YANG models to Provide Mapping Between Services and ACTN TE

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Abstract

Abstraction and Control of TE Networks (ACTN) refers to the set of

virtual network operations needed to operate, control and manage

large-scale multi-domain, multi-layer and multi-vendor TE networks, so as to facilitate network programmability, automation, efficient resource sharing, and end-to-end virtual service aware connectivity.

This document provides a YANG data model to map service model (e.g. L3SM) and Traffic Engineering model (e.g. TE Tunnel or ACTN VN model). This model is referred to as TE service Mapping Model. This model is applicable to the operation’s need for a seamless control and management of their L3VPN with TE tunnel support.

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# Introduction

Abstraction and Control of TE Networks (ACTN) describes a method for operating a Traffic Engineered (TE) network (such as an MPLS-TE network or a layer 1/0 transport network) to provide connectivity and virtual network services for customers of the TE network [ACTN-Frame]. The services provided can be tuned to meet the requirements (such as traffic patterns, quality, and reliability) of the applications hosted by the customers. Data models are a representation of objects that can be configured or monitored within a system. Within the IETF, YANG [RFC6020] is the language of choice for documenting data models, and YANG models have been produced to allow configuration or modeling of a variety of network devices, protocol instances, and network services. YANG data models have been classified in [Netmod-Yang-Model-Classification] and [Service-YANG].

[ACTN-VN-YANG] describes how customers or end to end orchestrators can request and/or instantiate a generic virtual network service. [ACTN-Applicability] describes a connection between IETF YANG model classifications to ACTN interfaces. In particular, it describes the customer service model can be mapped into the CMI (CNC-MDSC Interface) of the ACTN architecture.

[RFC4110] provides a framework for Layer 3 Provider-Provisioned Virtual Private Networks (PPVPNs). [L3SM-YANG] provides a L3VPN service delivery YANG model for PE-based VPNs.

The YANG model on the ACTN CMI is known as customer service model in [Service-YANG]. The YANG model developed in this document describes how operator’s end to end orchestrator interacts with the MDSC so that the MDSC then can coordinate the control and management of L3VPN MPLS TE tunnels that traverse both IP/MPLS and Transport networks. While IP Network Controller is responsible for provisioning the VPN service on the PE nodes, the MDSC can coordinate how to map the VPN services with TE tunnels. In some cases, under the confines of service policy, dynamic TE tunnel creation may need to be supported for the VPN service. This may occur when there are no suitable existing TE tunnels that can support VPN service requirements. Or the operator would like to dynamically create and bind tunnels to the VPN, which could not be shared for network slicing.

To summarize there are two mode of operations –

* Tunnel/VN Binding – Customer could use the VPN service model [L3SM-Yang] to communicate to the network operator to deliver

a L3VPN service. Based on the sites, QoS parameters, VPN service topology, the network operator could create an ACTN VN [ACTN-VN-YANG. Further the mapping yang model is used to set this mapping between the L3VPN service and the ACTN VN. Note that this could be done dynamically. The VN (and TE tunnels) could be binded to the L3VPN and not used for any other purpose.

* Tunnel/VN Selection – Customer could request an L3VPN service [L3SM-Yang], and with this model as input, configure the different network elements to deliver the service. Each network element would select a tunnel based on the configuration. New tunnels (or VN) are not created for each VPN. Thus the tunnels can be shared across multiple VPN. Further the mapping yang model is used to get the mapping between the L3VPN and the tunnels in use.

The YANG model described in this document provides an ACTN TE-service mapping model that enables a seamless service mapping across L3VPN, ACTN VN and TE-tunnel models at the controllers.

# L3VPN Architecture in ACTN context

Figure 1 and 2 shows the architectural context of this document.

| L3SM (+CMI)

V

+------+

| MDSC |

+------+

|

+-------------------------------+

| |

V V

+------+ +------+

| PNC1 | | PNC2 |

+------+ +------+

CE ! ! CE

\ ! ! /

A----B----C----ASBR1------ASBR2----D----E----F

| | | | | | | |

| | | | | | | |

G----H----I----ASBR3------ASBR4----J----K----L

/ ! ! \

CE AS100 ! ! AS200 CE

Figure 1: L3VPN Architecture From the IP Network Perspective (Multi Domain)

Service Orchestration Entity

|

| L3VPN Service Model

|

|

+------------------+

| |

| MDSC |

| |

| |

+------------------+

|| ||

|| ||

+--------------+ +----------------+

| IP Network | | Transport Net. |

| Controller |.... | Controller |................

| (IP PNC) | . |(Transport PNC) | .

+--------------+ . +----------------+ .

. .

. .

+------------------------------------+ .

| | .

| | .

+------+ | +------+ +------+ .

| CE 1 | | ---| PE | | CE 2 | .

|device| +------+ VPN tunnel | |device|----|device| .

| of |----| |================================| | | of | .

|VPN A| | | | +------+ |VPN A| .

+------+ | PE | | | | +------+ .

+------+ |device|---- | | | | .

| CE 3 | | | | VPN tunnel | +------+ +------+ .

|device|----| |================================| PE | | CE 4 | .

| of | +------+ | | |device| |device| .

|VPN B| | | | | -| |----| of | .

+------+ | | | | | +------+ |VPN B| .

| | | | MPLS/IP Network | | +------+ .

| | | | | | | .

+---------+ +------|-----------------------|-|---+ .

| | | .

| | | .

+------------------------------------+ .

| | .

| Transport Network |.......................

| |

+------------------------------------+

Figure 2: L3VPN Architecture in ACTN context (IP + Optical)

There are three main entities in the architecture.

* MDSC: This entity is responsible for coordinating a L3VPN service request (expressed in L3SM) with the IP Network Controller and the Transport Network Controller (PNC). One of the key responsibilities of the MDSC for TE services is to coordinate with both the IP Network Controller and the Transport network Controller for the mapping of L3VPN Service Model and ACTN VN/TE-Tunnel models. The MDSC could select an existing suitable VN/TE tunnel that can support VPN service requirement or the MDSC will coordinate with the Transport Network Controller to dynamically create ACTN VN (and TE-tunnel(s)) and then provide this TE-tunnel information to the IP Network Controller.
* IP Network Controller: This entity is responsible for device configuration to create PE-PE L3VPN tunnels for the VPN customer and for the configuration of the L3VPN VRF on the PE nodes.
* Transport Network Controller: This entity is responsible for device configuration for TE tunnels in the transport networks.

High-Level Control Flows

1. Customer asks for a L3VPN between CE1 and CE2 with TE constraints using L3SM model. The customer can provide tunnel creation policy where it allows dynamic TE tunnel creation or not. Under this policy, Dynamic TE tunnels can be created when there are no proper TE-tunnels that can support L3VPN tunnels or when there is a strict isolation requirement for the VPN service, e.g., no sharing with other tunnels is allowed.
2. The MDSC determines if any existing underlay TE-tunnels can be used to map this PE-PE VPN tunnel. If available, then assign the VPN tunnel to a TE-tunnel and update the state. If unavailable, create a new tunnel for this VPN.
3. The MDSC interacts with both the IP Network Controller and the Transport Network Controller to create a PE-PE tunnel in the IP network mapped to a TE tunnel in the transport network by providing the inter-layer access points and tunnel requirements. The specific service information are passed to the IP controller for the actual VPN configuration and activation.
   1. The Transport Network Controller creates the corresponding TE tunnel matching with the access point and egress point.
   2. The IP Network Controller maps the PE-PE tunnel ID with the corresponding TE tunnel ID to bind these two IDs.
4. The IP Network Controller creates/updates a VRF instance for this VPN customer.

# TE-Service Mapping Model

The role of TE-service Mapping model is to create a binding relationship across L3SM and TE Tunnel model via generic ACTN VN Model. The ACTN VN YANG model is a generic virtual network service model that allows customers (internal or external) to create a VN that meets the customer’s service objective with various constraints. The TE-service mapping model is needed to bind L3VPN specific service model with TE-specific parameters. This binding will facilitate a seamless service operation with underlay-TE network visibility. The TE-service model developed in this document can also be extended to support other services such as L2SM and so one.

      +---------+          +-------------+         +----------+

      |  L3SM   | <------> |             | <-----> | TE-Tunnel|

      +---------+          |             |         |  Model   |

                           | TE-Service  |         +-----^----+

                           |Mapping Model|               |

      +---------+          |             |         +-----v----+

      |  L2SM   | <------> |             | <-----> | ACTN VN  |

      +---------+          +-------------+         |  Model   |

                                                   +----------+

. . .

# YANG Data Tree

module: ietf-te-service-mapping

   +--rw te-service-mapping

   |  +--rw service-mapping

   |  |  +--rw mapping-list\* [map-id]

   |  |     +--rw map-id            uint32

   |  |     +--rw (service)?

   |  |     |  +--:(l3vpn)

   |  |     |  |  +--rw l3vpn-ref?        -> /l3:l3vpn-svc/vpn-services/vpn-service/vpn-id

   |  |     |  +--:(l2vpn)

   |  |     +--rw (te)?

   |  |        +--:(actn-vn)

   |  |        |  +--rw actn-vn-ref?      -> /vn:actn/vn/vn-list/vn-id

   |  |        +--:(te)

   |  |           +--rw te-tunnel-list\*   te:tunnel-ref

   |  +--rw site-mapping

   |     +--rw mapping-list\* [map-id]

   |        +--rw map-id         uint32

   |        +--rw (service)?

   |        |  +--:(l3vpn)

   |        |  |  +--rw l3vpn-ref?     -> /l3:l3vpn-svc/sites/site/site-id

   |        |  +--:(l2vpn)

   |        +--rw (te)?

   |           +--:(actn-vn)

   |           |  +--rw actn-vn-ref?   -> /vn:actn/ap/access-point-list/access-point-id

   |           +--:(te)

   +--ro te-service-mapping-state

      +--ro service-mapping

      |  +--ro mapping-list\* [map-id]

      |     +--ro map-id            uint32

      |     +--ro (service)?

      |     |  +--:(l3vpn)

      |     |  |  +--ro l3vpn-ref?        -> /l3:l3vpn-svc/vpn-services/vpn-service/vpn-id

      |     |  +--:(l2vpn)

      |     +--ro (te)?

      |        +--:(actn-vn)

      |        |  +--ro actn-vn-ref?      -> /vn:actn/vn/vn-list/vn-id

      |        +--:(te)

      |           +--ro te-tunnel-list\*   te:tunnel-ref

      +--ro site-mapping

         +--ro mapping-list\* [map-id]

            +--ro map-id         uint32

            +--ro (service)?

            |  +--:(l3vpn)

            |  |  +--ro l3vpn-ref?     -> /l3:l3vpn-svc/sites/site/site-id

            |  +--:(l2vpn)

            +--ro (te)?

               +--:(actn-vn)

               |  +--ro actn-vn-ref?   -> /vn:actn/ap/access-point-list/access-point-id

               +--:(te)

# Yang Data Model

The YANG code is as follows:

<CODE BEGINS> file "ietf-te-service-mapping@2016-11-23.yang"

module ietf-te-service-mapping {

namespace "urn:ietf:params:xml:ns:yang:ietf-te-service-mapping";

prefix "tm";

import ietf-l3vpn-svc {

prefix "l3";

}

import ietf-te {

prefix "te";

}

import ietf-actn-vn {

prefix "vn";

}

organization

"IETF Traffic Engineering Architecture and Signaling (TEAS)

Working Group";

contact

"Editor: Young Lee <leeyoung@huawei.com>

Dhruv Dhody <dhruv.ietf@gmail.com>";

description

"This module contains a YANG module for the mapping of

service (ex L3VPN) to the TE tunnels or ACTN VN.";

revision 2016-11-23 {

description

"initial version.";

reference

"TBD";

}

/\*

\* Identities

\*/

identity service-type {

description

"Base identity from which specific service types are

derived.";

}

identity l3vpn-service {

base service-type;

description

"L3VPN service type.";

}

identity l2vpn-service {

base service-type;

description

"L2VPN service type.";

}

grouping service-ref{

description

"The reference to the service.";

choice service {

description

"The service";

case l3vpn {

leaf l3vpn-ref {

type leafref {

path "/l3:l3vpn-svc/l3:vpn-services/"

+ "l3:vpn-service/l3:vpn-id";

}

description

"The reference to L3VPN Service Yang Model";

}

}

case l2vpn {

}

}

}

grouping site-ref {

description

"The reference to the site.";

choice service {

description

"The service choice";

case l3vpn {

leaf l3vpn-ref{

type leafref {

path "/l3:l3vpn-svc/l3:sites/l3:site/"

+ "l3:site-id";

}

description

"The reference to L3VPN Service Yang Model";

}

}

case l2vpn {}

}

}

grouping te-ref {

description

"The reference to TE.";

choice te {

description

"The TE";

case actn-vn {

leaf actn-vn-ref {

type leafref {

path "/vn:actn/vn:vn/vn:vn-list/vn:vn-id";

}

description

"The reference to ACTN VN";

}

}

case te {

leaf-list te-tunnel-list {

type te:tunnel-ref;

description

"Reference to TE Tunnels";

}

}

}

}

grouping te-endpoint-ref {

description

"The reference to TE endpoints.";

choice te {

description

"The TE";

case actn-vn {

leaf actn-vn-ref {

type leafref {

path "/vn:actn/vn:ap/vn:access-point-list"

+ "/vn:access-point-id";

}

description

"The reference to ACTN VN";

}

}

case te {

}

}

}

grouping service-mapping {

description

"Mapping between Services and TE";

container service-mapping {

description

"Mapping between Services and TE";

list mapping-list {

key "map-id";

description

"Mapping identified via a map-id";

leaf map-id {

type uint32;

description

"a unique mapping identifier";

}

uses service-ref;

uses te-ref;

}

}

}

grouping site-mapping {

description

"Mapping between VPN access site and TE

endpoints or AP";

container site-mapping {

description

"Mapping between VPN access site and TE

endpoints or AP";

list mapping-list {

key "map-id";

description

"Mapping identified via a map-id";

leaf map-id {

type uint32;

description

"a unique mapping identifier";

}

uses site-ref;

uses te-endpoint-ref;

}

}

}

/\*

\* Configuration data nodes

\*/

container te-service-mapping {

description

"Mapping between Services and TE";

uses service-mapping;

uses site-mapping;

}

/\*

\* Operational data nodes

\*/

container te-service-mapping-state{

config false;

description

"Mapping between Services and TE";

uses service-mapping;

uses site-mapping;

}

}

<CODE ENDS>

# Security

This document is an informational draft. When the models mentioned in this draft are implemented, detailed security consideration will be given in such work.

How security fits into the whole architecture has the following components:

- the use of Restconf security between components

- the use of authentication and policy to govern which services can be requested by different parties.

- how security may be requested as an element of a service and mapped down to protocol security mechanisms as well as separation (slicing) of physical resources)

# Acknowledgements

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