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# OTN Tunnel YANG Model
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## Abstract

This document describes the YANG data model for OTN Tunnels.

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## 1. Introduction

OTN transport networks, specified in [ITU-Tg709], can carry various types of client services. In many cases, the client signal is carried over an OTN tunnel across connected domains in a multi-domain network. These OTN services can either be transported or switched in the OTN network. If an OTN tunnel is switched, then additional parameters need to be provided to create a Mux OTN service.

This document provides YANG model for creating OTN tunnel. The model augments the TE Tunnel model.

## 2. Terminology and Notations

A simplified graphical representation of the data model is used in this document. The meaning of the symbols in the YANG data tree presented later in this draft is defined in [RFC8340]. They are provided below for reference.

o Brackets "[" and "]" enclose list keys.

o Abbreviations before data node names: "rw" means configuration (read-write) and "ro" state data (read-only).

o Symbols after data node names: "?" means an optional node, "!" means a presence container, and "*" denotes a list and leaf-list.

- o Parentheses enclose choice and case nodes, and case nodes are also marked with a colon (":").

- o Ellipsis ("...") stands for contents of subtrees that are not shown.

- o More OTN specific terms can be found in [I-D.ietf-ccamp-otn-topo-yang].

## 3. OTN Tunnel Model Description

### 3.1. Overview of OTN Tunnel Model

The OTN tunnel model is using TE tunnel [I-D.ietf-teas-yang-te] as a basic model and augment to the TE tunnel with OTN-specific parameters, including the bandwidth information and label information. It is also worth noting that the OTN tunnel provisioning is usually based on the OTN topology. Therefore the OTN tunnel model is usually used together with OTN topology model specified in [I-D.ietf-ccamp-otn-topo-yang]. The OTN tunnel model also imports a few type modules, including ietf-otn-types, ietf-te-types and ietf-inet-types.

More scenarios and model applications can be found in [I-D.ietf-ccamp-transport-nbi-app-statement] and [I-D.ietf-teas-actn-yang]. The current model is following the YANG language specification as [RFC7950], and the corresponding protocol is recommended to be Netconf protocol in [RFC6241] or RESTconf protocol in [RFC8040].

The YANG module ietf-otn-tunnel defined in this document conforms to the Network Management Datastore Architecture (NMDA) defined in [RFC8342].

### 3.2. OTN-specific Parameters in Tunnel Model

OTN specific parameters have been augmenting to the TE tunnel models. The attributes on both of the source and destination need to be configured when setting up the tunnel. Typical parameters, including client signal, TPN, TSG and corresponding tributary slot information, are required in the OTN tunnel model. These parameters are consistent with the framework in [RFC7062], and the specification in [RFC7138] and [RFC7139].

The OTN bandwidth information has been augmenting to various sections of TE tunnel models, including tunnel bandwidth, primary path bandwidth and so on. The OTN label information has been augmenting to label hop of a group of routing objects and also LSPs.

### 3.3. OTN Path Compute RPC

Similarly with TE tunnel, a 'compute-only' mode of OTN tunnel model is also supported for stateful path computation. Given the OTN tunnel computed, the client may query and/or subscribe on the tunnel to be notified whenever it changes. In addition, also a stateless Remote Procedural Call (RPC) is specified. On receiving this RPC, the provider is expected to compute the available path subject to the constraints specified in RPC and feedback to the client without any changing of the OTN network or the OTN tunnels.

## 4. OTN Tunnel YANG Tree

```
module: ietf-otn-tunnel
  augment /te:te/te:tunnels/te:tunnel:
    +--rw src-client-signal?   identityref
    +--rw dst-client-signal?   identityref
  augment /te:te/te:globals/te:named-path-constraints
            /te:named-path-constraint/te:te-bandwidth
            /te:technology:
    +--:(otn)
       +--rw odu-type?   identityref
  augment /te:te/te:tunnels/te:tunnel/te:te-bandwidth
            /te:technology:
    +--:(otn)
       +--rw odu-type?   identityref
  augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
            /te:p2p-primary-path/te:te-bandwidth
            /te:technology:
    +--:(otn)
       +--rw odu-type?   identityref
  augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
            /te:p2p-primary-path/te:p2p-primary-reverse-path
            /te:te-bandwidth/te:technology:
    +--:(otn)
       +--rw odu-type?   identityref
  augment /te:te/te:tunnels/te:tunnel/te:p2p-secondary-paths
            /te:p2p-secondary-path/te:te-bandwidth
            /te:technology:
    +--:(otn)
       +--rw odu-type?   identityref
  augment /te:te/te:globals/te:named-path-constraints
            /te:named-path-constraint
            /te:explicit-route-objects-always
            /te:route-object-exclude-always/te:type/te:label
            /te:label-hop/te:te-label/te:technology:
    +--:(otn)
```

```
          +--rw tpn?       uint16
          +--rw tsg?       identityref
          +--rw ts-list?   string
     augment /te:te/te:globals/te:named-path-constraints
               /te:named-path-constraint
               /te:explicit-route-objects-always
               /te:route-object-include-exclude/te:type
               /te:label/te:label-hop/te:te-label
               /te:technology:
       +--:(otn)
          +--rw tpn?       uint16
          +--rw tsg?       identityref
          +--rw ts-list?   string
     augment /te:te/te:globals/te:named-path-constraints
               /te:named-path-constraint/te:path-in-segment
               /te:label-restrictions/te:label-restriction:
       +--rw range-type?      identityref
       +--rw tsg?             identityref
       +--rw odu-type-list*   identityref
       +--rw priority?        uint8
     augment /te:te/te:globals/te:named-path-constraints
               /te:named-path-constraint/te:path-in-segment
               /te:label-restrictions/te:label-restriction
               /te:label-start/te:te-label/te:technology:
       +--:(otn)
          +--rw (otn-label-type)?
             +--:(tributary-port)
             |  +--rw tpn?   uint16
             +--:(tributary-slot)
                +--rw ts?    uint16
     augment /te:te/te:globals/te:named-path-constraints
               /te:named-path-constraint/te:path-in-segment
               /te:label-restrictions/te:label-restriction
               /te:label-end/te:te-label/te:technology:
       +--:(otn)
          +--rw (otn-label-type)?
             +--:(tributary-port)
             |  +--rw tpn?   uint16
             +--:(tributary-slot)
                +--rw ts?    uint16
     augment /te:te/te:globals/te:named-path-constraints
               /te:named-path-constraint/te:path-out-segment
               /te:label-restrictions/te:label-restriction:
       +--rw range-type?      identityref
       +--rw tsg?             identityref
       +--rw odu-type-list*   identityref
       +--rw priority?        uint8
     augment /te:te/te:globals/te:named-path-constraints
```

```
               /te:named-path-constraint/te:path-out-segment
               /te:label-restrictions/te:label-restriction
               /te:label-start/te:te-label/te:technology:
       +--:(otn)
          +--rw (otn-label-type)?
             +--:(tributary-port)
             |  +--rw tpn?   uint16
             +--:(tributary-slot)
                +--rw ts?    uint16
     augment /te:te/te:globals/te:named-path-constraints
               /te:named-path-constraint/te:path-out-segment
               /te:label-restrictions/te:label-restriction
               /te:label-end/te:te-label/te:technology:
       +--:(otn)
          +--rw (otn-label-type)?
             +--:(tributary-port)
             |  +--rw tpn?   uint16
             +--:(tributary-slot)
                +--rw ts?    uint16
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
               /te:p2p-primary-path/te:optimizations
               /te:algorithm/te:metric/te:optimization-metric
               /te:explicit-route-exclude-objects
               /te:route-object-exclude-object/te:type/te:label
               /te:label-hop/te:te-label/te:technology:
       +--:(otn)
          +--rw tpn?       uint16
          +--rw tsg?       identityref
          +--rw ts-list?   string
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
               /te:p2p-primary-path/te:optimizations
               /te:algorithm/te:metric/te:optimization-metric
               /te:explicit-route-include-objects
               /te:route-object-include-object/te:type/te:label
               /te:label-hop/te:te-label/te:technology:
       +--:(otn)
          +--rw tpn?       uint16
          +--rw tsg?       identityref
          +--rw ts-list?   string
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
               /te:p2p-primary-path
               /te:explicit-route-objects-always
               /te:route-object-exclude-always/te:type/te:label
               /te:label-hop/te:te-label/te:technology:
       +--:(otn)
          +--rw tpn?       uint16
          +--rw tsg?       identityref
          +--rw ts-list?   string
```

```
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
               /te:p2p-primary-path
               /te:explicit-route-objects-always
               /te:route-object-include-exclude/te:type
               /te:label/te:label-hop/te:te-label
               /te:technology:
       +--:(otn)
          +--rw tpn?       uint16
          +--rw tsg?       identityref
          +--rw ts-list?   string
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
               /te:p2p-primary-path/te:path-in-segment
               /te:label-restrictions/te:label-restriction:
       +--rw range-type?      identityref
       +--rw tsg?             identityref
       +--rw odu-type-list*   identityref
       +--rw priority?        uint8
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
               /te:p2p-primary-path/te:path-in-segment
               /te:label-restrictions/te:label-restriction
               /te:label-start/te:te-label/te:technology:
       +--:(otn)
          +--rw (otn-label-type)?
             +--:(tributary-port)
             |  +--rw tpn?   uint16
             +--:(tributary-slot)
                +--rw ts?    uint16
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
               /te:p2p-primary-path/te:path-in-segment
               /te:label-restrictions/te:label-restriction
               /te:label-end/te:te-label/te:technology:
       +--:(otn)
          +--rw (otn-label-type)?
             +--:(tributary-port)
             |  +--rw tpn?   uint16
             +--:(tributary-slot)
                +--rw ts?    uint16
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
               /te:p2p-primary-path/te:path-out-segment
               /te:label-restrictions/te:label-restriction:
       +--rw range-type?      identityref
       +--rw tsg?             identityref
       +--rw odu-type-list*   identityref
       +--rw priority?        uint8
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
               /te:p2p-primary-path/te:path-out-segment
               /te:label-restrictions/te:label-restriction
               /te:label-start/te:te-label/te:technology:
```

```
       +--:(otn)
          +--rw (otn-label-type)?
             +--:(tributary-port)
             |  +--rw tpn?   uint16
             +--:(tributary-slot)
                +--rw ts?    uint16
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
               /te:p2p-primary-path/te:path-out-segment
               /te:label-restrictions/te:label-restriction
               /te:label-end/te:te-label/te:technology:
       +--:(otn)
          +--rw (otn-label-type)?
             +--:(tributary-port)
             |  +--rw tpn?   uint16
             +--:(tributary-slot)
                +--rw ts?    uint16
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
               /te:p2p-primary-path
               /te:computed-paths-properties
               /te:computed-path-properties/te:path-properties
               /te:path-route-objects
               /te:path-computed-route-object/te:type/te:label
               /te:label-hop/te:te-label/te:technology:
       +--:(otn)
          +--ro tpn?       uint16
          +--ro tsg?       identityref
          +--ro ts-list?   string
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
               /te:p2p-primary-path/te:lsps/te:lsp
               /te:lsp-record-route-information
               /te:lsp-record-route-information/te:type
               /te:label/te:label-hop/te:te-label
               /te:technology:
       +--:(otn)
          +--ro tpn?       uint16
          +--ro tsg?       identityref
          +--ro ts-list?   string
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
               /te:p2p-primary-path/te:lsps/te:lsp
               /te:path-properties/te:path-route-objects
               /te:path-computed-route-object/te:type/te:label
               /te:label-hop/te:te-label/te:technology:
       +--:(otn)
          +--ro tpn?       uint16
          +--ro tsg?       identityref
          +--ro ts-list?   string
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
               /te:p2p-primary-path/te:p2p-primary-reverse-path
```

```
               /te:optimizations/te:algorithm/te:metric
               /te:optimization-metric
               /te:explicit-route-exclude-objects
               /te:route-object-exclude-object/te:type/te:label
               /te:label-hop/te:te-label/te:technology:
       +--:(otn)
          +--rw tpn?       uint16
          +--rw tsg?       identityref
          +--rw ts-list?   string
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
               /te:p2p-primary-path/te:p2p-primary-reverse-path
               /te:optimizations/te:algorithm/te:metric
               /te:optimization-metric
               /te:explicit-route-include-objects
               /te:route-object-include-object/te:type/te:label
               /te:label-hop/te:te-label/te:technology:
       +--:(otn)
          +--rw tpn?       uint16
          +--rw tsg?       identityref
          +--rw ts-list?   string
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
               /te:p2p-primary-path/te:p2p-primary-reverse-path
               /te:explicit-route-objects-always
               /te:route-object-exclude-always/te:type/te:label
               /te:label-hop/te:te-label/te:technology:
       +--:(otn)
          +--rw tpn?       uint16
          +--rw tsg?       identityref
          +--rw ts-list?   string
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
               /te:p2p-primary-path/te:p2p-primary-reverse-path
               /te:explicit-route-objects-always
               /te:route-object-include-exclude/te:type
               /te:label/te:label-hop/te:te-label
               /te:technology:
       +--:(otn)
          +--rw tpn?       uint16
          +--rw tsg?       identityref
          +--rw ts-list?   string
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
               /te:p2p-primary-path/te:p2p-primary-reverse-path
               /te:path-in-segment/te:label-restrictions
               /te:label-restriction:
       +--rw range-type?      identityref
       +--rw tsg?             identityref
       +--rw odu-type-list*   identityref
       +--rw priority?        uint8
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
```

```
                /te:p2p-primary-path/te:p2p-primary-reverse-path
                /te:path-in-segment/te:label-restrictions
                /te:label-restriction/te:label-start/te:te-label
                /te:technology:
        +--:(otn)
           +--rw (otn-label-type)?
              +--:(tributary-port)
              |  +--rw tpn?   uint16
              +--:(tributary-slot)
                 +--rw ts?    uint16
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
                /te:p2p-primary-path/te:p2p-primary-reverse-path
                /te:path-in-segment/te:label-restrictions
                /te:label-restriction/te:label-end/te:te-label
                /te:technology:
        +--:(otn)
           +--rw (otn-label-type)?
              +--:(tributary-port)
              |  +--rw tpn?   uint16
              +--:(tributary-slot)
                 +--rw ts?    uint16
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
                /te:p2p-primary-path/te:p2p-primary-reverse-path
                /te:path-out-segment/te:label-restrictions
                /te:label-restriction:
        +--rw range-type?      identityref
        +--rw tsg?             identityref
        +--rw odu-type-list*   identityref
        +--rw priority?        uint8
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
                /te:p2p-primary-path/te:p2p-primary-reverse-path
                /te:path-out-segment/te:label-restrictions
                /te:label-restriction/te:label-start/te:te-label
                /te:technology:
        +--:(otn)
           +--rw (otn-label-type)?
              +--:(tributary-port)
              |  +--rw tpn?   uint16
              +--:(tributary-slot)
                 +--rw ts?    uint16
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
                /te:p2p-primary-path/te:p2p-primary-reverse-path
                /te:path-out-segment/te:label-restrictions
                /te:label-restriction/te:label-end/te:te-label
                /te:technology:
        +--:(otn)
           +--rw (otn-label-type)?
              +--:(tributary-port)
```

```
             |  +--rw tpn?   uint16
             +--:(tributary-slot)
                +--rw ts?    uint16
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
               /te:p2p-primary-path/te:p2p-primary-reverse-path
               /te:computed-paths-properties
               /te:computed-path-properties/te:path-properties
               /te:path-route-objects
               /te:path-computed-route-object/te:type/te:label
               /te:label-hop/te:te-label/te:technology:
       +--:(otn)
          +--ro tpn?       uint16
          +--ro tsg?       identityref
          +--ro ts-list?   string
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
               /te:p2p-primary-path/te:p2p-primary-reverse-path
               /te:lsps/te:lsp/te:lsp-record-route-information
               /te:lsp-record-route-information/te:type
               /te:label/te:label-hop/te:te-label
               /te:technology:
       +--:(otn)
          +--ro tpn?       uint16
          +--ro tsg?       identityref
          +--ro ts-list?   string
     augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
               /te:p2p-primary-path/te:p2p-primary-reverse-path
               /te:lsps/te:lsp/te:path-properties
               /te:path-route-objects
               /te:path-computed-route-object/te:type/te:label
               /te:label-hop/te:te-label/te:technology:
       +--:(otn)
          +--ro tpn?       uint16
          +--ro tsg?       identityref
          +--ro ts-list?   string
     augment /te:te/te:tunnels/te:tunnel/te:p2p-secondary-paths
               /te:p2p-secondary-path/te:optimizations
               /te:algorithm/te:metric/te:optimization-metric
               /te:explicit-route-exclude-objects
               /te:route-object-exclude-object/te:type/te:label
               /te:label-hop/te:te-label/te:technology:
       +--:(otn)
          +--rw tpn?       uint16
          +--rw tsg?       identityref
          +--rw ts-list?   string
     augment /te:te/te:tunnels/te:tunnel/te:p2p-secondary-paths
               /te:p2p-secondary-path/te:optimizations
               /te:algorithm/te:metric/te:optimization-metric
               /te:explicit-route-include-objects
```

```
               /te:route-object-include-object/te:type/te:label
               /te:label-hop/te:te-label/te:technology:
       +--:(otn)
          +--rw tpn?       uint16
          +--rw tsg?       identityref
          +--rw ts-list?   string
     augment /te:te/te:tunnels/te:tunnel/te:p2p-secondary-paths
               /te:p2p-secondary-path
               /te:explicit-route-objects-always
               /te:route-object-exclude-always/te:type/te:label
               /te:label-hop/te:te-label/te:technology:
       +--:(otn)
          +--rw tpn?       uint16
          +--rw tsg?       identityref
          +--rw ts-list?   string
     augment /te:te/te:tunnels/te:tunnel/te:p2p-secondary-paths
               /te:p2p-secondary-path
               /te:explicit-route-objects-always
               /te:route-object-include-exclude/te:type
               /te:label/te:label-hop/te:te-label
               /te:technology:
       +--:(otn)
          +--rw tpn?       uint16
          +--rw tsg?       identityref
          +--rw ts-list?   string
     augment /te:te/te:tunnels/te:tunnel/te:p2p-secondary-paths
               /te:p2p-secondary-path/te:path-in-segment
               /te:label-restrictions/te:label-restriction:
       +--rw range-type?      identityref
       +--rw tsg?             identityref
       +--rw odu-type-list*   identityref
       +--rw priority?        uint8
     augment /te:te/te:tunnels/te:tunnel/te:p2p-secondary-paths
               /te:p2p-secondary-path/te:path-in-segment
               /te:label-restrictions/te:label-restriction
               /te:label-start/te:te-label/te:technology:
       +--:(otn)
          +--rw (otn-label-type)?
             +--:(tributary-port)
             |  +--rw tpn?   uint16
             +--:(tributary-slot)
                +--rw ts?    uint16
     augment /te:te/te:tunnels/te:tunnel/te:p2p-secondary-paths
               /te:p2p-secondary-path/te:path-in-segment
               /te:label-restrictions/te:label-restriction
               /te:label-end/te:te-label/te:technology:
       +--:(otn)
          +--rw (otn-label-type)?
```

```
             +--:(tributary-port)
             |  +--rw tpn?   uint16
             +--:(tributary-slot)
                +--rw ts?    uint16
     augment /te:te/te:tunnels/te:tunnel/te:p2p-secondary-paths
               /te:p2p-secondary-path/te:path-out-segment
               /te:label-restrictions/te:label-restriction:
       +--rw range-type?      identityref
       +--rw tsg?             identityref
       +--rw odu-type-list*   identityref
       +--rw priority?        uint8
     augment /te:te/te:tunnels/te:tunnel/te:p2p-secondary-paths
               /te:p2p-secondary-path/te:path-out-segment
               /te:label-restrictions/te:label-restriction
               /te:label-start/te:te-label/te:technology:
       +--:(otn)
          +--rw (otn-label-type)?
             +--:(tributary-port)
             |  +--rw tpn?   uint16
             +--:(tributary-slot)
                +--rw ts?    uint16
     augment /te:te/te:tunnels/te:tunnel/te:p2p-secondary-paths
               /te:p2p-secondary-path/te:path-out-segment
               /te:label-restrictions/te:label-restriction
               /te:label-end/te:te-label/te:technology:
       +--:(otn)
          +--rw (otn-label-type)?
             +--:(tributary-port)
             |  +--rw tpn?   uint16
             +--:(tributary-slot)
                +--rw ts?    uint16
     augment /te:te/te:tunnels/te:tunnel/te:p2p-secondary-paths
               /te:p2p-secondary-path
               /te:computed-paths-properties
               /te:computed-path-properties/te:path-properties
               /te:path-route-objects
               /te:path-computed-route-object/te:type/te:label
               /te:label-hop/te:te-label/te:technology:
       +--:(otn)
          +--ro tpn?       uint16
          +--ro tsg?       identityref
          +--ro ts-list?   string
     augment /te:te/te:tunnels/te:tunnel/te:p2p-secondary-paths
               /te:p2p-secondary-path/te:lsps/te:lsp
               /te:lsp-record-route-information
               /te:lsp-record-route-information/te:type
               /te:label/te:label-hop/te:te-label
               /te:technology:
```

```
      +--:(otn)
         +--ro tpn?       uint16
         +--ro tsg?       identityref
         +--ro ts-list?   string
    augment /te:te/te:tunnels/te:tunnel/te:p2p-secondary-paths
              /te:p2p-secondary-path/te:lsps/te:lsp
              /te:path-properties/te:path-route-objects
              /te:path-computed-route-object/te:type/te:label
              /te:label-hop/te:te-label/te:technology:
      +--:(otn)
         +--ro tpn?       uint16
         +--ro tsg?       identityref
         +--ro ts-list?   string
    augment /te:te/te:lsps-state/te:lsp
              /te:lsp-record-route-information
              /te:lsp-record-route-information/te:type
              /te:label/te:label-hop/te:te-label
              /te:technology:
      +--:(otn)
         +--ro tpn?       uint16
         +--ro tsg?       identityref
         +--ro ts-list?   string
```

## 5. OTN Tunnel YANG Code

```
<CODE BEGINS>file "ietf-otn-tunnel@2019-11-02.yang"
module ietf-otn-tunnel {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-otn-tunnel";
  prefix "otn-tunnel";

  import ietf-te {
    prefix "te";
    reference
    "I-D.ietf-teas-yang-te: A YANG Data Model for Traffic Engineering
    Tunnels and Interfaces. ";
  }

  import ietf-layer1-types {
    prefix "layer1-types";
    reference
    "I-D.ietf-ccamp-layer1-types:
        A YANG Data Model for Layer 1 Types. ";
```

```
    }

    organization
      "IETF CCAMP Working Group";
    contact
      "WG Web: <http://tools.ietf.org/wg/ccamp/>
       WG List: <mailto:ccamp@ietf.org>

       Editor: Haomian Zheng
               <mailto:zhenghaomian@huawei.com>

       Editor: Italo Busi
               <mailto:italo.busi@huawei.com>

       Editor: Sergio Belotti
               <mailto:sergio.belotti@nokia.com>

       Editor: Victor Lopez
               <mailto:victor.lopezalvarez@telefonica.com>

       Editor: Yunbin Xu
               <mailto:xuyunbin@ritt.cn>";

    description
      "This module defines a model for OTN Tunnel Services.
          The model fully conforms to the Network Management
          Datastore Architecture (NMDA).

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          identified as authors of the code.  All rights reserved.

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          without modification, is permitted pursuant to, and subject
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          set forth in Section 4.c of the IETF Trust's Legal Provisions
          Relating to IETF Documents
          (https://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 "2019-11-02" {
      description
        "Initial Revision";
      reference
        "RFC XXXX: OTN Tunnel YANG Model";
      // RFC Ed.: replace XXXX with actual RFC number, update date
      // information and remove this note
    }
```

```
   /*
    * Groupings
    */

    grouping otn-tunnel-attributes {
      description "Parameters for OTN tunnel";

      leaf src-client-signal {
        type identityref {
          base layer1-types:client-signal;
        }
        description
          "Client signal at the source endpoint of the tunnel. ";
      }

      leaf dst-client-signal {
        type identityref {
          base layer1-types:client-signal;
        }
        description
          "Client signal at the destination endpoint of the tunnel";
      }

   }

   /*
    * Data nodes
    */

    augment "/te:te/te:tunnels/te:tunnel" {
      description
        "Augment with additional parameters required for OTN service";
      uses otn-tunnel-attributes;
    }

    /*
     * Augment TE bandwidth
     */

           /* Augment bandwidth of named-path-constraints */
    augment "/te:te/te:globals/te:named-path-constraints/"
          + "te:named-path-constraint/"
          + "te:te-bandwidth/te:technology" {
      description "OTN bandwidth.";
      case otn {
        uses layer1-types:otn-path-bandwidth;
      }
    }
```

```
    /* Augment bandwdith of tunnel */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:te-bandwidth/te:technology" {
      description "OTN bandwidth.";
      case otn {
        uses layer1-types:otn-path-bandwidth;
      }
    }

    /* Augment bandwidth of primary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:te-bandwidth/te:technology" {
      description "OTN bandwidth.";
      case otn {
        uses layer1-types:otn-path-bandwidth;
      }
    }

    /* Augment bandwidth of reverse primary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:p2p-primary-reverse-path/"
          + "te:te-bandwidth/te:technology" {
      description "OTN bandwidth.";
      case otn {
        uses layer1-types:otn-path-bandwidth;
      }
    }

    /* Augment bandwidth of secondary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-secondary-paths/te:p2p-secondary-path/"
          + "te:te-bandwidth/te:technology" {
      description "OTN bandwidth.";
      case otn {
        uses layer1-types:otn-path-bandwidth;
      }
    }

    /*
     * Augment TE label.
     */

    /* Augment label hop of route-object-exclude-always
     * of named-path-constraints */
    augment "/te:te/te:globals/te:named-path-constraints/"
          + "te:named-path-constraint/te:explicit-route-objects-always/"
```

```
          + "te:route-object-exclude-always/te:type/te:label/"
          + "te:label-hop/te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-hop;
      }
    }

    /* Augment label hop of route-object-include-exclude
     * of named-path-constraints */
    augment "/te:te/te:globals/te:named-path-constraints/"
          + "te:named-path-constraint/te:explicit-route-objects-always/"
          + "te:route-object-include-exclude/te:type/te:label/"
          + "te:label-hop/te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-hop;
      }
    }

    /* Augment label restrictions for the forwarding direction
     * of path-in-segment of named-path-constraints */
    augment "/te:te/te:globals/te:named-path-constraints/"
          + "te:named-path-constraint/te:path-in-segment/"
          + "te:label-restrictions/te:label-restriction"  {
      description "OTN label.";
      uses layer1-types:otn-label-range-info;
    }

    /* Augment label restrictions start for the forwarding direction
     * of path-in-segment of named-path-constraints */
    augment "/te:te/te:globals/te:named-path-constraints/"
          + "te:named-path-constraint/te:path-in-segment/"
          + "te:label-restrictions/"
          + "te:label-restriction/te:label-start/"
          + "te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-start-end;
      }
    }

    /* Augment label restrictions end for the forwarding direction
     * of path-in-segment of named-path-constraints */
    augment "/te:te/te:globals/te:named-path-constraints/"
          + "te:named-path-constraint/te:path-in-segment/"
          + "te:label-restrictions/"
          + "te:label-restriction/te:label-end/"
```

```
          + "te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-start-end;
      }
    }

    /* Augment label restrictions for the forwarding direction
     * of path-out-segment of named-path-constraints */
    augment "/te:te/te:globals/te:named-path-constraints/"
          + "te:named-path-constraint/te:path-out-segment/"
          + "te:label-restrictions/"
          + "te:label-restriction" {
      description "OTN label.";
      uses layer1-types:otn-label-range-info;
    }
    /* Augment label restrictions start for the forwarding direction
     * of path-out-segment of named-path-constraints */
    augment "/te:te/te:globals/te:named-path-constraints/"
          + "te:named-path-constraint/te:path-out-segment/"
          + "te:label-restrictions/"
          + "te:label-restriction/te:label-start/"
          + "te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-start-end;
      }
    }

    /* Augment label restrictions end for the forwarding direction
     * of path-out-segment of named-path-constraints */
    augment "/te:te/te:globals/te:named-path-constraints/"
          + "te:named-path-constraint/te:path-out-segment/"
          + "te:label-restrictions/"
          + "te:label-restriction/te:label-end/"
          + "te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-start-end;
      }
    }

    /* Augment label hop of route-exclude of primary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:optimizations/te:algorithm/te:metric/"
          + "te:optimization-metric/te:explicit-route-exclude-objects/"
          + "te:route-object-exclude-object/te:type/te:label/"
```

```
          + "te:label-hop/te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-hop;
      }
    }

    /* Augment label hop of route-include of primary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:optimizations/te:algorithm/te:metric/"
          + "te:optimization-metric/te:explicit-route-include-objects/"
          + "te:route-object-include-object/te:type/te:label/"
          + "te:label-hop/te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-hop;
      }
    }

    /* Augment label hop of route-object-exclude-always of
     * primary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:explicit-route-objects-always/"
          + "te:route-object-exclude-always/te:type/te:label/"
          + "te:label-hop/te:te-label/te:technology" {
      description "OTN label.";
      case otn {

        uses layer1-types:otn-label-hop;
      }
    }

    /* Augment label hop of route-object-include-exclude of
     * primary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:explicit-route-objects-always/"
          + "te:route-object-include-exclude/te:type/te:label/"
          + "te:label-hop/te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-hop;
      }
    }

    /* Augment label restrictions for the forwarding direction
```

```
     * of path-in-segment of primary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:path-in-segment/te:label-restrictions/"
          + "te:label-restriction" {
      description "OTN label.";
      uses layer1-types:otn-label-range-info;
    }

    /* Augment label restrictions start for the forwarding direction
     * of path-in-segment of primary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:path-in-segment/te:label-restrictions/"
          + "te:label-restriction/te:label-start/"
          + "te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-start-end;
      }
    }

    /* Augment label restrictions end for the forwarding direction
     * of path-in-segment of primary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:path-in-segment/te:label-restrictions/"
          + "te:label-restriction/te:label-end/"
          + "te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-start-end;
      }
    }

    /* Augment label restrictions for the forwarding direction of
     * path-out-segment of primary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:path-out-segment/te:label-restrictions/"
          + "te:label-restriction" {
      description "OTN label.";
      uses layer1-types:otn-label-range-info;
    }

    /* Augment label restrictions start for the forwarding direction
     * of path-out-segment of primary path */
    augment "/te:te/te:tunnels/te:tunnel/"
```

```
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:path-out-segment/te:label-restrictions/"
          + "te:label-restriction/te:label-start/"
          + "te:te-label/te:technology" {

      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-start-end;
      }
    }

    /* Augment label restrictions end for the forwarding direction
     * of path-out-segment of primary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:path-out-segment/te:label-restrictions/"
          + "te:label-restriction/te:label-end/"
          + "te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-start-end;
      }
    }

    /* Augment label hop of path-route of primary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:computed-paths-properties/"
          + "te:computed-path-properties/te:path-properties/"
          + "te:path-route-objects/te:path-computed-route-object/"
          + "te:type/te:label/"
          + "te:label-hop/te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-hop;
      }
    }

    /* Augment label hop of record-route of primary LSP */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:lsps/te:lsp/te:lsp-record-route-information/"
          + "te:lsp-record-route-information/te:type/te:label/"
          + "te:label-hop/te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-hop;
      }
```

```
    }

    /* Augment label hop of path-route of primary LSP */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:lsps/te:lsp/te:path-properties/"
          + "te:path-route-objects/te:path-computed-route-object/"
          + "te:type/te:label/"
          + "te:label-hop/te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-hop;
      }
    }

    /* Augment label hop of route-exclude of reverse primary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:p2p-primary-reverse-path/"
          + "te:optimizations/te:algorithm/te:metric/"
          + "te:optimization-metric/te:explicit-route-exclude-objects/"
          + "te:route-object-exclude-object/te:type/te:label/"
          + "te:label-hop/te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-hop;
      }
    }

    /* Augment label hop of route-include of reverse primary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:p2p-primary-reverse-path/"
          + "te:optimizations/te:algorithm/te:metric/"
          + "te:optimization-metric/te:explicit-route-include-objects/"
          + "te:route-object-include-object/te:type/te:label/"
          + "te:label-hop/te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-hop;
      }
    }

    /* Augment label hop of route-object-exclude-always of
     * reverse primary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:p2p-primary-reverse-path/"
```

```
          + "te:explicit-route-objects-always/"
          + "te:route-object-exclude-always/"
          + "te:type/te:label/"
          + "te:label-hop/te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-hop;
      }
    }

    /* Augment label hop of route-object-include-exclude of
     * reverse primary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:p2p-primary-reverse-path/"
          + "te:explicit-route-objects-always/"
          + "te:route-object-include-exclude/"
          + "te:type/te:label/"
          + "te:label-hop/te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-hop;
      }
    }

    /* Augment label restrictions for the forwarding direction
     * of path-in-segment of reverse primary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:p2p-primary-reverse-path/"
          + "te:path-in-segment/te:label-restrictions/"
          + "te:label-restriction" {
      description "OTN label.";
      uses layer1-types:otn-label-range-info;
    }

    /* Augment label restrictions start for the forwarding direction
     * of path-in-segment of reverse primary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:p2p-primary-reverse-path/"
          + "te:path-in-segment/te:label-restrictions/"
          + "te:label-restriction/te:label-start/"
          + "te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-start-end;
      }
```

```
    }

    /* Augment label restrictions end for the forwarding direction
     * of path-in-segment of reverse primary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:p2p-primary-reverse-path/"
          + "te:path-in-segment/te:label-restrictions/"
          + "te:label-restriction/te:label-end/"
          + "te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-start-end;
      }
    }

    /* Augment label restrictions for the forwarding direction
     * of path-out-segment of reverse primary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:p2p-primary-reverse-path/"
          + "te:path-out-segment/te:label-restrictions/"
          + "te:label-restriction" {
      description "OTN label.";
      uses layer1-types:otn-label-range-info;
    }

    /* Augment label restrictions start for the forwarding direction
     * of path-out-segment of reverse primary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:p2p-primary-reverse-path/"
          + "te:path-out-segment/te:label-restrictions/"
          + "te:label-restriction/te:label-start/"
          + "te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-start-end;
      }
    }

    /* Augment label restrictions end for the forwarding direction
     * of path-out-segment of reverse primary path */

    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:p2p-primary-reverse-path/"
          + "te:path-out-segment/te:label-restrictions/"
```

```
          + "te:label-restriction/te:label-end/"
          + "te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-start-end;
      }
    }

    /* Augment label hop of path-route of reverse primary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:p2p-primary-reverse-path/"
          + "te:computed-paths-properties/te:computed-path-properties/"
          + "te:path-properties/te:path-route-objects/"
          + "te:path-computed-route-object/te:type/te:label/"
          + "te:label-hop/te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-hop;
      }
    }

    /* Augment label hop of record-route of reverse primary LSP */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:p2p-primary-reverse-path/"
          + "te:lsps/te:lsp/te:lsp-record-route-information/"
          + "te:lsp-record-route-information/te:type/te:label/"
          + "te:label-hop/te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-hop;
      }
    }

    /* Augment label hop of path-route of reverse primary LSP */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-primary-paths/te:p2p-primary-path/"
          + "te:p2p-primary-reverse-path/"
          + "te:lsps/te:lsp/te:path-properties/"
          + "te:path-route-objects/te:path-computed-route-object/"
          + "te:type/te:label/"
          + "te:label-hop/te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-hop;
      }
    }
```

```
    /* Augment label hop of route-exclude of secondary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-secondary-paths/te:p2p-secondary-path/"
          + "te:optimizations/te:algorithm/te:metric/"
          + "te:optimization-metric/te:explicit-route-exclude-objects/"
          + "te:route-object-exclude-object/te:type/te:label/"
          + "te:label-hop/te:te-label/te:technology" {

      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-hop;
      }
    }

    /* Augment label hop of route-include of secondary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-secondary-paths/te:p2p-secondary-path/"
          + "te:optimizations/te:algorithm/te:metric/"
          + "te:optimization-metric/te:explicit-route-include-objects/"
          + "te:route-object-include-object/te:type/te:label/"
          + "te:label-hop/te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-hop;
      }
    }

    /* Augment label hop of route-object-exclude-always
     * of secondary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-secondary-paths/te:p2p-secondary-path/"
          + "te:explicit-route-objects-always/"
          + "te:route-object-exclude-always/te:type/te:label/"
          + "te:label-hop/te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-hop;
      }
    }

    /* Augment label hop of route-object-include-exclude of
     * secondary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-secondary-paths/te:p2p-secondary-path/"
          + "te:explicit-route-objects-always/"
          + "te:route-object-include-exclude/te:type/te:label/"
          + "te:label-hop/te:te-label/te:technology" {
      description "OTN label.";
```

```
      case otn {
        uses layer1-types:otn-label-hop;
      }
    }

    /* Augment label restrictions for the forwarding direction
     * of path-in-segment of secondary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-secondary-paths/te:p2p-secondary-path/"
          + "te:path-in-segment/te:label-restrictions/"
          + "te:label-restriction" {

      description "OTN label.";
      uses layer1-types:otn-label-range-info;
    }

    /* Augment label restrictions start for the forwarding direction
     * of path-in-segment of secondary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-secondary-paths/te:p2p-secondary-path/"
          + "te:path-in-segment/te:label-restrictions/"
          + "te:label-restriction/te:label-start/"
          + "te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-start-end;
      }
    }

    /* Augment label restrictions end for the forwarding direction
     * of path-in-segment of secondary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-secondary-paths/te:p2p-secondary-path/"
          + "te:path-in-segment/te:label-restrictions/"
          + "te:label-restriction/te:label-end/"
          + "te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-start-end;
      }
    }

    /* Augment label restrictions for the forwarding direction
     * of path-out-segment of secondary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-secondary-paths/te:p2p-secondary-path/"
          + "te:path-out-segment/te:label-restrictions/"
          + "te:label-restriction" {
```

```
      description "OTN label.";
      uses layer1-types:otn-label-range-info;
    }

    /* Augment label restrictions start for the forwarding direction
     * of path-out-segment of secondary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-secondary-paths/te:p2p-secondary-path/"
          + "te:path-out-segment/te:label-restrictions/"
          + "te:label-restriction/te:label-start/"
          + "te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-start-end;
      }
    }

    /* Augment label restrictions end for the forwarding direction
     * of path-out-segment of secondary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-secondary-paths/te:p2p-secondary-path/"
          + "te:path-out-segment/te:label-restrictions/"
          + "te:label-restriction/te:label-end/"
          + "te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-start-end;
      }
    }

    /* Augment label hop of path-route of secondary path */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-secondary-paths/te:p2p-secondary-path/"
                  + "te:computed-paths-properties/"
                  + "te:computed-path-properties/"
          + "te:path-properties/te:path-route-objects/"
          + "te:path-computed-route-object/te:type/te:label/"
          + "te:label-hop/te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-hop;
      }
    }

    /* Augment label hop of record-route of secondary LSP */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-secondary-paths/te:p2p-secondary-path/"
          + "te:lsps/te:lsp/te:lsp-record-route-information/"
```

```
          + "te:lsp-record-route-information/te:type/te:label/"
          + "te:label-hop/te:te-label/te:technology" {

      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-hop;
      }
    }

    /* Augment label hop of path-route of secondary LSP */
    augment "/te:te/te:tunnels/te:tunnel/"
          + "te:p2p-secondary-paths/te:p2p-secondary-path/"
          + "te:lsps/te:lsp/te:path-properties/"
          + "te:path-route-objects/"
          + "te:path-computed-route-object/te:type/te:label/"
          + "te:label-hop/te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-hop;
      }
    }

    /* Augment label hop of record-route of LSP */
    augment "/te:te/te:lsps-state/"
          + "te:lsp/te:lsp-record-route-information/"
          + "te:lsp-record-route-information/te:type/te:label/"
          + "te:label-hop/te:te-label/te:technology" {
      description "OTN label.";
      case otn {
        uses layer1-types:otn-label-hop;
      }
    }
  }

  <CODE ENDS>
```

## 6. 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 NETCONF access control model [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:

/te:te/te:tunnels/te:tunnel /te:te/../te:te-bandwidth/te:technology /te:te/../te:type/te:label/te:label-hop/te:te-label/te:technology /te:te/../te:label-restrictions/te:label-restriction/te:label-start/ te:te-label/te:technology /te:te/../te:label-restrictions/te:label-restriction/te:label-end/te:te-label/te:technology /te:te/../te:label-restrictions/te:label-restriction/ Editors note: we are using simplified description by folding similar branches to avoid repetation.

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:

/te:te/../te:type/te:label/te:label-hop/te:te-label/te:technology Editors note: we are using simplified description by folding similar branches to avoid repetation.

Some of the RPC operations in this YANG module may be considered sensitive or vulnerable in some network environments. It is thus important to control access to these operations. These are the operations and their sensitivity/vulnerability:

+---x otn-te-tunnel-path-compute This path compute RPC provides a mechanism to enable the client to query and/or subscribe on the tunnel to be notified whenever it changes. Thus path computation is only for the client reference, with no real deploy or resource reservation.

## 7. IANA Considerations

It is proposed that IANA should assign new URIs from the "IETF XML Registry" [RFC3688] as follows:

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

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

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

```
name:         ietf-otn-tunnel
namespace:    urn:ietf:params:xml:ns:yang:ietf-otn-tunnel
prefix:       otn-tunnel
reference:    RFC XXXX

name:         ietf-otn-types
namespace:    urn:ietf:params:xml:ns:yang:ietf-otn-types
prefix:       otn-types
reference:    RFC XXXX
```

## 8. Acknowledgements

TBD.

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## 10. References

### 10.1. Normative References

[I-D.ietf-ccamp-otn-topo-yang]
Zheng, H., Guo, A., Busi, I., Sharma, A., Liu, X., Belotti, S., Xu, Y., Wang, L., and O. Dios, "A YANG Data Model for Optical Transport Network Topology", draft-ietf-ccamp-otn-topo-yang-08 (work in progress), September 2019.

[I-D.ietf-teas-yang-te]
Saad, T., Gandhi, R., Liu, X., Beeram, V., and I. Bryskin, "A YANG Data Model for Traffic Engineering Tunnels and Interfaces", draft-ietf-teas-yang-te-21 (work in progress), April 2019.

[ITU-Tg709]
International Telecommunication Union, "Interfaces for the optical transport network", ITU-T G.709, June 2016.

[RFC3688] Mealling, M., "The IETF XML Registry", BCP 81, RFC 3688, DOI 10.17487/RFC3688, January 2004, <https://www.rfc-editor.org/info/rfc3688>.

[RFC6241] Enns, R., Ed., Bjorklund, M., Ed., Schoenwaelder, J., Ed., and A. Bierman, Ed., "Network Configuration Protocol (NETCONF)", RFC 6241, DOI 10.17487/RFC6241, June 2011, <https://www.rfc-editor.org/info/rfc6241>.

[RFC6242] Wasserman, M., "Using the NETCONF Protocol over Secure Shell (SSH)", RFC 6242, DOI 10.17487/RFC6242, June 2011, <https://www.rfc-editor.org/info/rfc6242>.

[RFC7139] Zhang, F., Ed., Zhang, G., Belotti, S., Ceccarelli, D., and K. Pithewan, "GMPLS Signaling Extensions for Control of Evolving G.709 Optical Transport Networks", RFC 7139, DOI 10.17487/RFC7139, March 2014, <https://www.rfc-editor.org/info/rfc7139>.

[RFC7950] Bjorklund, M., Ed., "The YANG 1.1 Data Modeling Language", RFC 7950, DOI 10.17487/RFC7950, August 2016, <https://www.rfc-editor.org/info/rfc7950>.

[RFC8040] Bierman, A., Bjorklund, M., and K. Watsen, "RESTCONF Protocol", RFC 8040, DOI 10.17487/RFC8040, January 2017, <https://www.rfc-editor.org/info/rfc8040>.

[RFC8341] Bierman, A. and M. Bjorklund, "Network Configuration Access Control Model", STD 91, RFC 8341, DOI 10.17487/RFC8341, March 2018, <https://www.rfc-editor.org/info/rfc8341>.

[RFC8342] Bjorklund, M., Schoenwaelder, J., Shafer, P., Watsen, K., and R. Wilton, "Network Management Datastore Architecture (NMDA)", RFC 8342, DOI 10.17487/RFC8342, March 2018, <https://www.rfc-editor.org/info/rfc8342>.

[RFC8446] Rescorla, E., "The Transport Layer Security (TLS) Protocol Version 1.3", RFC 8446, DOI 10.17487/RFC8446, August 2018, <https://www.rfc-editor.org/info/rfc8446>.

## 10.2. Informative References

[I-D.ietf-ccamp-transport-nbi-app-statement]
Busi, I., King, D., Zheng, H., and Y. Xu, "Transport Northbound Interface Applicability Statement", draft-ietf-ccamp-transport-nbi-app-statement-08 (work in progress), November 2019.

[I-D.ietf-teas-actn-yang]
Lee, Y., Zheng, H., Ceccarelli, D., Yoon, B., Dios, O., Shin, J., and S. Belotti, "Applicability of YANG models for Abstraction and Control of Traffic Engineered Networks", draft-ietf-teas-actn-yang-04 (work in progress), August 2019.

[RFC7062] Zhang, F., Ed., Li, D., Li, H., Belotti, S., and D. Ceccarelli, "Framework for GMPLS and PCE Control of G.709 Optical Transport Networks", RFC 7062, DOI 10.17487/RFC7062, November 2013, <https://www.rfc-editor.org/info/rfc7062>.

[RFC7138] Ceccarelli, D., Ed., Zhang, F., Belotti, S., Rao, R., and J. Drake, "Traffic Engineering Extensions to OSPF for GMPLS Control of Evolving G.709 Optical Transport Networks", RFC 7138, DOI 10.17487/RFC7138, March 2014, <https://www.rfc-editor.org/info/rfc7138>.

[RFC8340] Bjorklund, M. and L. Berger, Ed., "YANG Tree Diagrams", BCP 215, RFC 8340, DOI 10.17487/RFC8340, March 2018, <https://www.rfc-editor.org/info/rfc8340>.

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