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RFC 9836
A YANG Data Model for Augmenting VPN Service and Network Models with Attachment Circuits

Abstract

This document defines a YANG data model, referred to as the "AC Glue" model, to augment the LxVPN Service Model (LxSM) and LxVPN Network Model (LxNM) with references to attachment circuits (ACs). The AC Glue model enables a provider to associate Layer 2/3 VPN (LxVPN) services with the underlying AC infrastructure, thereby facilitating consistent provisioning and management of new or existing ACs in conjunction with LxVPN services. Specifically, by introducing an integrated approach to AC and LxVPN management, this model supports Attachment Circuit as a Service (ACaaS) and provides a standardized mechanism for aligning AC/VPN requests with the network configurations required to deliver them.

Status of This Memo

This is an Internet Standards Track document.

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1. Introduction

To facilitate data transfer within the provider network, it is assumed that the appropriate setup is provisioned over the links that connect customer termination points and a provider network (usually via a Provider Edge (PE)), allowing data to be successfully exchanged over these links. The required setup is referred to in this document as an attachment circuit (AC), while the underlying link is referred to as "bearer".

The document specifies a YANG module ("ietf-ac-glue", Section 6) that updates existing service and network Virtual Private Network (VPN) modules with the required information to bind specific services to ACs that are created using the AC service model [RFC9834]. Specifically, the following modules are augmented:

- The L2VPN Service Model (L2SM) [RFC8466]
- The L3VPN Service Model (L3SM) [RFC8299]
- The L2VPN Network Model (L2NM) [RFC9291]
- The L3VPN Network Model (L3NM) [RFC9182]

Likewise, the document augments the L2NM and L3NM with references to the ACs that are managed using the AC network model [RFC9835].

This approach allows operators to separate AC provisioning from actual VPN service provisioning. Refer to Section 4.2 for more discussion.

The YANG data model in this document conforms to the Network Management Datastore Architecture (NMDA) defined in [RFC8342].

Examples to illustrate the use of the "ietf-ac-glue" module are provided in Appendix A.

2.   Conventions and Definitions

The meanings of the symbols in the YANG tree diagrams are defined in [RFC8340].

This document uses terms defined in [RFC9834].

LxSM refers to both the L2SM and the L3SM.

LxNM refers to both the L2NM and the L3NM.

The following terms are used in the module's prefixes:

ac: Attachment circuit

ntw: Network

ref: Reference

svc: Service

The names of data nodes are prefixed using the prefix associated with the corresponding imported YANG module as shown in Table 1:

Prefix	Module	Reference
ac-svc	ietf-ac-svc	Section 6.2 of [RFC9834]

Prefix	Module	Reference
ac-ntw	ietf-ac-ntw	[RFC9835]
l2nm	ietf-l2vpn-ntw	[RFC9291]
l2vpn-svc	ietf-l2vpn-svc	[RFC8466]
l3nm	ietf-l3vpn-ntw	[RFC9182]
l3vpn-svc	ietf-l3vpn-svc	[RFC8299]

Table 1: Modules and Their Associated Prefixes

3. Relationship to Other AC Data Models

Figure 1 depicts the relationship between the various AC data models:

- "ietf-ac-common" [RFC9833]
- "ietf-bearer-svc" (Section 6.1 of [RFC9834])
- "ietf-ac-svc" (Section 6.2 of [RFC9834])
- "ietf-ac-ntw" [RFC9835]
- "ietf-ac-glue" (Section 6)

```
                          ietf-ac-common
                        ▲       ▲       ▲
                        │       │       │
                        │       │       │
                        │       │       │
      ietf-ac-svc  ◄────── ietf-bearer-svc       │
        ▲      ▲                                  │
        │      │                                  │
        │      └──────────────────┐   ietf-ac-ntw
        │                         │        ▲
        │                         │        │
        │      ietf-ac-glue ──────────────┘

X ───▶ Y: X imports Y
```
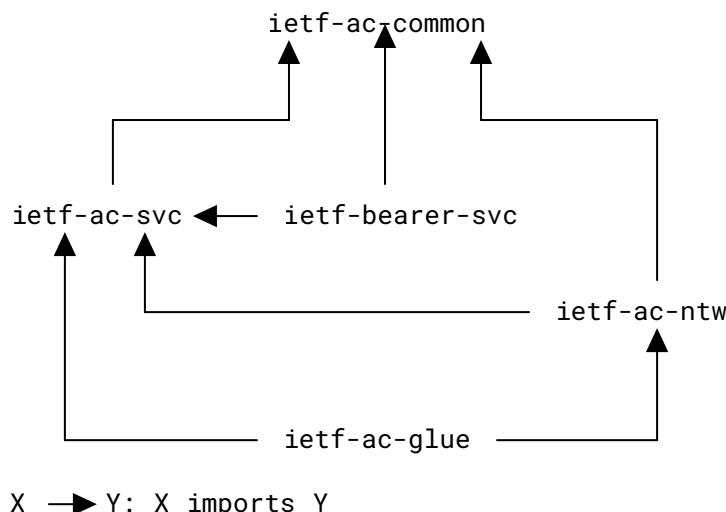
Figure 1: AC Data Models

The "ietf-ac-common" module is imported by the "ietf-bearer-svc", "ietf-ac-svc", and "ietf-ac-ntw" modules. Bearers managed using the "ietf-bearer-svc" module may be referenced by service ACs managed using the "ietf-ac-svc" module. Similarly, a bearer managed using the "ietf-bearer-svc"
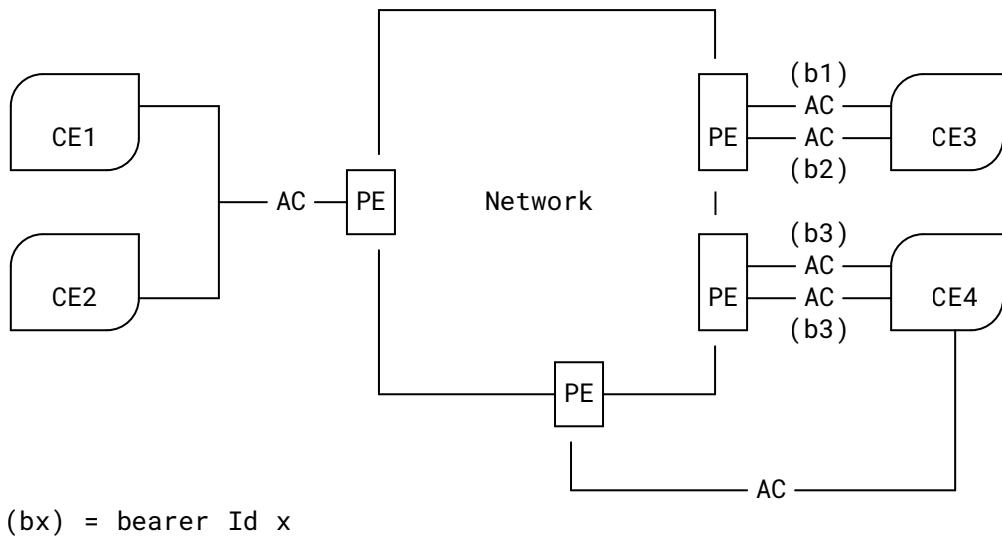
module may list the set of ACs that use that bearer. To facilitate correlation between an AC service request and the actual AC provisioned in the network, "ietf-ac-ntw" leverages the AC references exposed by the "ietf-ac-svc" module. Furthermore, to bind Layer 2 VPN (L2VPN) or Layer 3 VPN (L3VPN) services with ACs, the "ietf-ac-glue" module augments the LxSM and LxNM with AC service references exposed by the "ietf-ac-svc" module and AC network references exposed by the "ietf-ac-ntw" module.

4. Sample Uses of the Data Models

4.1. ACs Terminated by One or Multiple Customer Edges (CEs)

Figure 2 depicts two target topology flavors that involve ACs. These topologies have the following characteristics:

- A Customer Edge (CE) can be either a physical device or a logical entity. Such logical entity is typically a software component (e.g., a virtual service function that is hosted within the provider's network or a third-party infrastructure). A CE is seen by the network as a peer Service Attachment Point (SAP) [RFC9408].

- CEs may be either dedicated to one single connectivity service or host multiple connectivity services (e.g., CEs with roles of service functions [RFC7665]).

- A network provider may bind a single AC to one or multiple peer SAPs (e.g., CE1 and CE2 are tagged as peer SAPs for the same AC). For example, and as discussed in [RFC4364], multiple CEs can be attached to a PE over the same AC. This scenario is typically implemented when the Layer 2 infrastructure between the CE and the network is a multipoint service.

- A single CE may terminate multiple ACs, which can be associated with the same bearer or distinct bearers (e.g., CE4).

- Customers may request protection schemes in which the ACs associated with their endpoints are terminated by the same PE (e.g., CE3), distinct PEs (e.g., CE4), etc. The network provider uses this request to decide where to terminate the AC in the service provider network and also whether to enable specific capabilities (e.g., Virtual Router Redundancy Protocol (VRRP)).

```
                      _____
                     |                           |
   _____            |                           |      (b1)   _____
  |      \           |                          _|_____  AC   |      \
  |  CE1  |_____    |                         |     |_____|      |
  |       |      |   |                         | PE  |  AC    | CE3  |
  |_____|      |  _|_                        |_____|_____|      |
                 |_| PE|     Network              |      (b2)  |_____|
   _____        | |___|                          |
  |      \    AC   |                               |     (b3)   _____
  |  CE2  |_____  |                          _____|__  AC     |      \
  |       |        |                         |     |_____|   \
  |_____|        |                         | PE  |  AC    | CE4  |
                   |                         |_____|_____|      |
                   |          _____             |      (b3)  |     |
                   |_____|     |_____|            |     |
                             | PE  |                         |_____|
                             |_____|                            |
                               |                                |
                               |_____AC_____|


       (bx) = bearer Id x
```

Figure 2: Examples of ACs
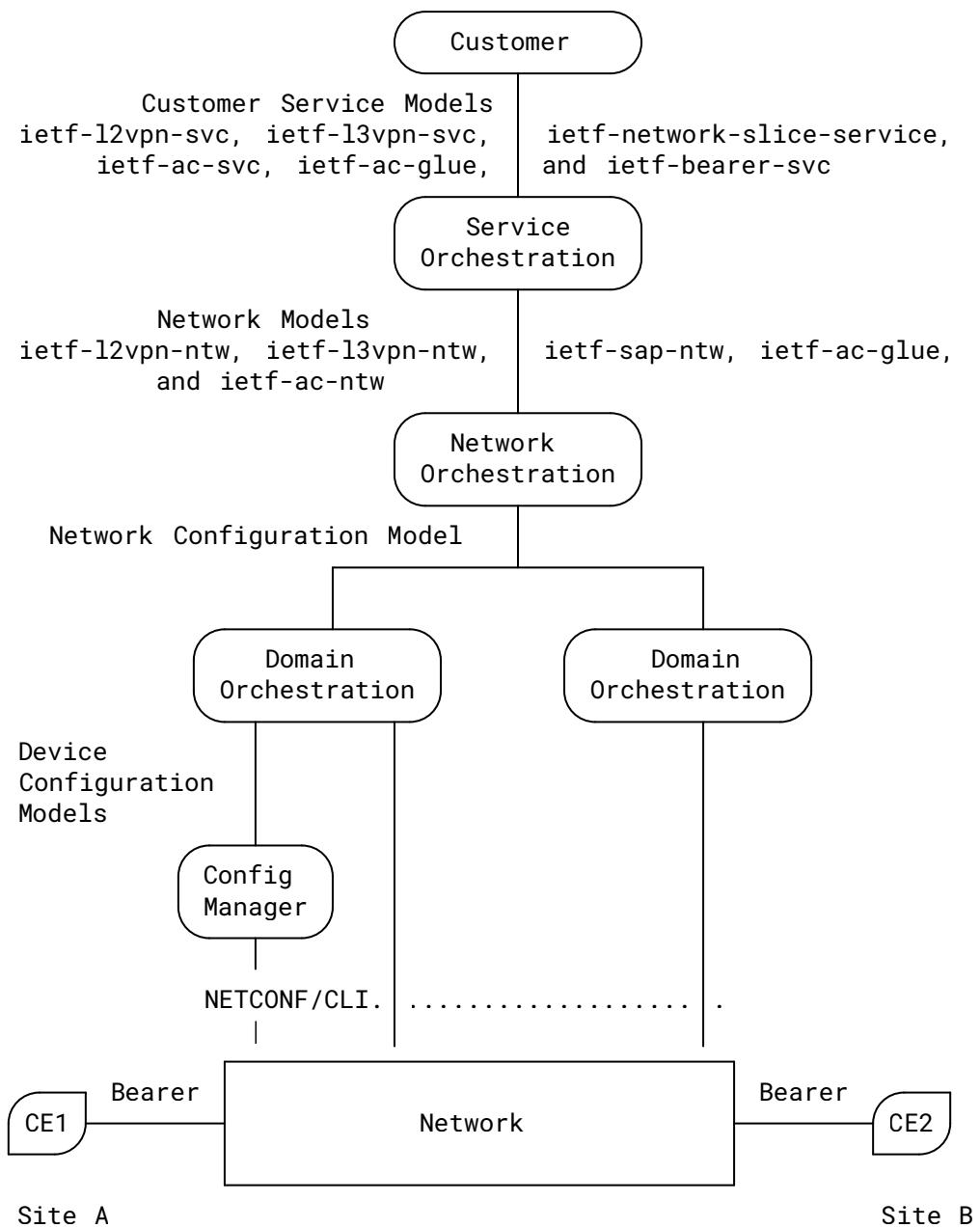
These ACs can be referenced when creating VPN services. Refer to the examples provided in Appendix A to illustrate how VPN services can be bound to ACs.

4.2. Separate AC Provisioning from Actual VPN Service Provisioning

The procedure to provision a service in a service provider network may depend on the practices adopted by a service provider. This includes the flow put in place for the provisioning of advanced network services and how they are bound to an AC. For example, a single AC may be used to host multiple connectivity services (e.g., L2VPN ("ietf-l2vpn-svc"), L3VPN ("ietf-l3vpn-svc"), Network Slice Service ("ietf-network-slice-service")). In order to avoid service interference and redundant information in various locations, a service provider may expose an interface to manage ACs network-wide using the modules in [RFC9834]. Customers can request for an AC ("ietf-ac-svc") to be put in place and then refer to that AC when requesting VPN services that are bound to the AC ("ietf-ac-glue").

Also, internal references ("ietf-ac-ntw") used within a service provider network to implement ACs can be used by network controllers to glue the L2NM ("ietf-l2vpn-ntw") or the L3NM ("ietf-l3vpn-ntw") services with relevant ACs.

Figure 3 shows the positioning of the AC models in the overall service delivery process.

```
                              ╭─────────────╮
                              │   Customer  │
                              ╰─────────────╯
                                    │
          Customer Service Models   │
     ietf-l2vpn-svc, ietf-l3vpn-svc, │ ietf-network-slice-service,
         ietf-ac-svc, ietf-ac-glue, │ and ietf-bearer-svc
                              ╭─────────────╮
                              │   Service   │
                              │ Orchestration│
                              ╰─────────────╯
                                    │
          Network Models            │
     ietf-l2vpn-ntw, ietf-l3vpn-ntw, │ ietf-sap-ntw, ietf-ac-glue,
            and ietf-ac-ntw          │
                              ╭─────────────╮
                              │   Network   │
                              │ Orchestration│
                              ╰─────────────╯
                                    │
       Network Configuration Model  │
                          ┌─────────┴─────────┐
                  ╭───────────────╮   ╭───────────────╮
                  │    Domain     │   │    Domain     │
                  │ Orchestration │   │ Orchestration │
                  ╰───────────────╯   ╰───────────────╯
                         │   │                 │
    Device               │   │                 │
    Configuration        │   │                 │
    Models               │   │                 │
                  ╭──────────╮│                 │
                  │  Config  ││                 │
                  │ Manager  ││                 │
                  ╰──────────╯│                 │
                       │      │                 │
             NETCONF/CLI.│.....│..................│.
                       │      │                 │
       ┌────┐  Bearer  ┌────────────────────────────┐  Bearer  ┌────┐
       │CE1 │──────────│          Network           │──────────│CE2 │
       └────┘          └────────────────────────────┘          └────┘

     Site A                                                   Site B
```

Figure 3: An Example of AC Models Usage

5. Module Tree Structure

[RFC8299] specifies that a 'site-network-access' attachment is achieved through a 'bearer' with an 'ip-connection' on top. From that standpoint, a 'site-network-access' is mapped to an AC with both Layer 2 and Layer 3 properties per [RFC9834]. [RFC8466] specifies that a 'site-network-

access' represents a logical Layer 2 connection to a site. A 'site-network-access' can thus be mapped to an AC with Layer 2 properties [RFC9834]. Similarly, 'vpn-network-access' defined in both [RFC9182] and [RFC9291] is mapped to an AC per [RFC9834] or [RFC9835].

As such, ACs created using the "ietf-ac-svc" module [RFC9834] can be referenced in other VPN-related modules (e.g., LxSM and LxNM). Also, ACs managed using the "ietf-ac-ntw" module [RFC9835] can be referenced in VPN-related network modules (mainly, the LxNM). The required augmentations to that aim are shown in Figure 4.

```
module: ietf-ac-glue

  augment /l2vpn-svc:l2vpn-svc/l2vpn-svc:sites/l2vpn-svc:site
          /l2vpn-svc:site-network-accesses:
    +--rw ac-svc-ref*    ac-svc:attachment-circuit-reference
  augment /l2vpn-svc:l2vpn-svc/l2vpn-svc:sites/l2vpn-svc:site
          /l2vpn-svc:site-network-accesses
          /l2vpn-svc:site-network-access:
    +--rw ac-svc-ref?  ac-svc:attachment-circuit-reference {ac-glue}?
  augment /l3vpn-svc:l3vpn-svc/l3vpn-svc:sites/l3vpn-svc:site
          /l3vpn-svc:site-network-accesses:
    +--rw ac-svc-ref*    ac-svc:attachment-circuit-reference
  augment /l3vpn-svc:l3vpn-svc/l3vpn-svc:sites/l3vpn-svc:site
          /l3vpn-svc:site-network-accesses
          /l3vpn-svc:site-network-access:
    +--rw ac-svc-ref?  ac-svc:attachment-circuit-reference {ac-glue}?
  augment /l2nm:l2vpn-ntw/l2nm:vpn-services/l2nm:vpn-service
          /l2nm:vpn-nodes/l2nm:vpn-node/l2nm:vpn-network-accesses:
    +--rw ac-svc-ref*    ac-svc:attachment-circuit-reference
    +--rw ac-ntw-ref* [ac-ref]
       +--rw ac-ref         leafref
       +--rw node-ref?      leafref
       +--rw network-ref?    -> /nw:networks/network/network-id
  augment /l2nm:l2vpn-ntw/l2nm:vpn-services/l2nm:vpn-service
          /l2nm:vpn-nodes/l2nm:vpn-node/l2nm:vpn-network-accesses
          /l2nm:vpn-network-access:
    +--rw ac-svc-ref?  ac-svc:attachment-circuit-reference {ac-glue}?
    +--rw ac-ntw-ref {ac-glue}?
       +--rw ac-ref?        leafref
       +--rw node-ref?      leafref
       +--rw network-ref?    -> /nw:networks/network/network-id
  augment /l3nm:l3vpn-ntw/l3nm:vpn-services/l3nm:vpn-service
          /l3nm:vpn-nodes/l3nm:vpn-node/l3nm:vpn-network-accesses:
    +--rw ac-svc-ref*    ac-svc:attachment-circuit-reference
    +--rw ac-ntw-ref* [ac-ref]
       +--rw ac-ref         leafref
       +--rw node-ref?      leafref
       +--rw network-ref?    -> /nw:networks/network/network-id
  augment /l3nm:l3vpn-ntw/l3nm:vpn-services/l3nm:vpn-service
          /l3nm:vpn-nodes/l3nm:vpn-node/l3nm:vpn-network-accesses
          /l3nm:vpn-network-access:
    +--rw ac-svc-ref?  ac-svc:attachment-circuit-reference {ac-glue}?
    +--rw ac-ntw-ref {ac-glue}?
       +--rw ac-ref?        leafref
       +--rw node-ref?      leafref
       +--rw network-ref?    -> /nw:networks/network/network-id
```

Figure 4: AC Glue Tree Structure

When an AC is referenced within a specific network access, that AC information takes precedence over any overlapping information that is also enclosed for this network access.

> This approach is consistent with the design in [YANG-NSS] where an AC service
> reference, called 'ac-svc-ref', is used to indicate the names of AC services. As per
> [YANG-NSS], when both 'ac-svc-ref' and the attributes of 'attachment-circuits' are
> defined, the 'ac-svc-ref' takes precedence.

The "ietf-ac-glue" module includes provisions to reference ACs within or outside a VPN network access to accommodate deployment contexts where an AC reference may be created before or after a VPN instance is created. Appendix A.1 illustrates how an AC reference can be included as part of a specific VPN network access, while Appendix A.2 shows how AC references can be indicated outside individual VPN network access entries.

6. The AC Glue ("ietf-ac-glue") YANG Module

This modules augments the L2SM [RFC8466], the L3SM [RFC8299], the L2NM [RFC9291], and the L3NM [RFC9182].

This module uses references defined in [RFC9834] and [RFC9835].

```
<CODE BEGINS> file "ietf-ac-glue@2025-09-29.yang"

module ietf-ac-glue {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-ac-glue";
  prefix ac-glue;

  import ietf-l3vpn-svc {
    prefix l3vpn-svc;
    reference
      "RFC 8299: YANG Data Model for L3VPN Service Delivery";
  }
  import ietf-l2vpn-svc {
    prefix l2vpn-svc;
    reference
      "RFC 8466: A YANG Data Model for Layer 2 Virtual Private
                 Network (L2VPN) Service Delivery";
  }
  import ietf-l3vpn-ntw {
    prefix l3nm;
    reference
      "RFC 9182: A YANG Network Data Model for Layer 3 VPNs";
  }
  import ietf-l2vpn-ntw {
    prefix l2nm;
    reference
      "RFC 9291: A YANG Network Data Model for Layer 2 VPNs";
  }
  import ietf-ac-svc {
    prefix ac-svc;
    reference
      "RFC 9834: YANG Data Models for Bearers and Attachment
                 Circuits as a Service (ACaaS)";
  }
```

```
  import ietf-ac-ntw {
    prefix ac-ntw;
    reference
      "RFC 9835: A Network YANG Data Model for Attachment Circuits";
  }

  organization
    "IETF OPSAWG (Operations and Management Area Working Group)";
  contact
    "WG Web:   <https://datatracker.ietf.org/wg/opsawg/>
     WG List:  <mailto:opsawg@ietf.org>

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               <mailto:oscar.gonzalezdedios@telefonica.com>";
  description
    "This YANG module defines a YANG data model for augmenting the
     LxSM and the LxNM with AC references.

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     This version of this YANG module is part of RFC 9836; see the
     RFC itself for full legal notices.";

  revision 2025-09-29 {
    description
      "Initial revision.";
    reference
      "RFC 9836: A YANG Data Model for Augmenting VPN Service
                 and Network Models with Attachment Circuits";
  }

  feature ac-glue {
    description
      "The VPN implementation supports binding a specific VPN
       network access or site access to an AC.";
  }

  grouping single-ac-svc-ref {
    description
      "A grouping with a single reference to a service AC.";
    leaf ac-svc-ref {
      type ac-svc:attachment-circuit-reference;
      description
        "A reference to the AC as exposed at the service that was
```

```
              provisioned using the ACaaS module.";
        }
      }

      grouping single-ac-svc-ntw-ref {
        description
          "A grouping with single AC references.";
        leaf ac-svc-ref {
          type ac-svc:attachment-circuit-reference;
          description
            "A reference to the AC as exposed at the service that was
             provisioned using the ACaaS module.";
        }
        container ac-ntw-ref {
          description
            "A reference to the AC that was provisioned using the AC
             network module.";
          uses ac-ntw:attachment-circuit-reference;
        }
      }

      grouping ac-svc-ref {
        description
          "A set of service-specific AC-related data.";
        leaf-list ac-svc-ref {
          type ac-svc:attachment-circuit-reference;
          description
            "A reference to the AC as exposed at the service that was
             provisioned using the ACaaS module.";
        }
      }

      grouping ac-svc-ntw-ref {
        description
          "A set of AC-related data.";
        leaf-list ac-svc-ref {
          type ac-svc:attachment-circuit-reference;
          description
            "A reference to the AC as exposed at the service that was
             provisioned using the ACaaS module.";
        }
        list ac-ntw-ref {
          key "ac-ref";
          description
            "A reference to the AC that was provisioned using the AC
             network module.";
          uses ac-ntw:attachment-circuit-reference;
        }
      }

      augment "/l2vpn-svc:l2vpn-svc"
            + "/l2vpn-svc:sites/l2vpn-svc:site"
            + "/l2vpn-svc:site-network-accesses" {
        description
          "Augments VPN site network accesses with AC provisioning
           details.  Concretely, it binds a site to a set of ACs with
           Layer 2 properties that were created using the ACaaS module.";
        uses ac-svc-ref;
```

```
         }

     augment "/l2vpn-svc:l2vpn-svc"
            + "/l2vpn-svc:sites/l2vpn-svc:site"
            + "/l2vpn-svc:site-network-accesses"
            + "/l2vpn-svc:site-network-access" {
       if-feature "ac-glue";
       description
         "Augments VPN site network access with AC provisioning
          details.  Concretely, it glues a 'site-network-access'
          to an AC with Layer 2 properties that was created using the
          ACaaS module.

          The ACaaS information takes precedence over any overlapping
          information that is also provided for a site network access.";
       uses single-ac-svc-ref;
     }

     augment "/l3vpn-svc:l3vpn-svc"
            + "/l3vpn-svc:sites/l3vpn-svc:site"
            + "/l3vpn-svc:site-network-accesses" {
       description
         "Augments VPN site network accesses with AC provisioning
          details.  Concretely, it binds a site to a set of ACs with
          both Layer 2 and Layer 3 properties that were created using
          the ACaaS module.";
       uses ac-svc-ref;
     }

     augment "/l3vpn-svc:l3vpn-svc"
            + "/l3vpn-svc:sites/l3vpn-svc:site"
            + "/l3vpn-svc:site-network-accesses"
            + "/l3vpn-svc:site-network-access" {
       if-feature "ac-glue";
       description
         "Augments VPN site network access with AC provisioning
          details.  Concretely, it glues a 'site-network-access' to an
          AC with both Layer 2 and Layer 3 properties that was created
          using the ACaaS module.

          The ACaaS information takes precedence over any overlapping
          information that is also provided for a site network access.";
       uses single-ac-svc-ref;
     }

     augment "/l2nm:l2vpn-ntw/l2nm:vpn-services/l2nm:vpn-service"
            + "/l2nm:vpn-nodes/l2nm:vpn-node"
            + "/l2nm:vpn-network-accesses" {
       description
         "Augments VPN network accesses with both service and network
          AC provisioning details.  Concretely, it binds a site to (1)
          a set of ACs with Layer 2 properties that were created using
          the ACaaS module and (2) a set of ACs with Layer 2 properties
          that were provisioned using the AC network model.";
       uses ac-svc-ntw-ref;
     }

     augment "/l2nm:l2vpn-ntw/l2nm:vpn-services/l2nm:vpn-service"
```

```
                + "/l2nm:vpn-nodes/l2nm:vpn-node"
                + "/l2nm:vpn-network-accesses"
                + "/l2nm:vpn-network-access" {
        if-feature "ac-glue";
        description
          "Augments VPN network access with service and network
           references to an AC.  Concretely, it glues a VPN network
           access to (1) an AC with Layer 2 properties
           that was created using the ACaaS module and (2) an AC with
           Layer 2 properties that was created using the AC network
           module.

           The AC service and network information takes precedence over
           any overlapping information that is also provided for a VPN
           network access.";
        uses single-ac-svc-ntw-ref;
      }

      augment "/l3nm:l3vpn-ntw/l3nm:vpn-services/l3nm:vpn-service"
            + "/l3nm:vpn-nodes/l3nm:vpn-node"
            + "/l3nm:vpn-network-accesses" {
        description
          "Augments VPN network accesses with both service and network
           AC provisioning details.  Concretely, it binds a site to (1)
           a set of ACs with both Layer 2 and Layer 3  properties that
           were created using the ACaaS module and (2) a set of ACs with
           both Layer 2 and Layer 3 properties that were provisioned
           using the AC network model.";
        uses ac-svc-ntw-ref;
      }

      augment "/l3nm:l3vpn-ntw/l3nm:vpn-services/l3nm:vpn-service"
            + "/l3nm:vpn-nodes/l3nm:vpn-node"
            + "/l3nm:vpn-network-accesses"
            + "/l3nm:vpn-network-access" {
        if-feature "ac-glue";
        description
          "Augments VPN network access with service and network
           references to an AC.  Concretely, it glues a VPN network
           access to (1) an AC with both Layer 2 and Layer 3 properties
           that was created using the ACaaS module and (2) an AC with
           both Layer 2 and Layer 3 properties that was created using the
           AC network module.

           The AC service and network information takes precedence over
           any overlapping information that is also provided for a VPN
           network access.";
        uses single-ac-svc-ntw-ref;
      }
    }

  <CODE ENDS>
```

7. Security Considerations

This section is modeled after the template described in Section 3.7 of [YANG-GUIDELINES].

The "ietf-ac-common" YANG module defines a data model that is designed to be accessed via YANG-based management protocols, such as NETCONF [RFC6241] and RESTCONF [RFC8040]. These protocols have to use a secure transport layer (e.g., SSH [RFC4252], TLS [RFC8446], and QUIC [RFC9000]) and have to use mutual authentication.

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). All writable data nodes are likely to be reasonably sensitive or vulnerable in some network environments. Write operations (e.g., edit-config) and delete operations to these data nodes without proper protection or authentication can have a negative effect on network operations. The following subtrees and data nodes have particular sensitivities/vulnerabilities:

'ac-svc-ref' and 'ac-ntw-ref':   An attacker who is able to access network nodes can undertake various attacks, such as deleting a running VPN service, interrupting all the traffic of a client. Specifically, an attacker may modify (including delete) the ACs that are bound to a running service, leading to malfunctioning of the service and therefore to Service Level Agreement (SLA) violations. Such activity can be detected by adequately monitoring and tracking network configuration changes.

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. Specifically, the following subtrees and data nodes have particular sensitivities/vulnerabilities:

'ac-svc-ref' and 'ac-ntw-ref':   These references do not expose privacy-related information per se; however, 'ac-svc-ref' may be used to track the set of VPN instances in which a given customer is involved.

Note that, unlike 'ac-svc-ref', 'ac-ntw-ref' is unique within the scope of a node and may multiplex many peer CEs.

8. IANA Considerations

IANA has registered the following URI in the "ns" subregistry within the "IETF XML Registry" [RFC3688]:

URI: urn:ietf:params:xml:ns:yang:ietf-ac-glue
Registrant Contact: The IESG.
XML: N/A; the requested URI is an XML namespace.

IANA has registered the following YANG module in the "YANG Module Names" registry [RFC6020] within the "YANG Parameters" registry group:

```
Name:   ietf-ac-glue
Maintained by IANA?   N
Namespace:   urn:ietf:params:xml:ns:yang:ietf-ac-glue
Prefix:   ac-glue
Reference:   RFC 9836
```

9. References

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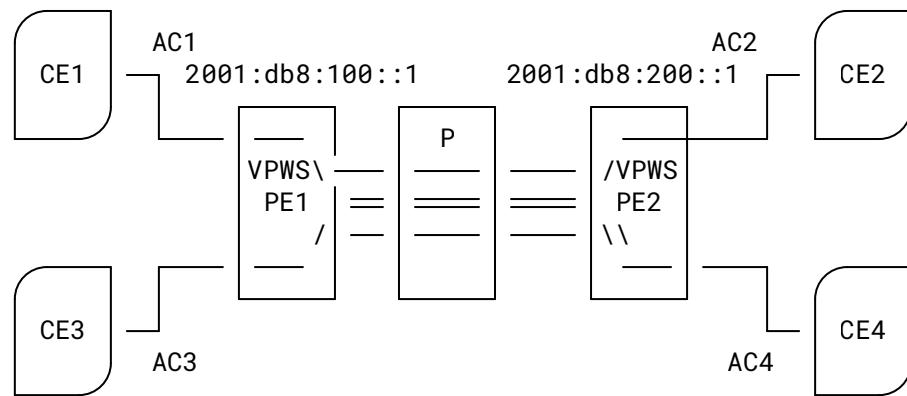
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Appendix A.   Examples

A.1.   A Service AC Reference Within the VPN Network Access

Let us consider the example depicted in Figure 5, which is inspired from Section 2.1 of [RFC4664].
Each PE is servicing two CEs. Let us also assume that the service references to identify ACs with
these CEs are shown in Figure 5.

```
        ___                                                        ___
       |   |   AC1                                       AC2      |   |
       |CE1|--- 2001:db8:100::1             2001:db8:200::1 ------|CE2|
       |   |    ___             ___                   ___         |   |
       |___|   |  _|           | P |                 |_  |        |___|
               |VPWS\ ===      |___|             === /VPWS|
        ___    |PE1  | === === |___| === === ===     |PE2  |       ___
       |   |   |   _/  ===     |___|                 \_\  |       |   |
       |CE3|---|__|                                  |___|--------|CE4|
       |   |    AC3                                       AC4      |   |
       |___|                                                      |___|
```

Figure 5: VPWS Topology Example

As shown in Figure 6, the service AC references can be explicitly indicated in the L2NM query
for the realization of the Virtual Private Wire Service (VPWS) (Section 3.1.1 of [RFC4664]).

```
=============== NOTE: '\' line wrapping per RFC 8792 ================

{
   "ietf-l2vpn-ntw:l2vpn-ntw":{
      "vpn-services":{
         "vpn-service":[
            {
               "vpn-id":"vpws12345",
               "vpn-description":"Sample VPWS with AC service \
                                                  references",
               "customer-name":"customer-12345",
               "vpn-type":"ietf-vpn-common:vpws",
               "bgp-ad-enabled":true,
               "signaling-type":"ietf-vpn-common:ldp-signaling",
               "global-parameters-profiles":{
                  "global-parameters-profile":[
                     {
                        "profile-id":"simple-profile",
                        "local-autonomous-system":65550,
                        "rd-auto":{
                           "auto":[
                              null
                           ]
                        },
                        "vpn-target":[
                           {
                              "id":1,
                              "route-targets":[
                                 {
                                    "route-target":"0:65535:1"
                                 }
                              ],
                              "route-target-type":"both"
                           }
                        ]
                     }
                  ]
               },
               "vpn-nodes":{
                  "vpn-node":[
                     {
                        "vpn-node-id":"pe1",
                        "ne-id":"2001:db8:100::1",
                        "active-global-parameters-profiles":{
                           "global-parameters-profile":[
                              {
                                 "profile-id":"simple-profile"
                              }
                           ]
                        },
                        "bgp-auto-discovery":{
                           "vpn-id":"587"
                        },
                        "signaling-option":{
                           "advertise-mtu":true,
                           "ldp-or-l2tp":{
                              "saii":1,
```

```
                     "remote-targets":[
                        {
                           "taii":2
                        }
                     ],
                     "t-ldp-pw-type":"ethernet"
                  }
               },
               "vpn-network-accesses":{
                  "vpn-network-access":[
                     {
                        "id":"1/1/1.1",
                        "interface-id":"1/1/1",
                        "description":"Interface to CE1",
                        "active-vpn-node-profile":"simple-\
                                             profile",
                        "status":{
                           "admin-status":{
                              "status":"ietf-vpn-common:\
                                             admin-up"
                           },
                           "ietf-ac-glue:ac-svc-ref":"AC1"
                        }
                     },
                     {
                        "id":"1/1/3.1",
                        "interface-id":"1/1/3",
                        "description":"Interface to CE3",
                        "active-vpn-node-profile":"simple-\
                                             profile",
                        "status":{
                           "admin-status":{
                              "status":"ietf-vpn-common:\
                                             admin-up"
                           },
                           "ietf-ac-glue:ac-svc-ref":"AC3"
                        }
                     }
                  ]
               }
            },
            {
               "vpn-node-id":"pe2",
               "ne-id":"2001:db8:200::1",
               "active-global-parameters-profiles":{
                  "global-parameters-profile":[
                     {
                        "profile-id":"simple-profile"
                     }
                  ]
               },
               "bgp-auto-discovery":{
                  "vpn-id":"587"
               },
               "signaling-option":{
                  "advertise-mtu":true,
                  "ldp-or-l2tp":{
                     "saii":2,
```

```
                                        "remote-targets":[
                                            {
                                                "taii":1
                                            }
                                        ],
                                        "t-ldp-pw-type":"ethernet"
                                    }
                                },
                                "vpn-network-accesses":{
                                    "vpn-network-access":[
                                        {
                                            "id":"2/1/2.1",
                                            "interface-id":"2/1/2",
                                            "description":"Interface to CE2",
                                            "active-vpn-node-profile":"simple-\
                                                                       profile",
                                            "status":{
                                                "admin-status":{
                                                    "status":"ietf-vpn-common:\
                                                                       admin-up"
                                                },
                                                "ietf-ac-glue:ac-svc-ref":"AC2"
                                            }
                                        },
                                        {
                                            "id":"2/1/4.1",
                                            "interface-id":"2/1/4",
                                            "description":"Interface to CE4",
                                            "active-vpn-node-profile":"simple-\
                                                                       profile",
                                            "status":{
                                                "admin-status":{
                                                    "status":"ietf-vpn-common:\
                                                                       admin-up"
                                                },
                                                "ietf-ac-glue:ac-svc-ref":"AC4"
                                            }
                                        }
                                    ]
                                }
                            }
                        ]
                    }
                }
            ]
        }
    }
}
```

Figure 6: Example of VPWS Creation with AC Service References

A.2. Network and Service AC References

Let us consider the example depicted in Figure 7 with two customer termination points (CE1 and CE2). Let us also assume that the bearers to attach these CEs to the service provider network are already in place. References to identify these bearers are shown in Figure 7.

```
                ┌──────┐   ┌───────────┐   ┌──────┐
        ╭─────┐ │ PE1  ├───┤           ├───┤ PE2  │ ╭─────╮
        │ CE1 ├─┤ "450"│   │   MPLS    │   │"451" ├─┤ CE2 │
        ╰─────┘ │      │   │           │   │      │ ╰─────╯
                └──────┘   │   Core    │   └──────┘
              ▲            └───────────┘          ▲
              │                                   │
        Bearer:1234                          Bearer:5678
```
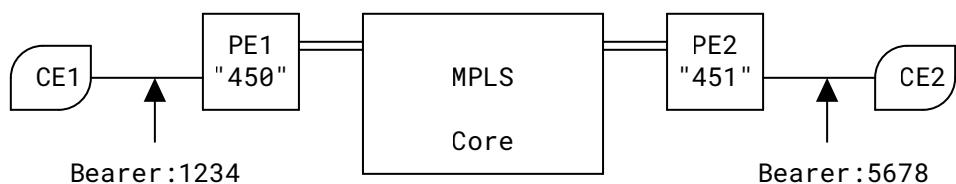
Figure 7: Topology Example
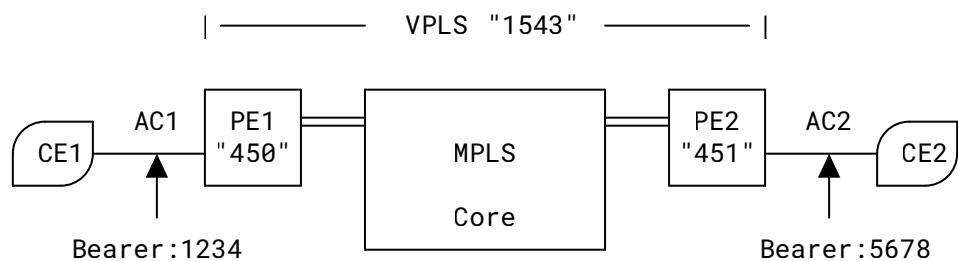
The AC service model [RFC9834] can be used by the provider to manage and expose the ACs over
existing bearers as shown in Figure 8.

```
{
  "ietf-ac-svc:attachment-circuits": {
    "ac-group-profile": [
      {
        "name": "an-ac-profile",
        "l2-connection": {
          "encapsulation": {
            "type": "ietf-vpn-common:dot1q",
            "dot1q": {
              "tag-type": "ietf-vpn-common:c-vlan",
              "cvlan-id": 550
            }
          }
        },
        "service": {
          "mtu": 1550,
          "svc-pe-to-ce-bandwidth": {
            "bandwidth": [
              {
                "bw-type": "ietf-vpn-common:bw-per-port",
                "cir": "20480000"
              }
            ]
          },
          "svc-ce-to-pe-bandwidth": {
            "bandwidth": [
              {
                "bw-type": "ietf-vpn-common:bw-per-port",
                "cir": "20480000"
              }
            ]
          },
          "qos": {
            "qos-profiles": {
              "qos-profile": [
                {
                  "profile": "QoS_Profile_A",
                  "direction": "ietf-vpn-common:both"
                }
              ]
            }
          }
        }
      }
    ],
    "ac": [
      {
        "name": "ac-1",
        "description": "First attachment",
        "ac-group-profile": [
          "an-ac-profile"
        ],
        "l2-connection": {
          "bearer-reference": "1234"
        }
      },
      {
```

```
        "name": "ac-2",
        "description": "Second attachment",
        "ac-group-profile": [
          "an-ac-profile"
        ],
        "l2-connection": {
          "bearer-reference": "5678"
        }
      }
    ]
  }
}
```

Figure 8: ACs Created Using ACaaS

Let us now consider that the customer wants to request a Virtual Private LAN Service (VPLS) instance between the sites as shown in Figure 9.

```
              | ——————————  VPLS "1543"  —————————— |

                   ┌─────┐                           ┌─────┐
            AC1    │ PE1 │   ┌───────────────────┐   │ PE2 │   AC2
      ┌────┐       │"450"│═══│                   │═══│"451"│       ┌────┐
      │CE1 ├───────┤     │   │      MPLS         │   │     ├───────┤CE2 │
      └────┘   ▲   └─────┘   │                   │   └─────┘   ▲   └────┘
               │             │      Core         │             │
               │             └───────────────────┘             │
        Bearer:1234                                      Bearer:5678
```

Figure 9: Example of VPLS

To that aim, existing ACs are referenced during the creation of the VPLS instance using the L2NM [RFC9291] and the "ietf-ac-glue" module as shown in Figure 10.

```
{
  "ietf-l2vpn-ntw:l2vpn-ntw": {
    "vpn-services": {
      "vpn-service": [
        {
          "vpn-id": "1543",
          "vpn-name": "CORPO-EXAMPLE",
          "customer-name": "EXAMPLE",
          "vpn-type": "ietf-vpn-common:vpls",
          "vpn-service-topology": "ietf-vpn-common:hub-spoke",
          "bgp-ad-enabled": false,
          "signaling-type": "ietf-vpn-common:ldp-signaling",
          "global-parameters-profiles": {
            "global-parameters-profile": [
              {
                "profile-id": "simple-profile",
                "ce-vlan-preservation": true,
                "ce-vlan-cos-preservation": true
              }
            ]
          },
          "vpn-nodes": {
            "vpn-node": [
              {
                "vpn-node-id": "450",
                "ne-id": "2001:db8:5::1",
                "role": "ietf-vpn-common:hub-role",
                "status": {
                  "admin-status": {
                    "status": "ietf-vpn-common:admin-up"
                  }
                },
                "active-global-parameters-profiles": {
                  "global-parameters-profile": [
                    {
                      "profile-id": "simple-profile"
                    }
                  ]
                },
                "signaling-option": {
                  "ldp-or-l2tp": {
                    "t-ldp-pw-type": "vpls-type",
                    "pw-peer-list": [
                      {
                        "peer-addr": "2001:db8:50::1",
                        "vc-id": "1543"
                      }
                    ]
                  }
                },
                "vpn-network-accesses": {
                  "ietf-ac-glue:ac-svc-ref": ["ac-1"]
                }
              },
              {
                "vpn-node-id": "451",
                "ne-id": "2001:db8:50::1",
```

```
                    "role": "ietf-vpn-common:spoke-role",
                    "status": {
                      "admin-status": {
                        "status": "ietf-vpn-common:admin-up"
                      }
                    },
                    "active-global-parameters-profiles": {
                      "global-parameters-profile": [
                        {
                          "profile-id": "simple-profile"
                        }
                      ]
                    },
                    "signaling-option": {
                      "ldp-or-l2tp": {
                        "t-ldp-pw-type": "vpls-type",
                        "pw-peer-list": [
                          {
                            "peer-addr": "2001:db8:5::1",
                            "vc-id": "1543"
                          }
                        ]
                      }
                    },
                    "vpn-network-accesses": {
                      "ietf-ac-glue:ac-svc-ref": ["ac-2"]
                    }
                  }
                ]
              }
            }
          ]
        }
      }
    }
```

Figure 10: Example of a VPLS Request Using L2NM and AC Glue (Message Body)

Note that before implementing the VPLS instance creation request, the provider service orchestrator may first check if the VPLS service can be provided to the customer using the target delivery locations. The orchestrator uses the SAP model [RFC9408] as exemplified in Figure 11. This example assumes that the query concerns only PE1. A similar query can be issued for PE2.

```
{
   "ietf-sap-ntw:service":[
      {
         "service-type":"ietf-vpn-common:vpls",
         "sap":[
            {
               "sap-id":"sap#1",
               "peer-sap-id":[
                  "ce-1"
               ],
               "description":"A parent SAP",
               "attachment-interface":"GE0/6/1",
               "interface-type":"ietf-sap-ntw:phy",
               "role":"ietf-sap-ntw:uni",
               "allows-child-saps":true,
               "sap-status":{
                  "status":"ietf-vpn-common:op-up"
               }
            }
         ]
      }
   ]
}
```

Figure 11: Example of SAP Response (Message Body)

The response in Figure 11 indicates that the VPLS service can be delivered to CE1. The "ietf-ac-ntw" module [RFC9835] can be also used to access AC-related details that are bound to the target SAP (Figure 12).

```
{
   "ietf-sap-ntw:service":[
      {
         "service-type":"ietf-vpn-common:vpls",
         "sap":[
            {
               "sap-id":"sap#1",
               "peer-sap-id":[
                  "ce-1"
               ],
               "description":"A parent SAP",
               "attachment-interface":"GE0/6/1",
               "interface-type":"ietf-sap-ntw:phy",
               "role":"ietf-sap-ntw:uni",
               "allows-child-saps":true,
               "sap-status":{
                  "status":"ietf-vpn-common:op-up"
               }
            },
            {
               "sap-id":"sap#11",
               "description":"A child SAP",
               "parent-termination-point":"GE0/6/4",
               "attachment-interface":"GE0/6/4.2",
               "interface-type":"ietf-sap-ntw:logical",
               "encapsulation-type":"ietf-vpn-common:vlan-type",
               "sap-status":{
                  "status":"ietf-vpn-common:op-up"
               },
               "ietf-ac-ntw:ac":[
                  {
                     "ac-ref":"ac-1",
                     "node-ref":"example:pe2",
                     "network-ref":"example:an-id"
                  }
               ]
            }
         ]
      }
   ]
}
```

Figure 12: Example of AC Network Response with SAP (Message Body)

The provisioned AC at PE1 can be retrieved using the AC network model [RFC9835] as depicted in
Figure 13.

```
{
   "ietf-ac-ntw:ac":[
      {
         "name":"ac-11",
         "svc-ref":"ac-1",
         "peer-sap-id":[
            "ce-1"
         ],
         "status":{
            "admin-status":{
               "status":"ietf-vpn-common:admin-up"
            },
            "oper-status":{
               "status":"ietf-vpn-common:op-up"
            }
         },
         "l2-connection":{
            "encapsulation":{
               "encap-type":"ietf-vpn-common:dot1q",
               "dot1q":{
                  "tag-type":"ietf-vpn-common:c-vlan",
                  "cvlan-id":550
               }
            },
            "bearer-reference":"1234"
         },
         "service":{
            "mtu":1550,
            "svc-pe-to-ce-bandwidth":{
               "bandwidth":[
                  {
                     "bw-type": "ietf-vpn-common:bw-per-port",
                     "cir":"20480000"
                  }
               ]
            },
            "svc-ce-to-pe-bandwidth":{
               "bandwidth":[
                  {
                     "bw-type": "ietf-vpn-common:bw-per-port",
                     "cir":"20480000"
                  }
               ]
            },
            "qos":{
               "qos-profiles":{
                  "qos-profile":[
                     {
                        "qos-profile-ref":"QoS_Profile_A",
                        "network-ref":"example:an-id",
                        "direction":"ietf-vpn-common:both"
                     }
                  ]
               }
            }
         }
      }
```

```
        ]
   }
```

Figure 13: Example of AC Network Response (Message Body)

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