf-bess-l2vpn-yang: YANG Data Model for MPLS-based
L2VPN";
  }

  organization
    "IETF PIM Working Group";

  contact
    "WG Web:   <http://datatracker.ietf.org/wg/pim/>
     WG List:  <mailto:pim@ietf.org>

     Editors:  Hongji Zhao
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    ";

  description
    "The module contains a collection of YANG definitions of
     IGMP & MLD Snooping in L2VPN service.

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     authors of the code.  All rights reserved.

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     forth in Section 4.c of the IETF Trust's Legal Provisions
     Relating to IETF Documents
```

```
     (http://trustee.ietf.org/license-info).

     This version of this YANG module is part of RFC XXXX; see the
     RFC itself for full legal notices.";

  revision 2022-10-11 {
    description
      "Initial revision.";
    reference
      "RFC XXXX: IGMP and MLD Snooping Yang Module Extension
       in L2VPN service";
  }

  /* identities */

  identity l2vpn {
    base ims:l2-service-type;
    description
      "This identity represents L2VPN service.";
  }

  /*
   * Groupings
   */

  grouping static-l2vpn-mrouter-interface-ac-pw {
    description
      "The static mrouter interface in L2VPN service.";

    leaf-list static-l2vpn-mrouter-interface-ac {
      when 'derived-from-or-self(../l2-service-type,"ims:l2vpn")';
      type if:interface-ref;
      description
        "The static mrouter interface whose type is interface
         in L2VPN service.";
    }

    leaf-list static-l2vpn-mrouter-interface-pw {
      when 'derived-from-or-self(../l2-service-type,"ims:l2vpn")';
      type pw:pseudowire-ref;
      description
        "The static mrouter interface whose type is PW
         in L2VPN service.";
    }
  }

  grouping dynamic-l2vpn-mrouter-interface-ac-pw {

    description
      "The dynamic mrouter interface in L2VPN service.";

    leaf-list l2vpn-mrouter-interface-ac {
```

```
      when 'derived-from-or-self(../l2-service-type,"ims:l2vpn")';
      type if:interface-ref;
      config false;
      description
        "The mrouter interface whose type is interface in L2VPN
         service. When switch receives IGMP/MLD queries from
         multicast router on an interface, this interface will
         become mrouter interface for IGMP/MLD snooping.";
    }

    leaf-list l2vpn-mrouter-interface-pw {
      when 'derived-from-or-self(../l2-service-type,"ims:l2vpn")';
      type pw:pseudowire-ref;
      config false;
      description
        "The mrouter interface whose type is PW in L2VPN service.
         When switch receives IGMP/MLD queries from multicast router
         on a PW, this PW will become mrouter interface for IGMP/MLD
         snooping.";
    }
  }

  grouping l2vpn-outgoing-ac-pw {
    description
      "Outgoing Attachment Circuit (AC) or Pseudo Wire (PW) in L2VPN.";

    leaf-list l2vpn-outgoing-ac {
      when 'derived-from-or-self(../../../l2-service-type,"ims:l2vpn")';
      type if:interface-ref;
      description "Outgoing Attachment Circuit (AC) in L2VPN";
    }

    leaf-list l2vpn-outgoing-pw {
      when 'derived-from-or-self(../../../l2-service-type,"ims:l2vpn")';
      type pw:pseudowire-ref;
      description "Outgoing Pseudo Wire (PW) in L2VPN";
    }
  }

  /*
   * The mrouter interface in L2VPN service.
   */

  augment "/rt:routing/rt:control-plane-protocols"+
        "/rt:control-plane-protocol/ims:igmp-snooping-instance" {

    description
      "The mrouter interface in L2VPN service for IGMP Snooping.";

    uses static-l2vpn-mrouter-interface-ac-pw;

    uses dynamic-l2vpn-mrouter-interface-ac-pw;
```

```
  }

  augment "/rt:routing/rt:control-plane-protocols"+
        "/rt:control-plane-protocol/ims:mld-snooping-instance" {
    description
      "The mrouter interface in L2VPN service for MLD Snooping.";

    uses static-l2vpn-mrouter-interface-ac-pw;

    uses dynamic-l2vpn-mrouter-interface-ac-pw;

  }

  /*
   * Static Outgoing AC or PW in L2VPN service
   */

  augment "/rt:routing/rt:control-plane-protocols"+
        "/rt:control-plane-protocol"+
        "/ims:igmp-snooping-instance/ims:static-l2-multicast-group" {

    description
      "Static Outgoing AC or PW in L2VPN service for IGMP snooping.";

    uses l2vpn-outgoing-ac-pw;

  }

  augment "/rt:routing/rt:control-plane-protocols"+
        "/rt:control-plane-protocol"+
        "/ims:mld-snooping-instance/ims:static-l2-multicast-group" {

    description
      "Static Outgoing AC or PW in L2VPN service for MLD snooping.";

    uses l2vpn-outgoing-ac-pw;

  }

  /*
   * Dynamic Outgoing AC or PW in L2VPN service
   */

  augment "/rt:routing/rt:control-plane-protocols"+
        "/rt:control-plane-protocol"+
        "/ims:igmp-snooping-instance/ims:group/ims:source" {

    description
      "Dynamic Outgoing AC or PW in L2VPN service for IGMP snooping.";

    uses l2vpn-outgoing-ac-pw;
```

```
  }

  augment "/rt:routing/rt:control-plane-protocols"+
        "/rt:control-plane-protocol"+
        "/ims:mld-snooping-instance/ims:group/ims:source" {

    description
      "Dynamic Outgoing AC or PW in L2VPN service for MLD snooping.";

    uses l2vpn-outgoing-ac-pw;

  }

  /*
   * Use IGMP & MLD snooping instance in L2VPN
   */

  augment "/ni:network-instances/ni:network-instance"+
    "/ni:ni-type/l2vpn:l2vpn" {

    description
      "Use IGMP & MLD snooping instance in L2VPN.";

    leaf igmp-snooping-instance {
      type ims:igmp-mld-snooping-instance-ref;
      description
        "Configure IGMP snooping instance in L2VPN.";
    }

    leaf mld-snooping-instance {
      type ims:igmp-mld-snooping-instance-ref;
      description
        "Configure MLD snooping instance in L2VPN.";
    }
  }
}
<CODE ENDS>
```

5. Security Considerations

The YANG module specified in this document defines a schema for data that is designed to be accessed via network management protocols such as NETCONF [RFC6241] or RESTCONF [RFC8040]. The lowest NETCONF layer is the secure transport layer, and the mandatory-to-implement secure transport is Secure Shell (SSH) [RFC6242]. The lowest RESTCONF layer is HTTPS, and the mandatory-to-implement secure transport is TLS [RFC8446].

The Network Configuration Access Control Model (NACM) [RFC8341] provides the means to restrict access for particular NETCONF or RESTCONF users to a preconfigured subset of all available NETCONF or RESTCONF protocol operations and content.

There are a number of data nodes defined in this YANG module that are writable/creatable/deletable (i.e., config true, which is the default). These data nodes may be considered sensitive or vulnerable in some network environments. Write operations (e.g., edit-config) to these data nodes without proper protection can have a negative effect on network operations. These are the subtrees and data nodes and their sensitivity/vulnerability, and they are all under /rt:routing/rt:control-plane-protocols/rt:control-plane-protocol:/ims:igmp-snooping-instance or /rt:routing/rt:control-plane-protocols/rt:control-plane-protocol:/ims:mld-snooping-instance :

/l2vpn-ims:static-l2vpn-mrouter-interface-ac

/l2vpn-ims:static-l2vpn-mrouter-interface-pw

/ims:static-l2-multicast-group/l2vpn-ims:l2vpn-outgoing-ac

/ims:static-l2-multicast-group/l2vpn-ims:l2vpn-outgoing-pw

The subtrees under /ni:network-instances/ni:network-instance/ni:ni-type/l2vpn:l2vpn

ims:igmp-snooping-instance

ims:mld-snooping-instance

Unauthorized access to any data node of these subtrees can adversely affect the IGMP & MLD Snooping subsystem of both the local device and the network. This may lead to network malfunctions, delivery of packets to inappropriate destinations, and other problems.

Some of the readable data nodes in this YANG module may be considered sensitive or vulnerable in some network environments. It is thus important to control read access (e.g., via get, get-config, or notification) to these data nodes. These are the subtrees and data nodes and their sensitivity/vulnerability, and they are all under /rt:routing/rt:control-plane-protocols/rt:control-plane-protocol:/ims:igmp-snooping-instance or /rt:routing/rt:control-plane-protocols/rt:control-plane-protocol:/ims:mld-snooping-instance:

/l2vpn-ims:l2vpn-mrouter-interface-ac

/l2vpn-ims:l2vpn-mrouter-interface-pw

/ims:group/ims:source/l2vpn-ims:l2vpn-outgoing-ac

/ims:group/ims:source/l2vpn-ims:l2vpn-outgoing-pw

Unauthorized access to any data node of these subtrees can disclose the operational state information of IGMP & MLD Snooping on this device. The devices that use this YANG module should heed the Security Considerations in [RFC4541].

6. IANA Considerations

RFC Ed.: In this section, replace all occurrences of 'XXXX' with the actual RFC number (and remove this note).

6.1. XML Registry

This document registers the following namespace URIs in the IETF XML

registry [RFC3688]:

URI: urn:ietf:params:xml:ns:yang:ietf-igmp-mld-snooping-l2vpn
Registrant Contact: The IETF.
XML: N/A, the requested URI is an XML namespace.

6.2. YANG Module Names Registry

This document registers the following YANG modules in the YANG Module Names registry [RFC7950]:

---

name: ietf-igmp-mld-snooping-l2vpn
namespace: urn:ietf:params:xml:ns:yang:ietf-igmp-mld-snooping-l2vpn
prefix: l2vpn-ims
reference: RFC XXXX

---

7. References

7.1. Normative References

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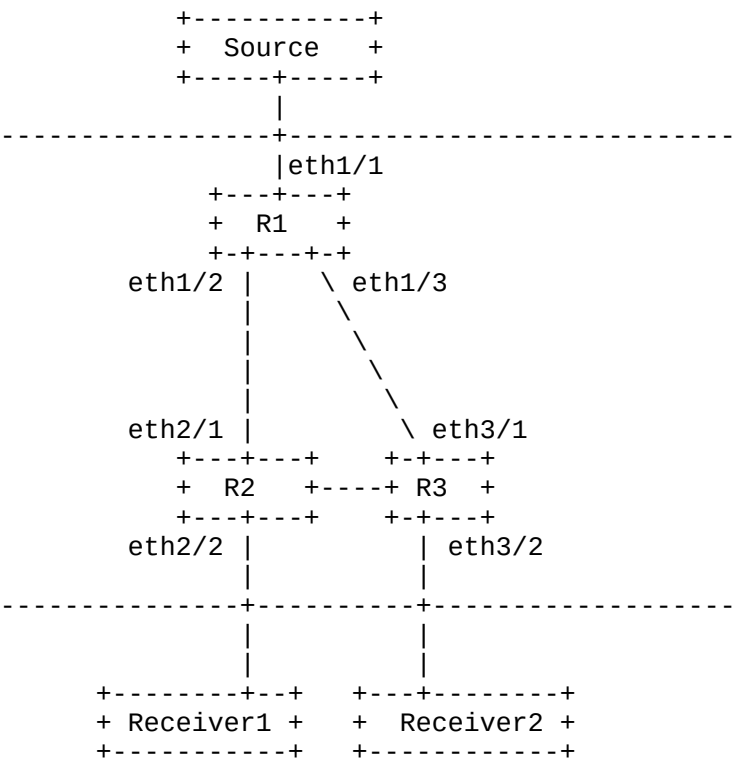
Appendix A. Data Tree Example

L2VPN service

This section contains an example for L2VPN service in the JSON encoding [RFC7951], containing both configuration and state data.



The configuration data for R1 in the above figure could be as follows:

```
{
"ietf-interfaces:interfaces":{
  "interface":[
   {
    "name":"eth1/1",
    "type":"iana-if-type:ethernetCsmacd"
   }
  ]
 },
 "ietf-pseudowires:pseudowires": {
  "pseudowire": [
   {
    "name": "pw2"
   },
```

```
   {
    "name": "pw3"
   }
  ]
 },
 "ietf-network-instance:network-instances": {
  "network-instance": [
   {
    "name": "vpls1",
    "ietf-igmp-mld-snooping:igmp-snooping-instance": "vis1",
    "ietf-l2vpn:type": "ietf-l2vpn:vpls-instance-type",
    "ietf-l2vpn:signaling-type": "ietf-l2vpn:ldp-signaling",
    "ietf-l2vpn:endpoint": [
     {
      "name": "acs",
      "ac": [
        {
         "name": "eth1/1"
        }
      ]
     },
     {
      "name": "pws",
      "pw": [
        {
         "name": "pw2"
        },
        {
         "name": "pw3"
        }
      ]
     }
    ]
   }
  ]
 },
 "ietf-routing:routing": {
  "control-plane-protocols": {
   "control-plane-protocol": [
    {
     "type": "ietf-igmp-mld-snooping:igmp-snooping",
     "name": "vis1",
     "ietf-igmp-mld-snooping:igmp-snooping-instance": {
      "l2-service-type": "l2vpn-ims:l2vpn",
      "enable": true
     }
    }
   ]
  }
 }
}
```

The corresponding operational state data for R1 could be as follows:


```
{
"ietf-interfaces:interfaces":{
  "interface":[
   {
    "name":"eth1/1",
    "type":"iana-if-type:ethernetCsmacd",
    "oper-status": "up",
    "statistics": {
     "discontinuity-time": "2018-05-23T12:34:56-05:00"
    }
   }
  ]
 },
 "ietf-pseudowires:pseudowires": {
  "pseudowire": [
   {
    "name": "pw2"
   },
   {
    "name": "pw3"
   }
  ]
 },
 "ietf-network-instance:network-instances": {
  "network-instance": [
   {
    "name": "vpls1",
    "ietf-igmp-mld-snooping:igmp-snooping-instance": "vis1",
    "ietf-l2vpn:type": "ietf-l2vpn:vpls-instance-type",
    "ietf-l2vpn:signaling-type": "ietf-l2vpn:ldp-signaling",
    "ietf-l2vpn:endpoint": [
     {
      "name": "acs",
      "ac": [
        {
         "name": "eth1/1"
        }
      ]
     },
     {
      "name": "pws",
      "pw": [
        {
         "name": "pw2"
        },
        {
         "name": "pw3"
        }
```

```
      ]
     }
    ]
   }
  ]
 },
 "ietf-routing:routing": {
  "control-plane-protocols": {
   "control-plane-protocol": [
    {
     "type": "ietf-igmp-mld-snooping:igmp-snooping",
     "name": "vis1",
     "ietf-igmp-mld-snooping:igmp-snooping-instance": {
      "l2-service-type": "l2vpn-ims:l2vpn",
      "enable": true
     }
    }
   ]
  }
 }
}
```

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