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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 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-reverse-primary-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
  /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
  /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:forward/te:label-restrictions/te:label-restriction:
  +--rw range-type?    identityref
  +--rw tsg?           identityref
  +--rw priority?      uint8
augment /te:te/te:globals/te:named-path-constraints
  /te:named-path-constraint/te:path-in-segment/te:forward
  /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:forward
  /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-in-segment/te:reverse
  /te:label-restrictions/te:label-restriction:
  +--rw range-type?    identityref
  +--rw tsg?           identityref
  +--rw priority?      uint8

```



```
augment /te:te/te:globals/te:named-path-constraints
  /te:named-path-constraint/te:path-in-segment/te:reverse
  /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:reverse
  /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:forward
  /te:label-restrictions/te:label-restriction:
  +--rw range-type?   identityref
  +--rw tsg?          identityref
  +--rw priority?     uint8
augment /te:te/te:globals/te:named-path-constraints
  /te:named-path-constraint/te:path-out-segment/te:forward
  /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:forward
  /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:reverse
```



```

        /te:label-restrictions/te:label-restriction:
+--rw range-type?    identityref
+--rw tsg?           identityref
+--rw priority?      uint8
augment /te:te/te:globals/te:named-path-constraints
    /te:named-path-constraint/te:path-out-segment/te:reverse
    /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:reverse
    /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
    /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
    /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:forward
    /te:label-restrictions/te:label-restriction:
    +--rw range-type?   identityref
    +--rw tsg?          identityref
    +--rw priority?     uint8
augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
    /te:p2p-primary-path/te:path-in-segment/te:forward
    /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:forward
    /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-in-segment/te:reverse
    /te:label-restrictions/te:label-restriction:
    +--rw range-type?   identityref
    +--rw tsg?          identityref
    +--rw priority?     uint8
augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
    /te:p2p-primary-path/te:path-in-segment/te:reverse
    /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:reverse
    /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:forward
    /te:label-restrictions/te:label-restriction:
    +--rw range-type?    identityref
    +--rw tsg?            identityref
    +--rw priority?      uint8
augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
    /te:p2p-primary-path/te:path-out-segment/te:forward
    /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:forward
    /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:reverse
    /te:label-restrictions/te:label-restriction:
    +--rw range-type?    identityref
    +--rw tsg?            identityref
    +--rw priority?      uint8
augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
    /te:p2p-primary-path/te:path-out-segment/te:reverse

```



```

    /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:reverse
  /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:state/te:path-properties
  /te:path-route-objects/te:path-computed-route-object
  /te:state/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:state/te:lsps/te:lsp
  /te:lsp-record-route-subobjects/te:record-route-subobject
  /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:state/te:lsps/te:lsp
  /te:path-properties/te:path-route-objects
  /te:path-computed-route-object/te:state/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-reverse-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:p2p-reverse-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:p2p-reverse-primary-path
  /te:explicit-route-objects/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-reverse-primary-path
  /te:explicit-route-objects/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-reverse-primary-path
  /te:path-in-segment/te:forward/te:label-restrictions
  /te:label-restriction:
  +--rw range-type?   identityref
  +--rw tsg?          identityref
  +--rw priority?     uint8
augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
  /te:p2p-primary-path/te:p2p-reverse-primary-path
  /te:path-in-segment/te:forward/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-reverse-primary-path
      /te:path-in-segment/te:forward/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-reverse-primary-path
      /te:path-in-segment/te:reverse/te:label-restrictions
      /te:label-restriction:
  +--rw range-type?    identityref
  +--rw tsg?            identityref
  +--rw priority?      uint8
augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
      /te:p2p-primary-path/te:p2p-reverse-primary-path
      /te:path-in-segment/te:reverse/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-reverse-primary-path
      /te:path-in-segment/te:reverse/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-reverse-primary-path
      /te:path-out-segment/te:forward/te:label-restrictions
      /te:label-restriction:
  +--rw range-type?    identityref
  +--rw tsg?            identityref

```



```
    +--rw priority?      uint8
augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
    /te:p2p-primary-path/te:p2p-reverse-primary-path
    /te:path-out-segment/te:forward/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-reverse-primary-path
    /te:path-out-segment/te:forward/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-reverse-primary-path
    /te:path-out-segment/te:reverse/te:label-restrictions
    /te:label-restriction:
    +--rw range-type?    identityref
    +--rw tsg?            identityref
    +--rw priority?      uint8
augment /te:te/te:tunnels/te:tunnel/te:p2p-primary-paths
    /te:p2p-primary-path/te:p2p-reverse-primary-path
    /te:path-out-segment/te:reverse/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-reverse-primary-path
    /te:path-out-segment/te:reverse/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-reverse-primary-path
    /te:state/te:path-properties/te:path-route-objects
    /te:path-computed-route-object/te:state/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-reverse-primary-path
    /te:state/te:lsps/te:lsp/te:lsp-record-route-subobjects
    /te:record-route-subobject/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-reverse-primary-path
    /te:state/te:lsps/te:lsp/te:path-properties
    /te:path-route-objects/te:path-computed-route-object
    /te:state/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
  /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
  /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:forward
  /te:label-restrictions/te:label-restriction:
  +--rw range-type?   identityref
  +--rw tsg?          identityref
  +--rw priority?     uint8
augment /te:te/te:tunnels/te:tunnel/te:p2p-secondary-paths
  /te:p2p-secondary-path/te:path-in-segment/te:forward
  /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:forward
  /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-in-segment/te:reverse

```



```
        /te:label-restrictions/te:label-restriction:
+--rw range-type?    identityref
+--rw tsg?           identityref
+--rw priority?      uint8
augment /te:te/te:tunnels/te:tunnel/te:p2p-secondary-paths
        /te:p2p-secondary-path/te:path-in-segment/te:reverse
        /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:reverse
        /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:forward
        /te:label-restrictions/te:label-restriction:
+--rw range-type?    identityref
+--rw tsg?           identityref
+--rw priority?      uint8
augment /te:te/te:tunnels/te:tunnel/te:p2p-secondary-paths
        /te:p2p-secondary-path/te:path-out-segment/te:forward
        /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:forward
        /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:reverse
      /te:label-restrictions/te:label-restriction:
    +--rw range-type?  identityref
    +--rw tsg?          identityref
    +--rw priority?     uint8
augment /te:te/te:tunnels/te:tunnel/te:p2p-secondary-paths
      /te:p2p-secondary-path/te:path-out-segment/te:reverse
      /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:reverse
      /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:state/te:path-properties
      /te:path-route-objects/te:path-computed-route-object
      /te:state/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:state/te:lsps/te:lsp
      /te:lsp-record-route-subobjects/te:record-route-subobject
      /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:state/te:lsps/te:lsp
      /te:path-properties/te:path-route-objects

```



```

        /te:path-computed-route-object/te:state/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-subobjects/te:record-route-subobject
  /te:type/te:label/te:label-hop/te:te-label/te:technology:
+---:(otn)
  +--ro tpn?          uint16
  +--ro tsg?          identityref
  +--ro ts-list?      string

rpcs:
+---x otn-te-tunnel-path-compute
+---w input
| +---w request* [id]
|   +---w id          uint8
|   +---w type?       identityref
|   +---w source?     inet:ip-address
|   +---w destination? inet:ip-address
|   +---w src-tp-id?   binary
|   +---w dst-tp-id?   binary
|   +---w switching-layer? identityref
|   +---w encoding?    identityref
|   +---w protection-type? identityref
|   +---w restoration-type? identityref
|   +---w provider-id? te-types:te-global-id
|   +---w client-id?   te-types:te-global-id
|   +---w te-topology-id? te-types:te-topology-id
|   +---w setup-priority? uint8
|   +---w hold-priority?  uint8
|   +---w te-path-metric-type? identityref
|   +---w odu-type?       identityref
|   +---w p2p-primary-paths
|   | +---w p2p-primary-path* [name]
|   |   +---w name          string
|   |   +---w te-default-metric? uint32
|   |   +---w te-delay-metric?  uint32
|   |   +---w te-hop-metric?    uint32
|   |   +---w explicit-route-objects
|   |   | +---w explicit-route-object* [index]
|   |   |   +---w explicit-route-usage? identityref
|   |   |   +---w index          uint32
|   |   |   +---w (type)?
|   |   |   +---:(num-unnum-hop)
|   |   |   | +---w num-unnum-hop

```



```

|         |         |         +---w node-id?      te-types:te-node-id
|         |         |         +---w link-tp-id?   te-types:te-tp-id
|         |         |         +---w hop-type?     te-hop-type
|         |         |         +---w direction?    te-link-direction
|         |         +---:(as-number)
|         |         |         +---w as-number-hop
|         |         |         +---w as-number?    binary
|         |         |         +---w hop-type?     te-hop-type
|         |         +---:(label)
|         |         +---w label-hop
|         |         +---w te-label
|         |         +---w (technology)?
|         |         |         +---:(generic)
|         |         |         |         +---w generic?    rt-
types:generalized-label
|         |         |         |         +---:(otn)
|         |         |         |         +---w tpn?      uint16
|         |         |         |         +---w tsg?      identityref
|         |         |         |         +---w ts-list?   string
|         |         +---w direction?    te-label-direction
|         +---w p2p-secondary-paths
|         |         +---w p2p-secondary-path* [name]
|         |         |         +---w name              string
|         |         |         +---w te-default-metric? uint32
|         |         |         +---w te-delay-metric?   uint32
|         |         |         +---w te-hop-metric?     uint32
|         |         +---w explicit-route-objects
|         |         |         +---w explicit-route-object* [index]
|         |         |         |         +---w explicit-route-usage? identityref
|         |         |         |         +---w index              uint32
|         |         |         +---w (type)?
|         |         |         |         +---:(num-unnum-hop)
|         |         |         |         |         +---w num-unnum-hop
|         |         |         |         |         +---w node-id?    te-types:te-node-id
|         |         |         |         |         +---w link-tp-id? te-types:te-tp-id
|         |         |         |         |         +---w hop-type?   te-hop-type
|         |         |         |         |         +---w direction?  te-link-direction
|         |         |         |         +---:(as-number)
|         |         |         |         |         +---w as-number-hop
|         |         |         |         |         +---w as-number?   binary
|         |         |         |         |         +---w hop-type?    te-hop-type
|         |         |         +---:(label)
|         |         |         +---w label-hop
|         |         |         +---w te-label
|         |         |         +---w (technology)?
|         |         |         |         +---:(generic)
|         |         |         |         |         +---w generic?    rt-
types:generalized-label

```

			+--:(otn)	
			+---w tpn?	uint16

```

|         |         |         +---w tsg?         identityref
|         |         |         +---w ts-list?      string
|         |         |         +---w direction?    te-label-direction
|         +---w src-client-signal?    identityref
|         +---w src-tributary-slots
|         |   +---w values*    uint8
|         +---w dst-client-signal?    identityref
|         +---w dst-tributary-slots
|         |   +---w values*    uint8
+--ro output
  +--ro return-code?    enumeration
  +--ro result* [id]
    +--ro id            uint8
    +--ro p2p-primary-paths
      | +--ro p2p-primary-path* [name]
      |   +--ro name            string
      |   +--ro te-default-metric?    uint32
      |   +--ro te-delay-metric?    uint32
      |   +--ro te-hop-metric?    uint32
      |   +--ro explicit-route-objects
      |     +--ro explicit-route-object* [index]
      |       +--ro explicit-route-usage?    identityref
      |       +--ro index            uint32
      |       +--ro (type)?
      |         +--:(num-unnum-hop)
      |         | +--ro num-unnum-hop
      |         |   +--ro node-id?    te-types:te-node-id
      |         |   +--ro link-tp-id? te-types:te-tp-id
      |         |   +--ro hop-type?    te-hop-type
      |         |   +--ro direction?  te-link-direction
      |         +--:(as-number)
      |         | +--ro as-number-hop
      |         |   +--ro as-number?    binary
      |         |   +--ro hop-type?    te-hop-type
      |         +--:(label)
      |         | +--ro label-hop
      |         |   +--ro te-label
      |         |     +--ro (technology)?
      |         |       | +--:(generic)
      |         |       | | +--ro generic?    rt-
types:generalized-label
      |         |       | | +--:(otn)
      |         |       |   +--ro tpn?    uint16
      |         |       |   +--ro tsg?    identityref
      |         |       |   +--ro ts-list? string
      |         |       |   +--ro direction?    te-label-direction
    +--ro p2p-secondary-paths
      +--ro p2p-secondary-path* [name]

```

+--ro name

string

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```

+--ro te-default-metric?          uint32
+--ro te-delay-metric?            uint32
+--ro te-hop-metric?              uint32
+--ro explicit-route-objects
  +--ro explicit-route-object* [index]
    +--ro explicit-route-usage?    identityref
    +--ro index                    uint32
    +--ro (type)?
      +--:(num-unnum-hop)
      | +--ro num-unnum-hop
      |   +--ro node-id?           te-types:te-node-id
      |   +--ro link-tp-id?        te-types:te-tp-id
      |   +--ro hop-type?          te-hop-type
      |   +--ro direction?         te-link-direction
      +--:(as-number)
      | +--ro as-number-hop
      |   +--ro as-number?         binary
      |   +--ro hop-type?          te-hop-type
      +--:(label)
        +--ro label-hop
          +--ro te-label
            +--ro (technology)?
            | +--:(generic)
            | | +--ro generic?      rt-
            |
            | +--:(otn)
            |   +--ro tpn?          uint16
            |   +--ro tsg?          identityref
            |   +--ro ts-list?      string
            +--ro direction?        te-label-direction
types:generalized-label

```

5. OTN Tunnel YANG Code

<CODE BEGINS>file "ietf-otn-tunnel@2018-08-23.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-otn-types {
  prefix "otn-types";
  reference
    "module ietf-otn-types in this Document";
}

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

import ietf-inet-types {
  prefix "inet";
  reference "RFC 6991: Common YANG Data 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>

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

  Editor: Yunbo Li
```


<mailto:liyunbo@chinamobile.com>

Editor: Yunbin Xu

<mailto:xuyunbin@rict.cn>;

description

"This module defines a model for OTN Tunnel Services.

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revision "2018-08-23" {

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 otn-types:client-signal;

}

description

"Client signal at the source endpoint of the tunnel";

}

leaf dst-client-signal {

type identityref {

base otn-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 otn-types:otn-path-bandwidth;
        }
    }
}

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

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

```
/* 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:forward/te:label-restrictions/"
  + "te:label-restriction" {
    description "OTN label.";
    uses otn-types:otn-label-restriction;
  }

/* 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:forward/te:label-restrictions/"
  + "te:label-restriction/te:label-start/"
  + "te:te-label/te:technology" {
    description "OTN label.";
    case otn {
      uses otn-types:otn-link-label;
    }
  }

/* 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:forward/te:label-restrictions/"
  + "te:label-restriction/te:label-end/"
  + "te:te-label/te:technology" {
    description "OTN label.";
    case otn {
      uses otn-types:otn-link-label;
    }
  }

/* Augment label restrictions for the reverse 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:reverse/te:label-restrictions/"
  + "te:label-restriction" {
    description "OTN label.";
    uses otn-types:otn-label-restriction;
  }

/* Augment label restrictions start for the reverse 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:reverse/te:label-restrictions/"
+ "te:label-restriction/te:label-start/"
+ "te:te-label/te:technology" {
description "OTN label.";
```

```
    case otn {
      uses otn-types:otn-link-label;
    }
  }

  /* Augment label restrictions end for the reverse 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:reverse/te:label-restrictions/"
    + "te:label-restriction/te:label-end/"
    + "te:te-label/te:technology" {
    description "OTN label.";
    case otn {
      uses otn-types:otn-link-label;
    }
  }

  /* 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:forward/te:label-restrictions/"
    + "te:label-restriction" {
    description "OTN label.";
    uses otn-types:otn-label-restriction;
  }

  /* 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:forward/te:label-restrictions/"
    + "te:label-restriction/te:label-start/"
    + "te:te-label/te:technology" {
    description "OTN label.";
    case otn {
      uses otn-types:otn-link-label;
    }
  }

  /* 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:forward/te:label-restrictions/"
    + "te:label-restriction/te:label-end/"
    + "te:te-label/te:technology" {
```

```
description "OTN label.";
case otn {
  uses otn-types:otn-link-label;
}
```

```
}
```

```
/* Augment label restrictions for the reverse 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:reverse/te:label-restrictions/"  
  + "te:label-restriction" {  
    description "OTN label.";   
    uses otn-types:otn-label-restriction;  
  }  
}
```

```
/* Augment label restrictions start for the reverse 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:reverse/te:label-restrictions/"  
  + "te:label-restriction/te:label-start/"  
  + "te:te-label/te:technology" {  
    description "OTN label.";   
    case otn {  
      uses otn-types:otn-link-label;  
    }  
  }  
}
```

```
}
```

```
/* Augment label restrictions end for the reverse 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:reverse/te:label-restrictions/"  
  + "te:label-restriction/te:label-end/"  
  + "te:te-label/te:technology" {  
    description "OTN label.";   
    case otn {  
      uses otn-types:otn-link-label;  
    }  
  }  
}
```

```
/* 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 otn-types:otn-path-label;  
  }  
}
```

```
/* 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 otn-types:otn-path-label;
  }
}
```

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

    uses otn-types:otn-path-label;
  }
}
```

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

```
/* 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:forward/te:label-restrictions/"
  + "te:label-restriction" {
  description "OTN label.";
  uses otn-types:otn-label-restriction;
}
```

```
/* 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:forward/te:label-restrictions/"
  + "te:label-restriction/te:label-start/"
  + "te:te-label/te:technology" {
  description "OTN label.";
  case otn {
    uses otn-types:otn-link-label;
  }
}

/* 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:forward/te:label-restrictions/"
  + "te:label-restriction/te:label-end/"
  + "te:te-label/te:technology" {
  description "OTN label.";
  case otn {
    uses otn-types:otn-link-label;
  }
}

/* Augment label restrictions for the reverse 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:reverse/te:label-restrictions/"
  + "te:label-restriction" {
  description "OTN label.";
  uses otn-types:otn-label-restriction;
}

/* Augment label restrictions start for the reverse 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:reverse/te:label-restrictions/"
  + "te:label-restriction/te:label-start/"
  + "te:te-label/te:technology" {
  description "OTN label.";
  case otn {
    uses otn-types:otn-link-label;
  }
}

/* Augment label restrictions end for the reverse 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:reverse/te:label-restrictions/"
```

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

/* 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:forward/te:label-restrictions/"
    + "te:label-restriction" {
    description "OTN label.";
    uses otn-types:otn-label-restriction;
}

/* 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:forward/te:label-restrictions/"
    + "te:label-restriction/te:label-start/"
    + "te:te-label/te:technology" {

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

/* 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:forward/te:label-restrictions/"
    + "te:label-restriction/te:label-end/"
    + "te:te-label/te:technology" {
    description "OTN label.";
    case otn {
        uses otn-types:otn-link-label;
    }
}

/* Augment label restrictions for the reverse 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:reverse/te:label-restrictions/"
+ "te:label-restriction" {
description "OTN label.";
```

```
    uses otn-types:otn-label-restriction;
}

/* Augment label restrictions start for the reverse 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:reverse/te:label-restrictions/"
    + "te:label-restriction/te:label-start/"
    + "te:te-label/te:technology" {
    description "OTN label.";
    case otn {
        uses otn-types:otn-link-label;
    }
}

/* Augment label restrictions end for the reverse 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:reverse/te:label-restrictions/"
    + "te:label-restriction/te:label-end/"
    + "te:te-label/te:technology" {
    description "OTN label.";
    case otn {
        uses otn-types:otn-link-label;
    }
}

/* 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:state/te:path-properties/"
    + "te:path-route-objects/te:path-computed-route-object/"
    + "te:state/te:type/te:label/"
    + "te:label-hop/te:te-label/te:technology" {
    description "OTN label.";
    case otn {
        uses otn-types:otn-path-label;
    }
}

/* 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:state/te:lsps/te:lsp/te:lsp-record-route-subobjects/"
    + "te:record-route-subobject/te:type/te:label/"
```

```
+ "te:label-hop/te:te-label/te:technology" {  
description "OTN label.";
```

```
    case otn {
      uses otn-types:otn-path-label;
    }
  }

/* 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:state/te:lsps/te:lsp/te:path-properties/"
  + "te:path-route-objects/te:path-computed-route-object/"
  + "te:state/te:type/te:label/"
  + "te:label-hop/te:te-label/te:technology" {
  description "OTN label.";
  case otn {
    uses otn-types:otn-path-label;
  }
}

/* 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-reverse-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 otn-types:otn-path-label;
  }
}

/* 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-reverse-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 otn-types:otn-path-label;
  }
}

/* Augment label hop of route-object-exclude-always of reverse primary path
```

* /

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

/* 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-reverse-primary-path/"
  + "te:explicit-route-objects/"
  + "te:route-object-include-exclude/"
  + "te:type/te:label/"
  + "te:label-hop/te:te-label/te:technology" {
  description "OTN label.";
  case otn {
    uses otn-types:otn-path-label;
  }
}
```

/* 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-reverse-primary-path/"
  + "te:path-in-segment/te:forward/te:label-restrictions/"
  + "te:label-restriction" {
  description "OTN label.";
  uses otn-types:otn-label-restriction;
}
```

/* 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-reverse-primary-path/"
  + "te:path-in-segment/te:forward/te:label-restrictions/"
  + "te:label-restriction/te:label-start/"
  + "te:te-label/te:technology" {
  description "OTN label.";
```

```
case otn {  
  uses otn-types:otn-link-label;  
}
```

```
}
```

```
/* 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-reverse-primary-path/"  
  + "te:path-in-segment/te:forward/te:label-restrictions/"  
  + "te:label-restriction/te:label-end/"  
  + "te:te-label/te:technology" {  
    description "OTN label.";  
    case otn {  
      uses otn-types:otn-link-label;  
    }  
  }  
}
```

```
/* Augment label restrictions for the reverse 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-reverse-primary-path/"  
  + "te:path-in-segment/te:reverse/te:label-restrictions/"  
  + "te:label-restriction" {  
    description "OTN label.";  
    uses otn-types:otn-label-restriction;  
  }  
}
```

```
/* Augment label restrictions start for the reverse 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-reverse-primary-path/"  
  + "te:path-in-segment/te:reverse/te:label-restrictions/"  
  + "te:label-restriction/te:label-start/"  
  + "te:te-label/te:technology" {  
    description "OTN label.";  
    case otn {  
      uses otn-types:otn-link-label;  
    }  
  }  
}
```

```
/* Augment label restrictions end for the reverse 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-reverse-primary-path/"  
  + "te:path-in-segment/te:reverse/te:label-restrictions/"
```

```
+ "te:label-restriction/te:label-end/"
+ "te:te-label/te:technology" {
description "OTN label.";
case otn {
```

```
    uses otn-types:otn-link-label;
  }
}

/* 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-reverse-primary-path/"
  + "te:path-out-segment/te:forward/te:label-restrictions/"
  + "te:label-restriction" {
  description "OTN label.";
  uses otn-types:otn-label-restriction;
}

/* 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-reverse-primary-path/"
  + "te:path-out-segment/te:forward/te:label-restrictions/"
  + "te:label-restriction/te:label-start/"
  + "te:te-label/te:technology" {
  description "OTN label.";
  case otn {
    uses otn-types:otn-link-label;
  }
}

/* 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-reverse-primary-path/"
  + "te:path-out-segment/te:forward/te:label-restrictions/"
  + "te:label-restriction/te:label-end/"
  + "te:te-label/te:technology" {
  description "OTN label.";
  case otn {
    uses otn-types:otn-link-label;
  }
}

/* Augment label restrictions for the reverse 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-reverse-primary-path/"
+ "te:path-out-segment/te:reverse/te:label-restrictions/"
+ "te:label-restriction" {
description "OTN label.";
```

```
    uses otn-types:otn-label-restriction;
}

/* Augment label restrictions start for the reverse 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-reverse-primary-path/"
    + "te:path-out-segment/te:reverse/te:label-restrictions/"
    + "te:label-restriction/te:label-start/"
    + "te:te-label/te:technology" {
    description "OTN label.";
    case otn {
        uses otn-types:otn-link-label;
    }
}

/* Augment label restrictions end for the reverse 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-reverse-primary-path/"
    + "te:path-out-segment/te:reverse/te:label-restrictions/"
    + "te:label-restriction/te:label-end/"
    + "te:te-label/te:technology" {
    description "OTN label.";
    case otn {
        uses otn-types:otn-link-label;
    }
}

/* 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-reverse-primary-path/"
    + "te:state/te:path-properties/"
    + "te:path-route-objects/te:path-computed-route-object/"
    + "te:state/te:type/te:label/"
    + "te:label-hop/te:te-label/te:technology" {
    description "OTN label.";
    case otn {
        uses otn-types:otn-path-label;
    }
}

/* 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-reverse-primary-path/"
- + "te:state/te:lsps/te:lsp/te:lsp-record-route-subobjects/"

```
    + "te:record-route-subobject/te:type/te:label/"
    + "te:label-hop/te:te-label/te:technology" {
description "OTN label.";
case otn {
    uses otn-types:otn-path-label;
}
}

/* 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-reverse-primary-path/"
    + "te:state/te:lsps/te:lsp/te:path-properties/"
    + "te:path-route-objects/te:path-computed-route-object/"
    + "te:state/te:type/te:label/"
    + "te:label-hop/te:te-label/te:technology" {
description "OTN label.";
case otn {
    uses otn-types:otn-path-label;
}
}

/* 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 otn-types:otn-path-label;
}
}

/* 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 otn-types:otn-path-label;
}
}
```



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

/* 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/"
  + "te:route-object-include-exclude/te:type/te:label/"
  + "te:label-hop/te:te-label/te:technology" {
  description "OTN label.";
  case otn {
    uses otn-types:otn-path-label;
  }
}

/* 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:forward/te:label-restrictions/"
  + "te:label-restriction" {

  description "OTN label.";
  uses otn-types:otn-label-restriction;
}

/* 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:forward/te:label-restrictions/"
  + "te:label-restriction/te:label-start/"
  + "te:te-label/te:technology" {
  description "OTN label.";
  case otn {
    uses otn-types:otn-link-label;
  }
}
```

```
/* 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:forward/te:label-restrictions/"
    + "te:label-restriction/te:label-end/"
    + "te:te-label/te:technology" {
description "OTN label.";
case otn {
    uses otn-types:otn-link-label;
}
}

/* Augment label restrictions for the reverse 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:reverse/te:label-restrictions/"
    + "te:label-restriction" {
description "OTN label.";
uses otn-types:otn-label-restriction;
}

/* Augment label restrictions start for the reverse 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:reverse/te:label-restrictions/"
    + "te:label-restriction/te:label-start/"
    + "te:te-label/te:technology" {
description "OTN label.";
case otn {
    uses otn-types:otn-link-label;
}
}

/* Augment label restrictions end for the reverse 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:reverse/te:label-restrictions/"
    + "te:label-restriction/te:label-end/"
    + "te:te-label/te:technology" {
description "OTN label.";
case otn {
    uses otn-types:otn-link-label;
}
}

/* 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:forward/te:label-restrictions/"
+ "te:label-restriction" {
```

```
    description "OTN label.";
    uses otn-types:otn-label-restriction;
}

/* 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:forward/te:label-restrictions/"
    + "te:label-restriction/te:label-start/"
    + "te:te-label/te:technology" {
    description "OTN label.";
    case otn {
        uses otn-types:otn-link-label;
    }
}

/* 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:forward/te:label-restrictions/"
    + "te:label-restriction/te:label-end/"
    + "te:te-label/te:technology" {
    description "OTN label.";
    case otn {
        uses otn-types:otn-link-label;
    }
}

/* Augment label restrictions for the reverse 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:reverse/te:label-restrictions/"
    + "te:label-restriction" {
    description "OTN label.";
    uses otn-types:otn-label-restriction;
}

/* Augment label restrictions start for the reverse 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:reverse/te:label-restrictions/"
    + "te:label-restriction/te:label-start/"
    + "te:te-label/te:technology" {
```

```
description "OTN label.";
case otn {
  uses otn-types:otn-link-label;
}
```

```
}
```

```
/* Augment label restrictions end for the reverse 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:reverse/te:label-restrictions/"  
  + "te:label-restriction/te:label-end/"  
  + "te:te-label/te:technology" {  
    description "OTN label.";  
    case otn {  
      uses otn-types:otn-link-label;  
    }  
  }  
}
```

```
/* 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:state/te:path-properties/te:path-route-objects/"  
  + "te:path-computed-route-object/te:state/te:type/te:label/"  
  + "te:label-hop/te:te-label/te:technology" {  
    description "OTN label.";  
    case otn {  
      uses otn-types:otn-path-label;  
    }  
  }  
}
```

```
/* 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:state/te:lsps/te:lsp/te:lsp-record-route-subobjects/"  
  + "te:record-route-subobject/te:type/te:label/"  
  + "te:label-hop/te:te-label/te:technology" {  
  
    description "OTN label.";  
    case otn {  
      uses otn-types:otn-path-label;  
    }  
  }  
}
```

```
/* 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:state/te:lsps/te:lsp/te:path-properties/"  
  + "te:path-route-objects/"  
  + "te:path-computed-route-object/te:state/te:type/te:label/"  
  + "te:label-hop/te:te-label/te:technology" {  
    description "OTN label.";
```

case otn {

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```
    uses otn-types:otn-path-label;
  }
}

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

grouping p2p-path-ero {
  description
    "TE tunnel ERO configuration grouping";

  leaf te-default-metric {
    type uint32;
    description
      "Traffic engineering metric.";
  }
  leaf te-delay-metric {
    type uint32;
    description
      "Traffic engineering delay metric.";
  }
  leaf te-hop-metric {
    type uint32;
    description
      "Traffic engineering hop metric.";
  }
}
container explicit-route-objects {
  description "Explicit route objects container";
  list explicit-route-object {
    key "index";
    description
      "List of explicit route objects";
    leaf explicit-route-usage {
      type identityref {
        base te-types:route-usage-type;
      }
      description "An explicit-route hop action.";
    }
    uses te-types:explicit-route-hop {
```



```
        augment "type/label/label-hop/te-label/technology" {
            description "OTN label.";
        case otn {
            uses otn-types:otn-path-label;
        }
    }
}
}
}

rpc otn-te-tunnel-path-compute {
    description "OTN TE tunnel path computation";
    input {
        list request {
            key "id";
            description "A list of path computation requests.";

            leaf id {
                type uint8;
                description
                    "Request ID.";
            }
            leaf type {
                type identityref {
                    base te-types:tunnel-type;
                }
                description "TE tunnel type.";
            }
            leaf source {
                type inet:ip-address;
                description
                    "TE tunnel source address.";
            }

            leaf destination {
                type inet:ip-address;
                description
                    "TE tunnel destination address";
            }
            leaf src-tp-id {
                type binary;
                description
                    "TE tunnel source termination point identifier.";
            }
            leaf dst-tp-id {
                type binary;
                description
```



```
    "TE tunnel destination termination point identifier.";
}
leaf switching-layer {
    type identityref {
        base te-types:switching-capabilities;
    }
    description
        "Switching layer where the requests are computed.";
}
leaf encoding {
    type identityref {
        base te-types:lsp-encoding-types;
    }
    description "LSP encoding type";
}
leaf protection-type {
    type identityref {
        base te-types:lsp-protection-type;
    }
    description "LSP protection type";
}
leaf restoration-type {
    type identityref {
        base te-types:lsp-restoration-type;
    }
    description "LSP restoration type";
}
leaf provider-id {
    type te-types:te-global-id;
    description
        "An identifier to uniquely identify a provider.";
}
leaf client-id {
    type te-types:te-global-id;
    description
        "An identifier to uniquely identify a client.";
}
leaf te-topology-id {
    type te-types:te-topology-id;
    description
        "It is presumed that a datastore will contain many
        topologies. To distinguish between topologies it is
        vital to have UNIQUE topology identifiers.";
}
leaf setup-priority {
    type uint8 {
        range "0..7";
    }
}
```



```
    }
    description
      "TE LSP setup priority";
  }
  leaf hold-priority {
    type uint8 {
      range "0..7";
    }
    description
      "TE LSP hold priority";
  }
  leaf te-path-metric-type {
    type identityref {
      base te-types:path-metric-type;
    }
    default te-types:path-metric-te;
    description
      "The tunnel path metric type.";
  }

  leaf odu-type {
    type identityref {
      base otn-types:odu-type;
    }
    description "Type of ODU";
  }
  container p2p-primary-paths {
    description "Set of P2P primary paths container";
    list p2p-primary-path {
      key "name";
      description
        "List of primary paths for this tunnel.";
      leaf name {
        type string;
        description "TE path name";
      }

      uses p2p-path-ero;
    }
  }
  container p2p-secondary-paths {
    description "Set of P2P secondary paths container";
    list p2p-secondary-path {
      key "name";
      description
        "List of secondary paths for this tunnel.";
      leaf name {
        type string;
```



```
        description "TE path name";
    }
    uses p2p-path-ero;
}
}
uses otn-tunnel-attributes;
}
}
output {
    leaf return-code {
        type enumeration {
            enum success {
                description "success";
            }
            enum aborted {
                description "aborted";
            }
            enum destination-not-found {
                description "destination-not-found";
            }
            enum invalid-argument {
                description "invalid-argument";
            }
            enum no-memory {
                description "no-memory";
            }
            enum no-path-found {
                description "no-path-found";
            }
            enum other-error {
                description "other-error";
            }
            enum some-path-not-found {
                description "some-path-not-found";
            }
            enum source-not-found {
                description "source-not-found";
            }
            enum topology-error {
                description "topology-error";
            }
        }
    }
    description
        "Return code";
}
list result {
    key "id";
```



```
description
  "A list of results for all requests.";

leaf id {
  type uint8;
  description
    "Request ID";
}
container p2p-primary-paths {
  description "Set of P2P primary paths container";
  list p2p-primary-path {
    key "name";
    description
      "List of resultant primary paths for this tunnel.";
    leaf name {
      type string;
      description "TE path name";
    }
    uses p2p-path-ero;
  }
}
container p2p-secondary-paths {
  description "Set of P2P secondary paths container";
  list p2p-secondary-path {
    key "name";
    description
      "List of resultant secondary paths for this tunnel.";
    leaf name {
      type string;
      description "TE path name";
    }
    uses p2p-path-ero;
  }
}
}
}
}
}
```

<CODE ENDS>

6. OTN Types YANG Code

<CODE BEGINS> file "ietf-otn-types@2018-08-23.yang"
module ietf-otn-types {


```
namespace "urn:ietf:params:xml:ns:yang:ietf-otn-types";
prefix "otn-types";

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

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

description
  "This module defines OTN types.";

revision "2018-08-23" {
  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
}
```



```
identity tributary-slot-granularity {
  description
    "Tributary slot granularity";
  reference
    "G.709/Y.1331, February 2016: Interfaces for the Optical
    Transport Network (OTN)";
}

identity tsg-1.25G {
  base tributary-slot-granularity;
  description
    "1.25G tributary slot granularity";
}

identity tsg-2.5G {
  base tributary-slot-granularity;
  description
    "2.5G tributary slot granularity";
}

identity odu-type {
  description
    "Base identity for protocol framing used by tributary signals";
}

identity ODU0 {
  base odu-type;
  description
    "ODU0 protocol (1.24G)";
}

identity ODU1 {
  base odu-type;
  description
    "ODU1 protocol (2.49G)";
}
/*
identity ODU1e {
  base odu-type;
  description
    "ODU1e protocol (10.35G).";
}

identity ODU1f {
  base odu-type;
  description
    "ODU1f protocol (10.56G).";
```



```
    }
  */
  identity ODU2 {
    base odu-type;
    description
      "ODU2 protocol (10.03G)";
  }

  identity ODU2e {
    base odu-type;
    description
      "ODU2e protocol (10.39G)";
  }
/*
  identity ODU2f {
    base odu-type;
    description
      "ODU2f protocol (10.60G).";
  }
*/
  identity ODU3 {
    base odu-type;
    description
      "ODU3 protocol (40.31G)";
  }
/*
  identity ODU3e1 {
    base odu-type;
    description
      "ODU3e1 protocol (41.77G).";
  }

  identity ODU3e2 {
    base odu-type;
    description
      "ODU3e2 protocol (41.78G).";
  }
*/
  identity ODU4 {
    base odu-type;
    description
      "ODU4 protocol (104.79G)";
  }

  identity ODUFlex-cbr {
    base odu-type;
    description
      "ODU Flex CBR protocol for transporting constant bit rate
```



```
        signal";
    }

    identity ODUFlex-gfp {
        base odu-type;
        description
            "ODU Flex GFP protocol for transporting stream of packets
            using Generic Framing Procedure";
    }

    identity ODUCn {
        base odu-type;
        description
            "ODUCn protocol (beyond 100G)";
    }

    identity client-signal {
        description
            "Base identity from which specific client signals for the
            tunnel are derived";
    }

    identity ETH-1Gb {
        base client-signal;
        description
            "Client signal type of 1GbE";
    }

    identity ETH-10Gb-LAN {
        base client-signal;
        description
            "Client signal type of 10GbE LAN";
    }

    identity ETH-10Gb-WAN {
        base client-signal;
        description
            "Client signal type of 10GbE WAN";
    }

    identity ETH-40Gb {
        base client-signal;
        description
            "Client signal type of 40GbE";
    }

    identity ETH-100Gb {
        base client-signal;
```



```
    description
      "Client signal type of 100GbE";
  }

  identity STM-1 {
    base client-signal;
    description
      "Client signal type of OC3 & STM-1";
  }

  identity STM-4 {
    base client-signal;
    description
      "Client signal type of OC12 & STM-4";
  }

  identity STM-16 {
    base client-signal;
    description
      "Client signal type of OC48 & STM-16";
  }

  identity STM-64 {
    base client-signal;
    description
      "Client signal type of OC192 & STM-64";
  }

  identity STM-256 {
    base client-signal;
    description
      "Client signal type of OC768 & STM-256";
  }

  identity FC-100 {
    base client-signal;
    description
      "Client signal type of Fibre Channel FC-100";
  }

  identity FC-200 {
    base client-signal;
    description
      "Client signal type of Fibre Channel FC-200";
  }

  identity FC-400 {
    base client-signal;
```



```
    description
      "Client signal type of Fibre Channel FC-400";
  }

  identity FC-800 {
    base client-signal;
    description
      "Client signal type of Fibre Channel FC-800";
  }

  identity FC-1200 {
    base client-signal;
    description
      "Client signal type of Fibre Channel FC-1200";
  }

  identity FC-1600 {
    base client-signal;
    description
      "Client signal type of Fibre Channel FC-1600";
  }

  identity FC-3200 {
    base client-signal;
    description
      "Client signal type of Fibre Channel FC-3200";
  }

  identity FICON-4G {
    base client-signal;
    description
      "Client signal type of Fibre Connection 4G";
  }

  identity FICON-8G {
    base client-signal;
    description
      "Client signal type of Fibre Connection 8G";
  }

  identity otn-label-range-type {
    description
      "Base identity from which specific OTN label
        range types derived";
  }

  identity label-range-trib-slot {
    base otn-label-range-type;
```



```
    description
      "Defines a range of OTN tributary slots";
  }

  identity label-range-trib-port {
    base otn-label-range-type;
    description
      "Defines a range of OTN tributary ports";
  }

  grouping otn-link-bandwidth {
    description "link bandwidth attributes for OTN";
    list odulist {
      key "odu-type";
      description
        "OTN bandwidth definition";
      leaf odu-type {
        type identityref {
          base otn-types:odu-type;
        }
        description "ODU type";
      }
      leaf number {
        type uint16;
        description "Number of ODUs";
      }
    }
  }

  grouping otn-path-bandwidth {
    description "path bandwidth attributes for OTN";
    leaf odu-type {
      type identityref {
        base otn-types:odu-type;
      }
      description "ODU type";
    }
  }

  grouping otn-label-restriction {
    description "label restriction information for OTN";
    leaf range-type {
      type identityref {
        base otn-types:otn-label-range-type;
      }
      description "type for range";
    }
    leaf tsg {
```



```
    type identityref {
      base otn-types:tributary-slot-granularity;
    }
    description "Tributary slot granularity.";
    reference
      "G.709/Y.1331, February 2016: Interfaces for the
      Optical Transport Network (OTN)";
  }
  leaf priority {
    type uint8;
    description "priority.";
  }
}
```

/* Note: Suggest to be changed as otn-label-range;
otn-topology/tunnel also need change */

```
  grouping otn-link-label {
    description "link label information for OTN, for label-start/end";
    choice otn-label-type {
      description
        "OTN label range type, either TPN range or TS range";
      case tributary-port {
        leaf tpn {
          type uint16 {
            range "1..4095";
          }
          description
            "Tributary Port Number. Applicable in case of mux services.";
          reference
            "RFC7139: GMPLS Signaling Extensions for Control of Evolving
            G.709 Optical Transport Networks.";
        }
      }
      case tributary-slot {
        leaf ts {
          type uint16 {
            range "1..4095";
          }
          description
            "Tributary Slot Number. Applicable in case of mux services.";
          reference
            "RFC7139: GMPLS Signaling Extensions for Control of Evolving
            G.709 Optical Transport Networks.";
        }
      }
    }
  }
}
```



```
/* Note: Suggest to be changed as otn-label;
otn-topology/tunnel also need change */
grouping otn-path-label {
  description "label information for OTN, for label-hop";
  leaf tpn {
    type uint16 {
      range "1..4095";
    }
    description
      "Tributary Port Number. Applicable in case of mux services.";
    reference
      "RFC7139: GMPLS Signaling Extensions for Control of Evolving
      G.709 Optical Transport Networks.";
  }
  leaf tsg {
    type identityref {
      base otn-types:tributary-slot-granularity;
    }
    description "Tributary slot granularity.";
    reference
      "G.709/Y.1331, February 2016: Interfaces for the
      Optical Transport Network (OTN)";
  }
  leaf ts-list {
    type string {
      pattern "([1-9][0-9]{0,3}(-[1-9][0-9]{0,3})?"
        + "(,[1-9][0-9]{0,3}(-[1-9][0-9]{0,3})?)*)";
    }
    description
      "A list of available tributary slots ranging
      between 1 and 9999.
      For example 1-20,25,50-1000";
    reference "RFC 7139: GMPLS Signaling Extensions for Control
      of Evolving G.709 Optical Transport Networks";
  }
}
}
```

<CODE ENDS>

7. 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 [[RFC5246](#)].

The NETCONF access control model [[RFC6536](#)] 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 repetition.
```

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 repetition.
```

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.

8. 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

9. Acknowledgements

TBD.

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