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A YANG Data Model for Optical Transport Network Topology
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Abstract

This document describes a YANG data model to describe the topologies of an Optical Transport Network (OTN). It is independent of control plane protocols and captures topological and resource related information pertaining to OTN. This model enables clients, which interact with a transport domain controller, for OTN topology related operations such as obtaining the relevant topology resource information.

Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on March 25, 2021.

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1. Introduction

A transport network is a server-layer network designed to provide connectivity services for a client-layer network to carry the client traffic transparently across the server-layer network resources. A transport network can be constructed of equipments utilizing any of a number of different transport technologies such as the Optical Transport Networks (OTN) or packet transport such as provided by the MPLS-Transport Profile (MPLS-TP).

This document defines a data model of an OTN network topology, using YANG [RFC7950]. The model can be used by an application exposing to a transport controller. Furthermore, it can be used by an application for the following purposes (but not limited to):

- To obtain a whole view of the network topology information of its interest;
- To receive notifications with regard to the information change of the OTN topology;
- To enforce the establishment and update of a network topology with the characteristic specified in the data model;

The YANG model defined in this document is independent of control plane protocols and captures topology related information pertaining to an Optical Transport Networks (OTN) electrical layer, as the scope specified by [RFC7062] . Furthermore, it is not a stand-alone model, but augmenting from the TE topology YANG model defined in [RFC8795], and importing from the generic Layer 1 types defined in [I-D.ietf-ccamp-layer1-types]. Following TE topology YANG model, the YANG model defined in this document is interface independent. The model is included in [I-D.ietf-teas-actn-yang], which indicates the typical usage of IETF YANG models in ACTN architecture specified by [RFC8453]. More specifically, the usage of this model between controllers is described in [I-D.ietf-ccamp-transport-nbi-app-statement].

Other topology models for Optical network technologies, including fixed Dense Wavelength Switched Optical Network (WSON) and flexible optical networks (a.k.a., flexi-grid networks), are covered in [I-D.ietf-ccamp-wson-yang] and [I-D.ietf-ccamp-flexigrid-yang], respectively.

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 document is defined in [RFC8340]. They are provided below for reference.

- Brackets "[" and "]" enclose list keys.
- Abbreviations before data node names: "rw" means configuration (read-write) and "ro" state data (read-only).
- Symbols after data node names: "?" means an optional node, "!" means a presence container, and "*" denotes a list and leaf-list.
- Parentheses enclose choice and case nodes, and case nodes are also marked with a colon (":").

- Ellipsis ("...") stands for contents of subtrees that are not shown.
- Some of the key terms used in this document are listed as follow.
- TS: Tributary Slot.
- TSG: Tributary Slot Granularity.
- TPN: Tributary Port Number.

3. YANG Data Model for OTN Topology

3.1. OTN Topology Data Model Overview

This document aims to describe the data model for OTN topology. As a classic Traffic-engineering (TE) technology, OTN provide TDM switching in transport network [ITU-Tg709]. Therefore the YANG module presented in this document augments from a more generic Traffic Engineered (TE) network topology data model, i.e., the ietf-te-topology, as specified in [RFC8795]. In section 6 of [RFC8795], the guideline for augmenting TE topology model was provided, and in this draft we respectively augment the OTN attributes, TE bandwidth and TE label. Generic groupings defined in [I-D.ietf-ccamp-layer1-types] is reused as well in this document. [RFC8345] describes a network topology model and provide the fundamental model for [RFC8795]. However, this work is not directly augmenting [RFC8345].

The entities and TE attributes, such as node, termination points and links, are still applicable for describing an OTN topology and the model presented in this document only specifies with technology-specific attributes/information. The OTN-specific attributes in [RFC7139], including the TPN, TS and TSG, can be used to represent the bandwidth and label information. These attributes have been specified in [I-D.ietf-ccamp-layer1-types], and used in this document for augmentation of the generic TE topology model.

For different order of ODU in OTN technology, the te-bandwidth is augmented to allow specifying the type of ODU container and the number a link can support per priority level. For example, for a ODU3 link, it may advertise 32*ODU0, 16*ODU1, 4*ODU2 available, or multiple ODUflex, assuming only a single priority level is supported. If one of ODU2 resource is taken to establish a ODU path, then the availability of this ODU link is updated as 24*ODU0, 12*ODU1, 3*ODU2, or multiple ODUflex available. If there are equipment hardware limitations, then a subset of potential ODU type SHALL be advertised. For instance, an ODU3 link may only support 4*ODU2.

Note the model in this document re-uses some typedefs, identities and groupings defined in ietf-layer1-types, which is specified in [I-D.ietf-ccamp-layer1-types].

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

3.2. YANG Tree for OTN topology

```
module: ietf-otn-topology
  augment /nw:networks/nw:network/nw:network-types/tet:te-topology:
    +--rw otn-topology!
  augment /nw:networks/nw:network/nt:link/tet:te
            /tet:te-link-attributes:
    +--rw tsg?        identityref
    +--rw distance?   uint32
  augment /nw:networks/nw:network/nw:node/nt:termination-point
            /tet:te:
    +--rw client-svc!
       +--rw client-facing?             boolean
       +--rw supported-client-signal*   identityref
  augment /nw:networks/nw:network/nw:node/nt:termination-point/tet:te
            /tet:interface-switching-capability/tet:max-lsp-bandwidth
            /tet:te-bandwidth/tet:technology:
    +--:(otn)
       +--rw odu-type?                     identityref
       +--rw (oduflex-type)?
          +--:(generic)
          |  +--rw nominal-bit-rate        uint64
          +--:(cbr)
          |  +--rw client-type             identityref
          +--:(gfp-n-k)
          |  +--rw gfp-n                   uint8
          |  +--rw gfp-k?                  gfp-k
          +--:(flexe-client)
          |  +--rw flexe-client            flexe-client-rate
          +--:(flexe-aware)
          |  +--rw flexe-aware-n           uint16
          +--:(packet)
             +--rw opuflex-payload-rate    uint64
  augment /nw:networks/nw:network/nw:node/tet:te
            /tet:te-node-attributes/tet:connectivity-matrices
            /tet:path-constraints/tet:te-bandwidth/tet:technology:
    +--:(otn)
       +--rw odulist* [odu-type]
          +--rw odu-type    identityref
```

```
         +--rw number?     uint16
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:te-node-attributes/tet:connectivity-matrices
               /tet:connectivity-matrix/tet:path-constraints
               /tet:te-bandwidth/tet:technology:
       +--:(otn)
          +--rw odulist* [odu-type]
             +--rw odu-type    identityref
             +--rw number?     uint16
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:information-source-entry/tet:connectivity-matrices
               /tet:path-constraints/tet:te-bandwidth/tet:technology:
       +--:(otn)
          +--ro odulist* [odu-type]
             +--ro odu-type    identityref
             +--ro number?     uint16
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:information-source-entry/tet:connectivity-matrices
               /tet:connectivity-matrix/tet:path-constraints
               /tet:te-bandwidth/tet:technology:
       +--:(otn)
          +--ro odulist* [odu-type]
             +--ro odu-type    identityref
             +--ro number?     uint16
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:tunnel-termination-point/tet:client-layer-adaptation
               /tet:switching-capability/tet:te-bandwidth
               /tet:technology:
       +--:(otn)
          +--rw odulist* [odu-type]
             +--rw odu-type    identityref
             +--rw number?     uint16
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:tunnel-termination-point
               /tet:local-link-connectivities/tet:path-constraints
               /tet:te-bandwidth/tet:technology:
       +--:(otn)
          +--rw odulist* [odu-type]
             +--rw odu-type    identityref
             +--rw number?     uint16
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:tunnel-termination-point
               /tet:local-link-connectivities
               /tet:local-link-connectivity/tet:path-constraints
               /tet:te-bandwidth/tet:technology:
       +--:(otn)
          +--rw odulist* [odu-type]
             +--rw odu-type    identityref
```

```
          +--rw number?     uint16
     augment /nw:networks/nw:network/nt:link/tet:te
               /tet:te-link-attributes
               /tet:interface-switching-capability/tet:max-lsp-bandwidth
               /tet:te-bandwidth/tet:technology:
       +--:(otn)
          +--rw odu-type?                    identityref
          +--rw (oduflex-type)?
             +--:(generic)
             |  +--rw nominal-bit-rate       uint64
             +--:(cbr)
             |  +--rw client-type            identityref
             +--:(gfp-n-k)
             |  +--rw gfp-n                  uint8
             |  +--rw gfp-k?                 gfp-k
             +--:(flexe-client)
             |  +--rw flexe-client           flexe-client-rate
             +--:(flexe-aware)
             |  +--rw flexe-aware-n          uint16
             +--:(packet)
                +--rw opuflex-payload-rate   uint64
     augment /nw:networks/nw:network/nt:link/tet:te
               /tet:te-link-attributes/tet:max-link-bandwidth
               /tet:te-bandwidth/tet:technology:
       +--:(otn)
          +--rw odulist* [odu-type]
             +--rw odu-type    identityref
             +--rw number?     uint16
     augment /nw:networks/nw:network/nt:link/tet:te
               /tet:te-link-attributes/tet:max-resv-link-bandwidth
               /tet:te-bandwidth/tet:technology:
       +--:(otn)
          +--rw odulist* [odu-type]
             +--rw odu-type    identityref
             +--rw number?     uint16
     augment /nw:networks/nw:network/nt:link/tet:te
               /tet:te-link-attributes/tet:unreserved-bandwidth
               /tet:te-bandwidth/tet:technology:
       +--:(otn)
          +--rw odulist* [odu-type]
             +--rw odu-type    identityref
             +--rw number?     uint16
     augment /nw:networks/nw:network/nt:link/tet:te
               /tet:information-source-entry
               /tet:interface-switching-capability/tet:max-lsp-bandwidth
               /tet:te-bandwidth/tet:technology:
       +--:(otn)
          +--ro odu-type?                    identityref
```

```
          +--ro (oduflex-type)?
             +--:(generic)
             |  +--ro nominal-bit-rate        uint64
             +--:(cbr)
             |  +--ro client-type             identityref
             +--:(gfp-n-k)
             |  +--ro gfp-n                   uint8
             |  +--ro gfp-k?                  gfp-k
             +--:(flexe-client)
             |  +--ro flexe-client            flexe-client-rate
             +--:(flexe-aware)
             |  +--ro flexe-aware-n           uint16
             +--:(packet)
                +--ro opuflex-payload-rate    uint64
     augment /nw:networks/nw:network/nt:link/tet:te
               /tet:information-source-entry/tet:max-link-bandwidth
               /tet:te-bandwidth/tet:technology:
       +--:(otn)
          +--ro odulist* [odu-type]
             +--ro odu-type    identityref
             +--ro number?     uint16
     augment /nw:networks/nw:network/nt:link/tet:te
               /tet:information-source-entry/tet:max-resv-link-bandwidth
               /tet:te-bandwidth/tet:technology:
       +--:(otn)
          +--ro odulist* [odu-type]
             +--ro odu-type    identityref
             +--ro number?     uint16
     augment /nw:networks/nw:network/nt:link/tet:te
               /tet:information-source-entry/tet:unreserved-bandwidth
               /tet:te-bandwidth/tet:technology:
       +--:(otn)
          +--ro odulist* [odu-type]
             +--ro odu-type    identityref
             +--ro number?     uint16
     augment /nw:networks/tet:te/tet:templates/tet:link-template
               /tet:te-link-attributes
               /tet:interface-switching-capability/tet:max-lsp-bandwidth
               /tet:te-bandwidth/tet:technology:
       +--:(otn)
          +--rw odu-type?                    identityref
          +--rw (oduflex-type)?
             +--:(generic)
             |  +--rw nominal-bit-rate        uint64
             +--:(cbr)
             |  +--rw client-type             identityref
             +--:(gfp-n-k)
             |  +--rw gfp-n                   uint8
```

```
          |  +--rw gfp-k?                 gfp-k
          +--:(flexe-client)
          |  +--rw flexe-client           flexe-client-rate
          +--:(flexe-aware)
          |  +--rw flexe-aware-n          uint16
          +--:(packet)
             +--rw opuflex-payload-rate   uint64
    augment /nw:networks/tet:te/tet:templates/tet:link-template
              /tet:te-link-attributes/tet:max-link-bandwidth
              /tet:te-bandwidth/tet:technology:
      +--:(otn)
         +--rw odulist* [odu-type]
            +--rw odu-type    identityref
            +--rw number?     uint16
    augment /nw:networks/tet:te/tet:templates/tet:link-template
              /tet:te-link-attributes/tet:max-resv-link-bandwidth
              /tet:te-bandwidth/tet:technology:
      +--:(otn)
         +--rw odulist* [odu-type]
            +--rw odu-type    identityref
            +--rw number?     uint16
    augment /nw:networks/tet:te/tet:templates/tet:link-template
              /tet:te-link-attributes/tet:unreserved-bandwidth
              /tet:te-bandwidth/tet:technology:
      +--:(otn)
         +--rw odulist* [odu-type]
            +--rw odu-type    identityref
            +--rw number?     uint16
    augment /nw:networks/nw:network/nw:node/tet:te
              /tet:te-node-attributes/tet:connectivity-matrices
              /tet:label-restrictions/tet:label-restriction:
      +--rw range-type?      otn-label-range-type
      +--rw tsg?             identityref
      +--rw odu-type-list*   identityref
      +--rw priority?        uint8
    augment /nw:networks/nw:network/nw:node/tet:te
              /tet:te-node-attributes/tet:connectivity-matrices
              /tet:connectivity-matrix/tet:from/tet:label-restrictions
              /tet:label-restriction:
      +--rw range-type?      otn-label-range-type
      +--rw tsg?             identityref
      +--rw odu-type-list*   identityref
      +--rw priority?        uint8
    augment /nw:networks/nw:network/nw:node/tet:te
              /tet:te-node-attributes/tet:connectivity-matrices
              /tet:connectivity-matrix/tet:to/tet:label-restrictions
              /tet:label-restriction:
      +--rw range-type?      otn-label-range-type
```

```
       +--rw tsg?             identityref
       +--rw odu-type-list*   identityref
       +--rw priority?        uint8
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:information-source-entry/tet:connectivity-matrices
               /tet:label-restrictions/tet:label-restriction:
       +--ro range-type?      otn-label-range-type
       +--ro tsg?             identityref
       +--ro odu-type-list*   identityref
       +--ro priority?        uint8
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:information-source-entry/tet:connectivity-matrices
               /tet:connectivity-matrix/tet:from/tet:label-restrictions
               /tet:label-restriction:
       +--ro range-type?      otn-label-range-type
       +--ro tsg?             identityref
       +--ro odu-type-list*   identityref
       +--ro priority?        uint8
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:information-source-entry/tet:connectivity-matrices
               /tet:connectivity-matrix/tet:to/tet:label-restrictions
               /tet:label-restriction:
       +--ro range-type?      otn-label-range-type
       +--ro tsg?             identityref
       +--ro odu-type-list*   identityref
       +--ro priority?        uint8
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:tunnel-termination-point
               /tet:local-link-connectivities/tet:label-restrictions
               /tet:label-restriction:
       +--rw range-type?      otn-label-range-type
       +--rw tsg?             identityref
       +--rw odu-type-list*   identityref
       +--rw priority?        uint8
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:tunnel-termination-point
               /tet:local-link-connectivities
               /tet:local-link-connectivity/tet:label-restrictions
               /tet:label-restriction:
       +--rw range-type?      otn-label-range-type
       +--rw tsg?             identityref
       +--rw odu-type-list*   identityref
       +--rw priority?        uint8
     augment /nw:networks/nw:network/nt:link/tet:te
               /tet:te-link-attributes/tet:label-restrictions
               /tet:label-restriction:
       +--rw range-type?      otn-label-range-type
       +--rw tsg?             identityref
```

```
      +--rw odu-type-list*   identityref
      +--rw priority?        uint8
    augment /nw:networks/nw:network/nt:link/tet:te
              /tet:information-source-entry/tet:label-restrictions
              /tet:label-restriction:
      +--ro range-type?      otn-label-range-type
      +--ro tsg?             identityref
      +--ro odu-type-list*   identityref
      +--ro priority?        uint8
    augment /nw:networks/tet:te/tet:templates/tet:link-template
              /tet:te-link-attributes/tet:label-restrictions
              /tet:label-restriction:
      +--rw range-type?      otn-label-range-type
      +--rw tsg?             identityref
      +--rw odu-type-list*   identityref
      +--rw priority?        uint8
    augment /nw:networks/nw:network/nw:node/tet:te
              /tet:te-node-attributes/tet:connectivity-matrices
              /tet:label-restrictions/tet:label-restriction
              /tet:label-start/tet:te-label/tet:technology:
      +--:(otn)
         +--rw (range-type)?
            +--:(trib-port)
            |  +--rw otn-tpn?   otn-tpn
            +--:(trib-slot)
               +--rw otn-ts?    otn-ts
    augment /nw:networks/nw:network/nw:node/tet:te
              /tet:te-node-attributes/tet:connectivity-matrices
              /tet:label-restrictions/tet:label-restriction
              /tet:label-end/tet:te-label/tet:technology:
      +--:(otn)
         +--rw (range-type)?
            +--:(trib-port)
            |  +--rw otn-tpn?   otn-tpn
            +--:(trib-slot)
               +--rw otn-ts?    otn-ts
    augment /nw:networks/nw:network/nw:node/tet:te
              /tet:te-node-attributes/tet:connectivity-matrices
              /tet:label-restrictions/tet:label-restriction
              /tet:label-step/tet:technology:
      +--:(otn)
         +--rw (range-type)?
            +--:(trib-port)
            |  +--rw otn-tpn?   otn-tpn
            +--:(trib-slot)
               +--rw otn-ts?    otn-ts
    augment /nw:networks/nw:network/nw:node/tet:te
              /tet:te-node-attributes/tet:connectivity-matrices
```

```
              /tet:underlay/tet:primary-path/tet:path-element/tet:type
              /tet:label/tet:label-hop/tet:te-label/tet:technology:
       +--:(otn)
          +--rw otn-tpn?   otn-tpn
          +--rw tsg?       identityref
          +--rw ts-list?   string
     augment /nw:networks/nw:network/nw:node/tet:te
              /tet:te-node-attributes/tet:connectivity-matrices
              /tet:underlay/tet:backup-path/tet:path-element/tet:type
              /tet:label/tet:label-hop/tet:te-label/tet:technology:
       +--:(otn)
          +--rw otn-tpn?   otn-tpn
          +--rw tsg?       identityref
          +--rw ts-list?   string
     augment /nw:networks/nw:network/nw:node/tet:te
              /tet:te-node-attributes/tet:connectivity-matrices
              /tet:optimizations/tet:algorithm/tet:metric
              /tet:optimization-metric
              /tet:explicit-route-exclude-objects
              /tet:route-object-exclude-object/tet:type/tet:label
              /tet:label-hop/tet:te-label/tet:technology:
       +--:(otn)
          +--rw otn-tpn?   otn-tpn
          +--rw tsg?       identityref
          +--rw ts-list?   string
     augment /nw:networks/nw:network/nw:node/tet:te
              /tet:te-node-attributes/tet:connectivity-matrices
              /tet:optimizations/tet:algorithm/tet:metric
              /tet:optimization-metric
              /tet:explicit-route-include-objects
              /tet:route-object-include-object/tet:type/tet:label
              /tet:label-hop/tet:te-label/tet:technology:
       +--:(otn)
          +--rw otn-tpn?   otn-tpn
          +--rw tsg?       identityref
          +--rw ts-list?   string
     augment /nw:networks/nw:network/nw:node/tet:te
              /tet:te-node-attributes/tet:connectivity-matrices
              /tet:path-properties/tet:path-route-objects
              /tet:path-route-object/tet:type/tet:label/tet:label-hop
              /tet:te-label/tet:technology:
       +--:(otn)
          +--ro otn-tpn?   otn-tpn
          +--ro tsg?       identityref
          +--ro ts-list?   string
     augment /nw:networks/nw:network/nw:node/tet:te
              /tet:te-node-attributes/tet:connectivity-matrices
              /tet:connectivity-matrix/tet:from/tet:label-restrictions
```

```
            /tet:label-restriction/tet:label-start/tet:te-label
            /tet:technology:
      +--:(otn)
         +--rw (range-type)?
            +--:(trib-port)
            |  +--rw otn-tpn?   otn-tpn
            +--:(trib-slot)
               +--rw otn-ts?    otn-ts
   augment /nw:networks/nw:network/nw:node/tet:te
            /tet:te-node-attributes/tet:connectivity-matrices
            /tet:connectivity-matrix/tet:from/tet:label-restrictions
            /tet:label-restriction/tet:label-end/tet:te-label
            /tet:technology:
      +--:(otn)
         +--rw (range-type)?
            +--:(trib-port)
            |  +--rw otn-tpn?   otn-tpn
            +--:(trib-slot)
               +--rw otn-ts?    otn-ts
   augment /nw:networks/nw:network/nw:node/tet:te
            /tet:te-node-attributes/tet:connectivity-matrices
            /tet:connectivity-matrix/tet:from/tet:label-restrictions
            /tet:label-restriction/tet:label-step/tet:technology:
      +--:(otn)
         +--rw (range-type)?
            +--:(trib-port)
            |  +--rw otn-tpn?   otn-tpn
            +--:(trib-slot)
               +--rw otn-ts?    otn-ts
   augment /nw:networks/nw:network/nw:node/tet:te
            /tet:te-node-attributes/tet:connectivity-matrices
            /tet:connectivity-matrix/tet:to/tet:label-restrictions
            /tet:label-restriction/tet:label-start/tet:te-label
            /tet:technology:
      +--:(otn)
         +--rw (range-type)?
            +--:(trib-port)
            |  +--rw otn-tpn?   otn-tpn
            +--:(trib-slot)
               +--rw otn-ts?    otn-ts
   augment /nw:networks/nw:network/nw:node/tet:te
            /tet:te-node-attributes/tet:connectivity-matrices
            /tet:connectivity-matrix/tet:to/tet:label-restrictions
            /tet:label-restriction/tet:label-end/tet:te-label
            /tet:technology:
      +--:(otn)
         +--rw (range-type)?
            +--:(trib-port)
```

```
          |  +--rw otn-tpn?   otn-tpn
          +--:(trib-slot)
             +--rw otn-ts?    otn-ts
   augment /nw:networks/nw:network/nw:node/tet:te
             /tet:te-node-attributes/tet:connectivity-matrices
             /tet:connectivity-matrix/tet:to/tet:label-restrictions
             /tet:label-restriction/tet:label-step/tet:technology:
     +--:(otn)
        +--rw (range-type)?
           +--:(trib-port)
           |  +--rw otn-tpn?   otn-tpn
           +--:(trib-slot)
              +--rw otn-ts?    otn-ts
   augment /nw:networks/nw:network/nw:node/tet:te
             /tet:te-node-attributes/tet:connectivity-matrices
             /tet:connectivity-matrix/tet:underlay/tet:primary-path
             /tet:path-element/tet:type/tet:label/tet:label-hop
             /tet:te-label/tet:technology:
     +--:(otn)
        +--rw otn-tpn?   otn-tpn
        +--rw tsg?       identityref
        +--rw ts-list?   string
   augment /nw:networks/nw:network/nw:node/tet:te
             /tet:te-node-attributes/tet:connectivity-matrices
             /tet:connectivity-matrix/tet:underlay/tet:backup-path
             /tet:path-element/tet:type/tet:label/tet:label-hop
             /tet:te-label/tet:technology:
     +--:(otn)
        +--rw otn-tpn?   otn-tpn
        +--rw tsg?       identityref
        +--rw ts-list?   string
   augment /nw:networks/nw:network/nw:node/tet:te
             /tet:te-node-attributes/tet:connectivity-matrices
             /tet:connectivity-matrix/tet:optimizations/tet:algorithm
             /tet:metric/tet:optimization-metric
             /tet:explicit-route-exclude-objects
             /tet:route-object-exclude-object/tet:type/tet:label
             /tet:label-hop/tet:te-label/tet:technology:
     +--:(otn)
        +--rw otn-tpn?   otn-tpn
        +--rw tsg?       identityref
        +--rw ts-list?   string
   augment /nw:networks/nw:network/nw:node/tet:te
             /tet:te-node-attributes/tet:connectivity-matrices
             /tet:connectivity-matrix/tet:optimizations/tet:algorithm
             /tet:metric/tet:optimization-metric
             /tet:explicit-route-include-objects
             /tet:route-object-include-object/tet:type/tet:label
```

```
            /tet:label-hop/tet:te-label/tet:technology:
      +--:(otn)
         +--rw otn-tpn?   otn-tpn
         +--rw tsg?       identityref
         +--rw ts-list?   string
   augment /nw:networks/nw:network/nw:node/tet:te
            /tet:te-node-attributes/tet:connectivity-matrices
            /tet:connectivity-matrix/tet:path-properties
            /tet:path-route-objects/tet:path-route-object/tet:type
            /tet:label/tet:label-hop/tet:te-label/tet:technology:
      +--:(otn)
         +--ro otn-tpn?   otn-tpn
         +--ro tsg?       identityref
         +--ro ts-list?   string
   augment /nw:networks/nw:network/nw:node/tet:te
            /tet:information-source-entry/tet:connectivity-matrices
            /tet:label-restrictions/tet:label-restriction
            /tet:label-start/tet:te-label/tet:technology:
      +--:(otn)
         +--ro (range-type)?
            +--:(trib-port)
            |  +--ro otn-tpn?   otn-tpn
            +--:(trib-slot)
               +--ro otn-ts?    otn-ts
   augment /nw:networks/nw:network/nw:node/tet:te
            /tet:information-source-entry/tet:connectivity-matrices
            /tet:label-restrictions/tet:label-restriction
            /tet:label-end/tet:te-label/tet:technology:
      +--:(otn)
         +--ro (range-type)?
            +--:(trib-port)
            |  +--ro otn-tpn?   otn-tpn
            +--:(trib-slot)
               +--ro otn-ts?    otn-ts
   augment /nw:networks/nw:network/nw:node/tet:te
            /tet:information-source-entry/tet:connectivity-matrices
            /tet:label-restrictions/tet:label-restriction
            /tet:label-step/tet:technology:
      +--:(otn)
         +--ro (range-type)?
            +--:(trib-port)
            |  +--ro otn-tpn?   otn-tpn
            +--:(trib-slot)
               +--ro otn-ts?    otn-ts
   augment /nw:networks/nw:network/nw:node/tet:te
            /tet:information-source-entry/tet:connectivity-matrices
            /tet:underlay/tet:primary-path/tet:path-element/tet:type
            /tet:label/tet:label-hop/tet:te-label/tet:technology:
```

```
       +--:(otn)
          +--ro otn-tpn?   otn-tpn
          +--ro tsg?       identityref
          +--ro ts-list?   string
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:information-source-entry/tet:connectivity-matrices
               /tet:underlay/tet:backup-path/tet:path-element/tet:type
               /tet:label/tet:label-hop/tet:te-label/tet:technology:
       +--:(otn)
          +--ro otn-tpn?   otn-tpn
          +--ro tsg?       identityref
          +--ro ts-list?   string
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:information-source-entry/tet:connectivity-matrices
               /tet:optimizations/tet:algorithm/tet:metric
               /tet:optimization-metric
               /tet:explicit-route-exclude-objects
               /tet:route-object-exclude-object/tet:type/tet:label
               /tet:label-hop/tet:te-label/tet:technology:
       +--:(otn)
          +--ro otn-tpn?   otn-tpn
          +--ro tsg?       identityref
          +--ro ts-list?   string
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:information-source-entry/tet:connectivity-matrices
               /tet:optimizations/tet:algorithm/tet:metric
               /tet:optimization-metric
               /tet:explicit-route-include-objects
               /tet:route-object-include-object/tet:type/tet:label
               /tet:label-hop/tet:te-label/tet:technology:
       +--:(otn)
          +--ro otn-tpn?   otn-tpn
          +--ro tsg?       identityref
          +--ro ts-list?   string
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:information-source-entry/tet:connectivity-matrices
               /tet:path-properties/tet:path-route-objects
               /tet:path-route-object/tet:type/tet:label/tet:label-hop
               /tet:te-label/tet:technology:
       +--:(otn)
          +--ro otn-tpn?   otn-tpn
          +--ro tsg?       identityref
          +--ro ts-list?   string
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:information-source-entry/tet:connectivity-matrices
               /tet:connectivity-matrix/tet:from/tet:label-restrictions
               /tet:label-restriction/tet:label-start/tet:te-label
               /tet:technology:
```

```
       +--:(otn)
          +--ro (range-type)?
             +--:(trib-port)
             |  +--ro otn-tpn?   otn-tpn
             +--:(trib-slot)
                +--ro otn-ts?    otn-ts
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:information-source-entry/tet:connectivity-matrices
               /tet:connectivity-matrix/tet:from/tet:label-restrictions
               /tet:label-restriction/tet:label-end/tet:te-label
               /tet:technology:
       +--:(otn)
          +--ro (range-type)?
             +--:(trib-port)
             |  +--ro otn-tpn?   otn-tpn
             +--:(trib-slot)
                +--ro otn-ts?    otn-ts
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:information-source-entry/tet:connectivity-matrices
               /tet:connectivity-matrix/tet:from/tet:label-restrictions
               /tet:label-restriction/tet:label-step/tet:technology:
       +--:(otn)
          +--ro (range-type)?
             +--:(trib-port)
             |  +--ro otn-tpn?   otn-tpn
             +--:(trib-slot)
                +--ro otn-ts?    otn-ts
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:information-source-entry/tet:connectivity-matrices
               /tet:connectivity-matrix/tet:to/tet:label-restrictions
               /tet:label-restriction/tet:label-start/tet:te-label
               /tet:technology:
       +--:(otn)
          +--ro (range-type)?
             +--:(trib-port)
             |  +--ro otn-tpn?   otn-tpn
             +--:(trib-slot)
                +--ro otn-ts?    otn-ts
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:information-source-entry/tet:connectivity-matrices
               /tet:connectivity-matrix/tet:to/tet:label-restrictions
               /tet:label-restriction/tet:label-end/tet:te-label
               /tet:technology:
       +--:(otn)
          +--ro (range-type)?
             +--:(trib-port)
             |  +--ro otn-tpn?   otn-tpn
             +--:(trib-slot)
```

```
            +--ro otn-ts?    otn-ts
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:information-source-entry/tet:connectivity-matrices
               /tet:connectivity-matrix/tet:to/tet:label-restrictions
               /tet:label-restriction/tet:label-step/tet:technology:
       +--:(otn)
          +--ro (range-type)?
             +--:(trib-port)
             |  +--ro otn-tpn?   otn-tpn
             +--:(trib-slot)
                +--ro otn-ts?    otn-ts
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:information-source-entry/tet:connectivity-matrices
               /tet:connectivity-matrix/tet:underlay/tet:primary-path
               /tet:path-element/tet:type/tet:label/tet:label-hop
               /tet:te-label/tet:technology:
       +--:(otn)
          +--ro otn-tpn?   otn-tpn
          +--ro tsg?       identityref
          +--ro ts-list?   string
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:information-source-entry/tet:connectivity-matrices
               /tet:connectivity-matrix/tet:underlay/tet:backup-path
               /tet:path-element/tet:type/tet:label/tet:label-hop
               /tet:te-label/tet:technology:
       +--:(otn)
          +--ro otn-tpn?   otn-tpn
          +--ro tsg?       identityref
          +--ro ts-list?   string
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:information-source-entry/tet:connectivity-matrices
               /tet:connectivity-matrix/tet:optimizations/tet:algorithm
               /tet:metric/tet:optimization-metric
               /tet:explicit-route-exclude-objects
               /tet:route-object-exclude-object/tet:type/tet:label
               /tet:label-hop/tet:te-label/tet:technology:
       +--:(otn)
          +--ro otn-tpn?   otn-tpn
          +--ro tsg?       identityref
          +--ro ts-list?   string
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:information-source-entry/tet:connectivity-matrices
               /tet:connectivity-matrix/tet:optimizations/tet:algorithm
               /tet:metric/tet:optimization-metric
               /tet:explicit-route-include-objects
               /tet:route-object-include-object/tet:type/tet:label
               /tet:label-hop/tet:te-label/tet:technology:
       +--:(otn)
```

```
          +--ro otn-tpn?   otn-tpn
          +--ro tsg?       identityref
          +--ro ts-list?   string
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:information-source-entry/tet:connectivity-matrices
               /tet:connectivity-matrix/tet:path-properties
               /tet:path-route-objects/tet:path-route-object/tet:type
               /tet:label/tet:label-hop/tet:te-label/tet:technology:
       +--:(otn)
          +--ro otn-tpn?   otn-tpn
          +--ro tsg?       identityref
          +--ro ts-list?   string
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:tunnel-termination-point
               /tet:local-link-connectivities/tet:label-restrictions
               /tet:label-restriction/tet:label-start/tet:te-label
               /tet:technology:
       +--:(otn)
          +--rw (range-type)?
             +--:(trib-port)
             |  +--rw otn-tpn?   otn-tpn
             +--:(trib-slot)
                +--rw otn-ts?    otn-ts
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:tunnel-termination-point
               /tet:local-link-connectivities/tet:label-restrictions
               /tet:label-restriction/tet:label-end/tet:te-label
               /tet:technology:
       +--:(otn)
          +--rw (range-type)?
             +--:(trib-port)
             |  +--rw otn-tpn?   otn-tpn
             +--:(trib-slot)
                +--rw otn-ts?    otn-ts
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:tunnel-termination-point
               /tet:local-link-connectivities/tet:label-restrictions
               /tet:label-restriction/tet:label-step/tet:technology:
       +--:(otn)
          +--rw (range-type)?
             +--:(trib-port)
             |  +--rw otn-tpn?   otn-tpn
             +--:(trib-slot)
                +--rw otn-ts?    otn-ts
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:tunnel-termination-point
               /tet:local-link-connectivities/tet:underlay
               /tet:primary-path/tet:path-element/tet:type/tet:label
```

```
            /tet:label-hop/tet:te-label/tet:technology:
      +--:(otn)
         +--rw otn-tpn?   otn-tpn
         +--rw tsg?       identityref
         +--rw ts-list?   string
     augment /nw:networks/nw:network/nw:node/tet:te
            /tet:tunnel-termination-point
            /tet:local-link-connectivities/tet:underlay
            /tet:backup-path/tet:path-element/tet:type/tet:label
            /tet:label-hop/tet:te-label/tet:technology:
      +--:(otn)
         +--rw otn-tpn?   otn-tpn
         +--rw tsg?       identityref
         +--rw ts-list?   string
     augment /nw:networks/nw:network/nw:node/tet:te
            /tet:tunnel-termination-point
            /tet:local-link-connectivities/tet:optimizations
            /tet:algorithm/tet:metric/tet:optimization-metric
            /tet:explicit-route-exclude-objects
            /tet:route-object-exclude-object/tet:type/tet:label
            /tet:label-hop/tet:te-label/tet:technology:
      +--:(otn)
         +--rw otn-tpn?   otn-tpn
         +--rw tsg?       identityref
         +--rw ts-list?   string
     augment /nw:networks/nw:network/nw:node/tet:te
            /tet:tunnel-termination-point
            /tet:local-link-connectivities/tet:optimizations
            /tet:algorithm/tet:metric/tet:optimization-metric
            /tet:explicit-route-include-objects
            /tet:route-object-include-object/tet:type/tet:label
            /tet:label-hop/tet:te-label/tet:technology:
      +--:(otn)
         +--rw otn-tpn?   otn-tpn
         +--rw tsg?       identityref
         +--rw ts-list?   string
     augment /nw:networks/nw:network/nw:node/tet:te
            /tet:tunnel-termination-point
            /tet:local-link-connectivities/tet:path-properties
            /tet:path-route-objects/tet:path-route-object/tet:type
            /tet:label/tet:label-hop/tet:te-label/tet:technology:
      +--:(otn)
         +--ro otn-tpn?   otn-tpn
         +--ro tsg?       identityref
         +--ro ts-list?   string
     augment /nw:networks/nw:network/nw:node/tet:te
            /tet:tunnel-termination-point
            /tet:local-link-connectivities
```

```
            /tet:local-link-connectivity/tet:label-restrictions
            /tet:label-restriction/tet:label-start/tet:te-label
            /tet:technology:
      +--:(otn)
         +--rw (range-type)?
            +--:(trib-port)
            |  +--rw otn-tpn?   otn-tpn
            +--:(trib-slot)
               +--rw otn-ts?    otn-ts
   augment /nw:networks/nw:network/nw:node/tet:te
            /tet:tunnel-termination-point
            /tet:local-link-connectivities
            /tet:local-link-connectivity/tet:label-restrictions
            /tet:label-restriction/tet:label-end/tet:te-label
            /tet:technology:
      +--:(otn)
         +--rw (range-type)?
            +--:(trib-port)
            |  +--rw otn-tpn?   otn-tpn
            +--:(trib-slot)
               +--rw otn-ts?    otn-ts
   augment /nw:networks/nw:network/nw:node/tet:te
            /tet:tunnel-termination-point
            /tet:local-link-connectivities
            /tet:local-link-connectivity/tet:label-restrictions
            /tet:label-restriction/tet:label-step/tet:technology:
      +--:(otn)
         +--rw (range-type)?
            +--:(trib-port)
            |  +--rw otn-tpn?   otn-tpn
            +--:(trib-slot)
               +--rw otn-ts?    otn-ts
   augment /nw:networks/nw:network/nw:node/tet:te
            /tet:tunnel-termination-point
            /tet:local-link-connectivities
            /tet:local-link-connectivity/tet:underlay
            /tet:primary-path/tet:path-element/tet:type/tet:label
            /tet:label-hop/tet:te-label/tet:technology:
      +--:(otn)
         +--rw otn-tpn?   otn-tpn
         +--rw tsg?       identityref
         +--rw ts-list?   string
   augment /nw:networks/nw:network/nw:node/tet:te
            /tet:tunnel-termination-point
            /tet:local-link-connectivities
            /tet:local-link-connectivity/tet:underlay/tet:backup-path
            /tet:path-element/tet:type/tet:label/tet:label-hop
            /tet:te-label/tet:technology:
```

```
       +--:(otn)
          +--rw otn-tpn?   otn-tpn
          +--rw tsg?       identityref
          +--rw ts-list?   string
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:tunnel-termination-point
               /tet:local-link-connectivities
               /tet:local-link-connectivity/tet:optimizations
               /tet:algorithm/tet:metric/tet:optimization-metric
               /tet:explicit-route-exclude-objects
               /tet:route-object-exclude-object/tet:type/tet:label
               /tet:label-hop/tet:te-label/tet:technology:
       +--:(otn)
          +--rw otn-tpn?   otn-tpn
          +--rw tsg?       identityref
          +--rw ts-list?   string
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:tunnel-termination-point
               /tet:local-link-connectivities
               /tet:local-link-connectivity/tet:optimizations
               /tet:algorithm/tet:metric/tet:optimization-metric
               /tet:explicit-route-include-objects
               /tet:route-object-include-object/tet:type/tet:label
               /tet:label-hop/tet:te-label/tet:technology:
       +--:(otn)
          +--rw otn-tpn?   otn-tpn
          +--rw tsg?       identityref
          +--rw ts-list?   string
     augment /nw:networks/nw:network/nw:node/tet:te
               /tet:tunnel-termination-point
               /tet:local-link-connectivities
               /tet:local-link-connectivity/tet:path-properties
               /tet:path-route-objects/tet:path-route-object/tet:type
               /tet:label/tet:label-hop/tet:te-label/tet:technology:
       +--:(otn)
          +--ro otn-tpn?   otn-tpn
          +--ro tsg?       identityref
          +--ro ts-list?   string
     augment /nw:networks/nw:network/nt:link/tet:te
               /tet:te-link-attributes/tet:underlay/tet:primary-path
               /tet:path-element/tet:type/tet:label/tet:label-hop
               /tet:te-label/tet:technology:
       +--:(otn)
          +--rw otn-tpn?   otn-tpn
          +--rw tsg?       identityref
          +--rw ts-list?   string
     augment /nw:networks/nw:network/nt:link/tet:te
               /tet:te-link-attributes/tet:underlay/tet:backup-path
```

```
            /tet:path-element/tet:type/tet:label/tet:label-hop
            /tet:te-label/tet:technology:
      +--:(otn)
         +--rw otn-tpn?   otn-tpn
         +--rw tsg?       identityref
         +--rw ts-list?   string
   augment /nw:networks/nw:network/nt:link/tet:te
            /tet:te-link-attributes/tet:label-restrictions
            /tet:label-restriction/tet:label-start/tet:te-label
            /tet:technology:
      +--:(otn)
         +--rw (range-type)?
            +--:(trib-port)
            |  +--rw otn-tpn?   otn-tpn
            +--:(trib-slot)
               +--rw otn-ts?    otn-ts
   augment /nw:networks/nw:network/nt:link/tet:te
            /tet:te-link-attributes/tet:label-restrictions
            /tet:label-restriction/tet:label-end/tet:te-label
            /tet:technology:
      +--:(otn)
         +--rw (range-type)?
            +--:(trib-port)
            |  +--rw otn-tpn?   otn-tpn
            +--:(trib-slot)
               +--rw otn-ts?    otn-ts
   augment /nw:networks/nw:network/nt:link/tet:te
            /tet:te-link-attributes/tet:label-restrictions
            /tet:label-restriction/tet:label-step/tet:technology:
      +--:(otn)
         +--rw (range-type)?
            +--:(trib-port)
            |  +--rw otn-tpn?   otn-tpn
            +--:(trib-slot)
               +--rw otn-ts?    otn-ts
   augment /nw:networks/nw:network/nt:link/tet:te
            /tet:information-source-entry/tet:label-restrictions
            /tet:label-restriction/tet:label-start/tet:te-label
            /tet:technology:
      +--:(otn)
         +--ro (range-type)?
            +--:(trib-port)
            |  +--ro otn-tpn?   otn-tpn
            +--:(trib-slot)
               +--ro otn-ts?    otn-ts
   augment /nw:networks/nw:network/nt:link/tet:te
            /tet:information-source-entry/tet:label-restrictions
            /tet:label-restriction/tet:label-end/tet:te-label
```

```
            /tet:technology:
      +--:(otn)
         +--ro (range-type)?
            +--:(trib-port)
            |  +--ro otn-tpn?   otn-tpn
            +--:(trib-slot)
               +--ro otn-ts?    otn-ts
    augment /nw:networks/nw:network/nt:link/tet:te
            /tet:information-source-entry/tet:label-restrictions
            /tet:label-restriction/tet:label-step/tet:technology:
      +--:(otn)
         +--ro (range-type)?
            +--:(trib-port)
            |  +--ro otn-tpn?   otn-tpn
            +--:(trib-slot)
               +--ro otn-ts?    otn-ts
    augment /nw:networks/tet:te/tet:templates/tet:link-template
            /tet:te-link-attributes/tet:underlay/tet:primary-path
            /tet:path-element/tet:type/tet:label/tet:label-hop
            /tet:te-label/tet:technology:
      +--:(otn)
         +--rw otn-tpn?   otn-tpn
         +--rw tsg?       identityref
         +--rw ts-list?   string
    augment /nw:networks/tet:te/tet:templates/tet:link-template
            /tet:te-link-attributes/tet:underlay/tet:backup-path
            /tet:path-element/tet:type/tet:label/tet:label-hop
            /tet:te-label/tet:technology:
      +--:(otn)
         +--rw otn-tpn?   otn-tpn
         +--rw tsg?       identityref
         +--rw ts-list?   string
    augment /nw:networks/tet:te/tet:templates/tet:link-template
            /tet:te-link-attributes/tet:label-restrictions
            /tet:label-restriction/tet:label-start/tet:te-label
            /tet:technology:
      +--:(otn)
         +--rw (range-type)?
            +--:(trib-port)
            |  +--rw otn-tpn?   otn-tpn
            +--:(trib-slot)
               +--rw otn-ts?    otn-ts
    augment /nw:networks/tet:te/tet:templates/tet:link-template
            /tet:te-link-attributes/tet:label-restrictions
            /tet:label-restriction/tet:label-end/tet:te-label
            /tet:technology:
      +--:(otn)
         +--rw (range-type)?
```

```
            +--:(trib-port)
            |  +--rw otn-tpn?   otn-tpn
            +--:(trib-slot)
               +--rw otn-ts?    otn-ts
  augment /nw:networks/tet:te/tet:templates/tet:link-template
            /tet:te-link-attributes/tet:label-restrictions
            /tet:label-restriction/tet:label-step/tet:technology:
    +--:(otn)
       +--rw (range-type)?
          +--:(trib-port)
          |  +--rw otn-tpn?   otn-tpn
          +--:(trib-slot)
             +--rw otn-ts?    otn-ts
```

4. The YANG Code

```
<CODE BEGINS> file "ietf-otn-topology@2020-09-21.yang"
module ietf-otn-topology {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-otn-topology";
  prefix "otntopo";

  import ietf-network {
    prefix "nw";
    reference "RFC 8345: A YANG Data Model for Network Topologies";
  }

  import ietf-network-topology {
    prefix "nt";
    reference "RFC 8345: A YANG Data Model for Network Topologies";
  }

  import ietf-te-topology {
    prefix "tet";
    reference
      "RFC 8795: YANG Data Model for Traffic Engineering
       (TE) Topologies";
  }

  import ietf-layer1-types {
    prefix "l1-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: Xufeng Liu
               <mailto:xufeng.liu.ietf@gmail.com>

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

       Editor: Oscar Gonzalez de Dios
               <mailto:oscar.gonzalezdedios@telefonica.com>";

    description
      "This module defines a protocol independent Layer 1/ODU topology
       data model. The model fully conforms
       to the Network Management Datastore Architecture (NMDA).

       Copyright (c) 2020 IETF Trust and the persons
       identified as authors of the code.  All rights reserved.

       Redistribution and use in source and binary forms, with or
       without modification, is permitted pursuant to, and subject
       to the license terms contained in, the Simplified BSD License
       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 2020-09-21 {
      description
        "Initial Revision";
      reference
        "RFC XXXX: A YANG Data Model for Optical Transport Network
        Topology";
      // RFC Ed.: replace XXXX with actual RFC number, update date
      // information and remove this note
    }
```

```
    /*
     * Groupings
     */

     grouping otn-link-attributes {
       description "link attributes for OTN";

       leaf tsg {
         type identityref {
           base l1-types:tributary-slot-granularity;
         }
         description "Tributary slot granularity.";
         reference
           "G.709/Y.1331, February 2016: Interfaces for the
            Optical Transport Network (OTN)";
       }
       leaf distance {
         type uint32;
         description "distance in the unit of kilometers";
       }
     }

     grouping otn-tp-attributes {
       description "tp attributes for OTN";

       container client-svc {
         presence "client-facing LTP.";
         description
           "OTN LTP Service attributes.";

         leaf client-facing {
           type boolean;
           default 'false';
           description
             "Indicates whether this LTP is a client-facing LTP.";
         }
         leaf-list supported-client-signal {
           type identityref {
             base l1-types:client-signal;
           }
           description
             "List of client signal types supported by the LTP.";
         }
       }
     }

    /*
     * Data nodes
```

```
     */

     augment "/nw:networks/nw:network/nw:network-types/"
           + "tet:te-topology" {
       container otn-topology {
         presence "indicates a topology type of Optical Transport
                   Network (OTN)-electrical layer.";
         description "otn topology type";
       }
       description "augment network types to include otn newtork";
     }

     augment "/nw:networks/nw:network/nt:link/tet:te/"
           + "tet:te-link-attributes" {
       when "../../../nw:network-types/tet:te-topology/"
          + "otntopo:otn-topology" {
         description "Augment only for otn network.";
       }
       description "Augment link configuration";
       uses otn-link-attributes;
     }

     augment "/nw:networks/nw:network/nw:node/nt:termination-point/"
           + "tet:te" {
       when "../../../nw:network-types/tet:te-topology/"
          + "otntopo:otn-topology" {
         description "Augment only for otn network";
       }
       description "OTN TP attributes config in ODU topology.";
       uses otn-tp-attributes;
     }

     /*
      * Augment TE bandwidth
      */

     augment "/nw:networks/nw:network/nw:node/nt:termination-point/"
           + "tet:te/"
           + "tet:interface-switching-capability/tet:max-lsp-bandwidth/"
           + "tet:te-bandwidth/tet:technology" {
       when "../../../../../../nw:network-types/tet:te-topology/"
          + "otntopo:otn-topology" {
         description
           "Augmentation parameters apply only for networks with
            OTN topology type.";
       }
       description
         "Augment maximum LSP TE bandwidth for the link termination
```

```
          point (LTP).";
        case otn {
          uses l1-types:otn-path-bandwidth;
        }
      }

      augment "/nw:networks/nw:network/nw:node/tet:te/"
            + "tet:te-node-attributes/tet:connectivity-matrices/"
            + "tet:path-constraints/tet:te-bandwidth/tet:technology" {
        when "../../../../../../nw:network-types/tet:te-topology/"
           + "otntopo:otn-topology" {
          description
            "Augmentation parameters apply only for networks with
             OTN topology type.";
        }
        description
          "Augment TE bandwidth path constraints of the TE node
           connectivity matrices.";
        case otn {
          uses l1-types:otn-link-bandwidth;
        }
      }

      augment "/nw:networks/nw:network/nw:node/tet:te/"
            + "tet:te-node-attributes/tet:connectivity-matrices/"
            + "tet:connectivity-matrix/"
            + "tet:path-constraints/tet:te-bandwidth/tet:technology" {
        when "../../../../../../../nw:network-types/tet:te-topology/"
           + "otntopo:otn-topology" {
          description
            "Augmentation parameters apply only for networks with
             OTN topology type.";
        }
        description
          "Augment TE bandwidth path constraints of the
           connectivity matrix entry.";
        case otn {
          uses l1-types:otn-link-bandwidth;
        }
      }

      augment "/nw:networks/nw:network/nw:node/tet:te/"
            + "tet:information-source-entry/tet:connectivity-matrices/"
            + "tet:path-constraints/tet:te-bandwidth/tet:technology" {
        when "../../../../../../nw:network-types/tet:te-topology/"
           + "otntopo:otn-topology" {
          description
            "Augmentation parameters apply only for networks with
```

```
            OTN topology type.";
        }
        description
          "Augment TE bandwidth path constraints of the TE node
           connectivity matrices information source.";
        case otn {
          uses l1-types:otn-link-bandwidth;
        }
      }

      augment "/nw:networks/nw:network/nw:node/tet:te/"
            + "tet:information-source-entry/tet:connectivity-matrices/"
            + "tet:connectivity-matrix/"
            + "tet:path-constraints/tet:te-bandwidth/tet:technology" {
        when "../../../../../../../nw:network-types/tet:te-topology/"
           + "otntopo:otn-topology" {
          description
            "Augmentation parameters apply only for networks with
             OTN topology type.";
        }
        description
          "Augment TE bandwidth path constraints of the
           connectivity matrix entry information source";
        case otn {
          uses l1-types:otn-link-bandwidth;
        }
      }

      augment "/nw:networks/nw:network/nw:node/tet:te/"
            + "tet:tunnel-termination-point/"
            + "tet:client-layer-adaptation/tet:switching-capability/"
            + "tet:te-bandwidth/tet:technology" {
        when "../../../../../../nw:network-types/tet:te-topology/"
           + "otntopo:otn-topology" {
          description
            "Augmentation parameters apply only for networks with
             OTN topology type.";
        }
        description
          "Augment client TE bandwidth of the tunnel termination point
           (TTP)";
        case otn {
          uses l1-types:otn-link-bandwidth;
        }
      }

      augment "/nw:networks/nw:network/nw:node/tet:te/"
            + "tet:tunnel-termination-point/"
```

```
          + "tet:local-link-connectivities/tet:path-constraints/"
          + "tet:te-bandwidth/tet:technology" {
      when "../../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE bandwidth path constraints for the TTP
         Local Link Connectivities.";
      case otn {
        uses l1-types:otn-link-bandwidth;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:tunnel-termination-point/"
          + "tet:local-link-connectivities/"
          + "tet:local-link-connectivity/tet:path-constraints/"
          + "tet:te-bandwidth/tet:technology" {
      when "../../../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE bandwidth path constraints for the TTP
         Local Link Connectivity entry.";
      case otn {
        uses l1-types:otn-link-bandwidth;
      }
    }

    augment "/nw:networks/nw:network/nt:link/tet:te/"
          + "tet:te-link-attributes/"
          + "tet:interface-switching-capability/tet:max-lsp-bandwidth/"
          + "tet:te-bandwidth/tet:technology" {
      when "../../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment maximum LSP TE bandwidth for the TE link.";
      case otn {
```

```
        uses l1-types:otn-path-bandwidth;
      }
    }

    augment "/nw:networks/nw:network/nt:link/tet:te/"
          + "tet:te-link-attributes/"
          + "tet:max-link-bandwidth/"
          + "tet:te-bandwidth/tet:technology" {
      when "../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment maximum TE bandwidth for the TE link";
      case otn {
        uses l1-types:otn-link-bandwidth;
      }
    }

    augment "/nw:networks/nw:network/nt:link/tet:te/"
          + "tet:te-link-attributes/"
          + "tet:max-resv-link-bandwidth/"
          + "tet:te-bandwidth/tet:technology" {
      when "../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment maximum reservable TE bandwidth for the TE link";
      case otn {
        uses l1-types:otn-link-bandwidth;
      }
    }

    augment "/nw:networks/nw:network/nt:link/tet:te/"
          + "tet:te-link-attributes/"
          + "tet:unreserved-bandwidth/"
          + "tet:te-bandwidth/tet:technology" {
      when "../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
```

```
      description
        "Augment unreserved TE bandwidth for the TE Link";
      case otn {
        uses l1-types:otn-link-bandwidth;
      }
    }

    augment "/nw:networks/nw:network/nt:link/tet:te/"
          + "tet:information-source-entry/"
          + "tet:interface-switching-capability/"
          + "tet:max-lsp-bandwidth/"
          + "tet:te-bandwidth/tet:technology" {
      when "../../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment maximum LSP TE bandwidth for the TE link
         information source";
      case otn {
        uses l1-types:otn-path-bandwidth;
      }
    }

    augment "/nw:networks/nw:network/nt:link/tet:te/"
          + "tet:information-source-entry/"
          + "tet:max-link-bandwidth/"
          + "tet:te-bandwidth/tet:technology" {
      when "../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment maximum TE bandwidth for the TE link
         information source";
      case otn {
        uses l1-types:otn-link-bandwidth;
      }
    }

    augment "/nw:networks/nw:network/nt:link/tet:te/"
          + "tet:information-source-entry/"
          + "tet:max-resv-link-bandwidth/"
          + "tet:te-bandwidth/tet:technology" {
```

```
      when "../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment maximum reservable TE bandwidth for the TE link
         information-source";
      case otn {
        uses l1-types:otn-link-bandwidth;
      }
    }

    augment "/nw:networks/nw:network/nt:link/tet:te/"
          + "tet:information-source-entry/"
          + "tet:unreserved-bandwidth/"
          + "tet:te-bandwidth/tet:technology" {
      when "../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment unreserved TE bandwidth of the TE link
         information source";
      case otn {
        uses l1-types:otn-link-bandwidth;
      }
    }

    augment "/nw:networks/tet:te/tet:templates/"
          + "tet:link-template/tet:te-link-attributes/"
          + "tet:interface-switching-capability/"
          + "tet:max-lsp-bandwidth/"
          + "tet:te-bandwidth/tet:technology" {
      description
        "Augment maximum LSP TE bandwidth of the TE link
         template";
      case otn {
        uses l1-types:otn-path-bandwidth;
      }
    }

    augment "/nw:networks/tet:te/tet:templates/"
          + "tet:link-template/tet:te-link-attributes/"
          + "tet:max-link-bandwidth/"
```

```
          + "tet:te-bandwidth/tet:technology" {
        description
          "Augment maximum TE bandwidth the TE link template";
        case otn {
          uses l1-types:otn-link-bandwidth;
        }
      }

      augment "/nw:networks/tet:te/tet:templates/"
            + "tet:link-template/tet:te-link-attributes/"
            + "tet:max-resv-link-bandwidth/"
            + "tet:te-bandwidth/tet:technology" {
        description
          "Augment maximum reservable TE bandwidth for the TE link
           template.";
        case otn {
          uses l1-types:otn-link-bandwidth;
        }
      }

      augment "/nw:networks/tet:te/tet:templates/"
            + "tet:link-template/tet:te-link-attributes/"
            + "tet:unreserved-bandwidth/"
            + "tet:te-bandwidth/tet:technology" {
        description
          "Augment unreserved TE bandwidth the TE link template";
        case otn {
          uses l1-types:otn-link-bandwidth;
        }
      }

      /*
       * Augment TE label range information
       */

      augment "/nw:networks/nw:network/nw:node/tet:te/"
            + "tet:te-node-attributes/tet:connectivity-matrices/"
            + "tet:label-restrictions/tet:label-restriction" {
        when "../../../../../../nw:network-types/tet:te-topology/"
           + "otntopo:otn-topology" {
          description
            "Augmentation parameters apply only for networks with
             OTN topology type.";
        }
        description
          "Augment TE label range information for the TE node
           connectivity matrices.";
        uses l1-types:otn-label-range-info;
```

```
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:te-node-attributes/tet:connectivity-matrices/"
          + "tet:connectivity-matrix/tet:from/"
          + "tet:label-restrictions/tet:label-restriction" {
      when "../../../../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range information for the source LTP
         of the connectivity matrix entry.";
      uses l1-types:otn-label-range-info;
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:te-node-attributes/tet:connectivity-matrices/"
          + "tet:connectivity-matrix/tet:to/"
          + "tet:label-restrictions/tet:label-restriction" {
      when "../../../../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range information for the destination LTP
         of the connectivity matrix entry.";
      uses l1-types:otn-label-range-info;
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:information-source-entry/"
          + "tet:connectivity-matrices/tet:label-restrictions/"
          + "tet:label-restriction" {
      when "../../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range information for the TE node
         connectivity matrices information source.";
      uses l1-types:otn-label-range-info;
```

```
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:information-source-entry/tet:connectivity-matrices/"
          + "tet:connectivity-matrix/"
          + "tet:from/tet:label-restrictions/tet:label-restriction" {
      when "../../../../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range information for the source LTP
         of the connectivity matrix entry information source.";
      uses l1-types:otn-label-range-info;
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:information-source-entry/tet:connectivity-matrices/"
          + "tet:connectivity-matrix/"
          + "tet:to/tet:label-restrictions/tet:label-restriction" {
      when "../../../../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range information for the destination LTP
         of the connectivity matrix entry information source.";
      uses l1-types:otn-label-range-info;
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:tunnel-termination-point/"
          + "tet:local-link-connectivities/"
          + "tet:label-restrictions/tet:label-restriction" {
      when "../../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range information for the TTP
         Local Link Connectivities.";
      uses l1-types:otn-label-range-info;
```

```
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:tunnel-termination-point/"
          + "tet:local-link-connectivities/"
          + "tet:local-link-connectivity/"
          + "tet:label-restrictions/tet:label-restriction" {
      when "../../../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range information for the TTP
         Local Link Connectivity entry.";
      uses l1-types:otn-label-range-info;
    }

    augment "/nw:networks/nw:network/nt:link/tet:te/"
          + "tet:te-link-attributes/"
          + "tet:label-restrictions/tet:label-restriction" {
      when "../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range information for the TE link.";
      uses l1-types:otn-label-range-info;
    }

    augment "/nw:networks/nw:network/nt:link/tet:te/"
          + "tet:information-source-entry/"
          + "tet:label-restrictions/tet:label-restriction" {
      when "../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range information for the TE link
         information source.";
      uses l1-types:otn-label-range-info;
    }
```

```
    augment "/nw:networks/tet:te/tet:templates/"
          + "tet:link-template/tet:te-link-attributes/"
          + "tet:label-restrictions/tet:label-restriction" {
      description
        "Augment TE label range information for the TE link template.";
      uses l1-types:otn-label-range-info;
    }

    /*
     * Augment TE label
     */

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:te-node-attributes/tet:connectivity-matrices/"
          + "tet:label-restrictions/tet:label-restriction/"
          + "tet:label-start/"
          + "tet:te-label/tet:technology" {
      when "../../../../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range start for the TE node
         connectivity matrices";
      case otn {
        uses l1-types:otn-label-start-end;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:te-node-attributes/tet:connectivity-matrices/"
          + "tet:label-restrictions/"
          + "tet:label-restriction/tet:label-end/"
          + "tet:te-label/tet:technology" {
      when "../../../../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range end for the TE node
         connectivity matrices";
      case otn {
        uses l1-types:otn-label-start-end;
      }
```

```
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:te-node-attributes/tet:connectivity-matrices/"
          + "tet:label-restrictions/"
          + "tet:label-restriction/tet:label-step/"
          + "tet:technology" {
      when "../../../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range step for the TE node
         connectivity matrices";
      case otn {
        uses l1-types:otn-label-step;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:te-node-attributes/tet:connectivity-matrices/"
          + "tet:underlay/tet:primary-path/tet:path-element/"
          + "tet:type/tet:label/tet:label-hop/"
          + "tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the underlay primary path of the
         TE node connectivity matrices";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:te-node-attributes/tet:connectivity-matrices/"
          + "tet:underlay/tet:backup-path/tet:path-element/"
          + "tet:type/tet:label/tet:label-hop/"
          + "tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
```

```
          + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the underlay backup path of the
         TE node connectivity matrices";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:te-node-attributes/tet:connectivity-matrices/"
          + "tet:optimizations/tet:algorithm/tet:metric/"
          + "tet:optimization-metric/"
          + "tet:explicit-route-exclude-objects/"
          + "tet:route-object-exclude-object/"
          + "tet:type/tet:label/tet:label-hop/"
          + "tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the explicit route objects excluded
         by the path computation of the TE node connectivity
         matrices";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:te-node-attributes/tet:connectivity-matrices/"
          + "tet:optimizations/tet:algorithm/tet:metric/"
          + "tet:optimization-metric/"
          + "tet:explicit-route-include-objects/"
          + "tet:route-object-include-object/"
          + "tet:type/tet:label/tet:label-hop/"
          + "tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
```

```
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the explicit route objects included
         by the path computation of the TE node connectivity
         matrices";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:te-node-attributes/tet:connectivity-matrices/"
          + "tet:path-properties/tet:path-route-objects/"
          + "tet:path-route-object/tet:type/tet:label/tet:label-hop/"
          + "tet:te-label/tet:technology" {
      when "../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the computed path route objects
         of the TE node connectivity matrices";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:te-node-attributes/tet:connectivity-matrices/"
          + "tet:connectivity-matrix/tet:from/"
          + "tet:label-restrictions/tet:label-restriction/"
          + "tet:label-start/"
          + "tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range start for the source LTP
```

```
          of the connectivity matrix entry.";
        case otn {
          uses l1-types:otn-label-start-end;
        }
      }

      augment "/nw:networks/nw:network/nw:node/tet:te/"
            + "tet:te-node-attributes/tet:connectivity-matrices/"
            + "tet:connectivity-matrix/tet:from/"
            + "tet:label-restrictions/tet:label-restriction/"
            + "tet:label-end/"
            + "tet:te-label/tet:technology" {
        when "../../../../../../../../../../"
           + "nw:network-types/tet:te-topology/"
           + "otntopo:otn-topology" {
          description
            "Augmentation parameters apply only for networks with
             OTN topology type.";
        }
        description
          "Augment TE label range end for the source LTP
           of the connectivity matrix entry.";
        case otn {
          uses l1-types:otn-label-start-end;
        }
      }

      augment "/nw:networks/nw:network/nw:node/tet:te/"
            + "tet:te-node-attributes/tet:connectivity-matrices/"
            + "tet:connectivity-matrix/tet:from/"
            + "tet:label-restrictions/tet:label-restriction/"
            + "tet:label-step/"
            + "tet:technology" {
        when "../../../../../../../../../../"
           + "nw:network-types/tet:te-topology/"
           + "otntopo:otn-topology" {
          description
            "Augmentation parameters apply only for networks with
             OTN topology type.";
        }
        description
          "Augment TE label range step for the source LTP
           of the connectivity matrix entry.";
        case otn {
          uses l1-types:otn-label-step;
        }
      }
```

```
    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:te-node-attributes/tet:connectivity-matrices/"
          + "tet:connectivity-matrix/tet:to/"
          + "tet:label-restrictions/tet:label-restriction/"
          + "tet:label-start/"
          + "tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range start for the destination LTP
         of the connectivity matrix entry.";
      case otn {
        uses l1-types:otn-label-start-end;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:te-node-attributes/tet:connectivity-matrices/"
          + "tet:connectivity-matrix/tet:to/"
          + "tet:label-restrictions/tet:label-restriction/"
          + "tet:label-end/"
          + "tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range end for the destination LTP
         of the connectivity matrix entry.";
      case otn {
        uses l1-types:otn-label-start-end;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:te-node-attributes/tet:connectivity-matrices/"
          + "tet:connectivity-matrix/tet:to/"
          + "tet:label-restrictions/tet:label-restriction/"
          + "tet:label-step/"
          + "tet:technology" {
```

```
        when "../../../../../../../../../"
           + "nw:network-types/tet:te-topology/"
           + "otntopo:otn-topology" {
          description
            "Augmentation parameters apply only for networks with
             OTN topology type.";
        }
        description
          "Augment TE label range step for the destination LTP
           of the connectivity matrix entry.";
        case otn {
          uses l1-types:otn-label-step;
        }
      }

      augment "/nw:networks/nw:network/nw:node/tet:te/"
            + "tet:te-node-attributes/tet:connectivity-matrices/"
            + "tet:connectivity-matrix/"
            + "tet:underlay/tet:primary-path/tet:path-element/"
            + "tet:type/tet:label/tet:label-hop/"
            + "tet:te-label/tet:technology" {
        when "../../../../../../../../../"
           + "nw:network-types/tet:te-topology/"
           + "otntopo:otn-topology" {
          description
            "Augmentation parameters apply only for networks with
             OTN topology type.";
        }
        description
          "Augment TE label hop for the underlay primary path
           of the connectivity matrix entry.";
        case otn {
          uses l1-types:otn-label-hop;
        }
      }

      augment "/nw:networks/nw:network/nw:node/tet:te/"
            + "tet:te-node-attributes/tet:connectivity-matrices/"
            + "tet:connectivity-matrix/"
            + "tet:underlay/tet:backup-path/tet:path-element/"
            + "tet:type/tet:label/tet:label-hop/"
            + "tet:te-label/tet:technology" {
        when "../../../../../../../../../"
           + "nw:network-types/tet:te-topology/"
           + "otntopo:otn-topology" {
          description
            "Augmentation parameters apply only for networks with
             OTN topology type.";
```

```
      }
      description
        "Augment TE label hop for the underlay backup path
         of the connectivity matrix entry.";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:te-node-attributes/tet:connectivity-matrices/"
          + "tet:connectivity-matrix/tet:optimizations/"
          + "tet:algorithm/tet:metric/tet:optimization-metric/"
          + "tet:explicit-route-exclude-objects/"
          + "tet:route-object-exclude-object/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      when "../../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the explicit route objects excluded
         by the path computation of the connectivity matrix entry.";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:te-node-attributes/tet:connectivity-matrices/"
          + "tet:connectivity-matrix/tet:optimizations/"
          + "tet:algorithm/tet:metric/tet:optimization-metric/"
          + "tet:explicit-route-include-objects/"
          + "tet:route-object-include-object/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      when "../../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the explicit route objects included
         by the path computation of the connectivity matrix entry.";
```

```
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:te-node-attributes/tet:connectivity-matrices/"
          + "tet:connectivity-matrix/"
          + "tet:path-properties/tet:path-route-objects/"
          + "tet:path-route-object/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the computed path route objects
         of the connectivity matrix entry.";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:information-source-entry/"
          + "tet:connectivity-matrices/tet:label-restrictions/"
          + "tet:label-restriction/"
          + "tet:label-start/tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range start for the TE node connectivity
         matrices information source.";
      case otn {
        uses l1-types:otn-label-start-end;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:information-source-entry/"
```

```
          + "tet:connectivity-matrices/tet:label-restrictions/"
          + "tet:label-restriction/"
          + "tet:label-end/tet:te-label/tet:technology" {
      when "../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range end for the TE node connectivity
         matrices information source.";
      case otn {
        uses l1-types:otn-label-start-end;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:information-source-entry/"
          + "tet:connectivity-matrices/tet:label-restrictions/"
          + "tet:label-restriction/"
          + "tet:label-step/tet:technology" {
      when "../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range step for the TE node connectivity
         matrices information source.";
      case otn {
        uses l1-types:otn-label-step;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:information-source-entry/tet:connectivity-matrices/"
          + "tet:underlay/tet:primary-path/tet:path-element/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
```

```
      }
      description
        "Augment TE label hop for the underlay primary path
         of the TE node connectivity matrices of the information
         source entry.";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:information-source-entry/tet:connectivity-matrices/"
          + "tet:underlay/tet:backup-path/tet:path-element/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      when "../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the underlay backup path
         of the TE node connectivity matrices of the information
         source entry.";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:information-source-entry/tet:connectivity-matrices/"
          + "tet:optimizations/tet:algorithm/tet:metric/"
          + "tet:optimization-metric/"
          + "tet:explicit-route-exclude-objects/"
          + "tet:route-object-exclude-object/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the explicit route objects excluded
         by the path computation of the TE node connectivity matrices
         information source.";
```

```
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:information-source-entry/tet:connectivity-matrices/"
          + "tet:optimizations/tet:algorithm/tet:metric/"
          + "tet:optimization-metric/"
          + "tet:explicit-route-include-objects/"
          + "tet:route-object-include-object/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the explicit route objects included
         by the path computation of the TE node connectivity matrices
         information source.";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:information-source-entry/tet:connectivity-matrices/"
          + "tet:path-properties/tet:path-route-objects/"
          + "tet:path-route-object/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the computed path route objects
         of the TE node connectivity matrices information source.";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }
```

```
    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:information-source-entry/tet:connectivity-matrices/"
          + "tet:connectivity-matrix/"
          + "tet:from/tet:label-restrictions/"
          + "tet:label-restriction/"
          + "tet:label-start/tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range start for the source LTP
         of the connectivity matrix entry information source.";
      case otn {
        uses l1-types:otn-label-start-end;
      }
    }
    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:information-source-entry/tet:connectivity-matrices/"
          + "tet:connectivity-matrix/"
          + "tet:from/tet:label-restrictions/"
          + "tet:label-restriction/"
          + "tet:label-end/tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range end for the source LTP
         of the connectivity matrix entry information source.";
      case otn {
        uses l1-types:otn-label-start-end;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:information-source-entry/tet:connectivity-matrices/"
          + "tet:connectivity-matrix/"
          + "tet:from/tet:label-restrictions/"
          + "tet:label-restriction/"
          + "tet:label-step/tet:technology" {
      when "../../../../../../../../../../"
```

```
          + "nw:network-types/tet:te-topology/"
          + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range step for the source LTP
         of the connectivity matrix entry information source.";
      case otn {
        uses l1-types:otn-label-step;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:information-source-entry/tet:connectivity-matrices/"
          + "tet:connectivity-matrix/"
          + "tet:to/tet:label-restrictions/tet:label-restriction/"
          + "tet:label-start/tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range start for the destination LTP
         of the connectivity matrix entry information source.";
      case otn {
        uses l1-types:otn-label-start-end;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:information-source-entry/tet:connectivity-matrices/"
          + "tet:connectivity-matrix/"
          + "tet:to/tet:label-restrictions/tet:label-restriction/"
          + "tet:label-end/tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range end for the destination LTP
```

```
          of the connectivity matrix entry information source.";
        case otn {
          uses l1-types:otn-label-start-end;
        }
      }

      augment "/nw:networks/nw:network/nw:node/tet:te/"
            + "tet:information-source-entry/tet:connectivity-matrices/"
            + "tet:connectivity-matrix/"
            + "tet:to/tet:label-restrictions/tet:label-restriction/"
            + "tet:label-step/tet:technology" {
        when "../../../../../../../../../"
           + "nw:network-types/tet:te-topology/"
           + "otntopo:otn-topology" {
          description
            "Augmentation parameters apply only for networks with
             OTN topology type.";
        }
        description
          "Augment TE label range step for the destination LTP
           of the connectivity matrix entry information source.";
        case otn {
          uses l1-types:otn-label-step;
        }
      }

      augment "/nw:networks/nw:network/nw:node/tet:te/"
            + "tet:information-source-entry/tet:connectivity-matrices/"
            + "tet:connectivity-matrix/"
            + "tet:underlay/tet:primary-path/tet:path-element/tet:type/"
            + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
        when "../../../../../../../../../"
           + "nw:network-types/tet:te-topology/"
           + "otntopo:otn-topology" {
          description
            "Augmentation parameters apply only for networks with
             OTN topology type.";
        }
        description
          "Augment TE label hop for the underlay primary path
           of the connectivity matrix entry information source.";
        case otn {
          uses l1-types:otn-label-hop;
        }
      }

      augment "/nw:networks/nw:network/nw:node/tet:te/"
            + "tet:information-source-entry/tet:connectivity-matrices/"
```

```
          + "tet:connectivity-matrix/"
          + "tet:underlay/tet:backup-path/tet:path-element/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the underlay backup path
         of the connectivity matrix entry information source.";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:information-source-entry/tet:connectivity-matrices/"
          + "tet:connectivity-matrix/"
          + "tet:optimizations/tet:algorithm/tet:metric/"
          + "tet:optimization-metric/"
          + "tet:explicit-route-exclude-objects/"
          + "tet:route-object-exclude-object/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the explicit route objects excluded
         by the path computation of the connectivity matrix entry
         information source.";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:information-source-entry/tet:connectivity-matrices/"
          + "tet:connectivity-matrix/"
          + "tet:optimizations/tet:algorithm/tet:metric/"
          + "tet:optimization-metric/"
          + "tet:explicit-route-include-objects/"
```

```
          + "tet:route-object-include-object/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      when "../../../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the explicit route objects included
         by the path computation of the connectivity matrix entry
         information source.";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:information-source-entry/tet:connectivity-matrices/"
          + "tet:connectivity-matrix/"
          + "tet:path-properties/tet:path-route-objects/"
          + "tet:path-route-object/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      when "../../../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the computed path route objects
         of the connectivity matrix entry information source.";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
        + "tet:tunnel-termination-point/"
        + "tet:local-link-connectivities/"
        + "tet:label-restrictions/tet:label-restriction/"
        + "tet:label-start/"
        + "tet:te-label/tet:technology" {
      when "../../../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
```

```
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range start for the TTP
         Local Link Connectivities.";
      case otn {
        uses l1-types:otn-label-start-end;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:tunnel-termination-point/"
          + "tet:local-link-connectivities/"
          + "tet:label-restrictions/tet:label-restriction/"
          + "tet:label-end/"
          + "tet:te-label/tet:technology"{
      when "../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range end for the TTP
         Local Link Connectivities.";
      case otn {
        uses l1-types:otn-label-start-end;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:tunnel-termination-point/"
          + "tet:local-link-connectivities/"
          + "tet:label-restrictions/tet:label-restriction/"
          + "tet:label-step/"
          + "tet:technology"{
      when "../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range step for the TTP
```

```
          Local Link Connectivities.";
        case otn {
          uses l1-types:otn-label-step;
        }
      }

      augment "/nw:networks/nw:network/nw:node/tet:te/"
            + "tet:tunnel-termination-point/"
            + "tet:local-link-connectivities/"
            + "tet:underlay/tet:primary-path/tet:path-element/tet:type/"
            + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
        when "../../../../../../../../../"
           + "nw:network-types/tet:te-topology/"
           + "otntopo:otn-topology" {
          description
            "Augmentation parameters apply only for networks with
             OTN topology type.";
        }
        description
          "Augment TE label hop for the underlay primary path
           of the TTP Local Link Connectivities.";
        case otn {
          uses l1-types:otn-label-hop;
        }
      }

      augment "/nw:networks/nw:network/nw:node/tet:te/"
            + "tet:tunnel-termination-point/"
            + "tet:local-link-connectivities/"
            + "tet:underlay/tet:backup-path/tet:path-element/tet:type/"
            + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
        when "../../../../../../../../../"
           + "nw:network-types/tet:te-topology/"
           + "otntopo:otn-topology" {
          description
            "Augmentation parameters apply only for networks with
             OTN topology type.";
        }
        description
          "Augment TE label hop for the underlay backup path
           of the TTP Local Link Connectivities.";
        case otn {
          uses l1-types:otn-label-hop;
        }
      }

      augment "/nw:networks/nw:network/nw:node/tet:te/"
            + "tet:tunnel-termination-point/"
```

```
          + "tet:local-link-connectivities/"
          + "tet:optimizations/tet:algorithm/tet:metric/"
          + "tet:optimization-metric/"
          + "tet:explicit-route-exclude-objects/"
          + "tet:route-object-exclude-object/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the explicit route objects excluded
         by the path computation of the TTP Local Link
         Connectivities.";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:tunnel-termination-point/"
          + "tet:local-link-connectivities/"
          + "tet:optimizations/tet:algorithm/tet:metric/"
          + "tet:optimization-metric/"
          + "tet:explicit-route-include-objects/"
          + "tet:route-object-include-object/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the explicit route objects included
         by the path computation of the TTP Local Link
         Connectivities.";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:tunnel-termination-point/"
```

```
          + "tet:local-link-connectivities/"
          + "tet:path-properties/tet:path-route-objects/"
          + "tet:path-route-object/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the computed path route objects
         of the TTP Local Link Connectivities.";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:tunnel-termination-point/"
          + "tet:local-link-connectivities/"
          + "tet:local-link-connectivity/"
          + "tet:label-restrictions/tet:label-restriction/"
          + "tet:label-start/tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range start for the TTP
         Local Link Connectivity entry.";
      case otn {
        uses l1-types:otn-label-start-end;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:tunnel-termination-point/"
          + "tet:local-link-connectivities/"
          + "tet:local-link-connectivity/"
          + "tet:label-restrictions/tet:label-restriction/"
          + "tet:label-end/tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
```

```
          + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range end for the TTP
         Local Link Connectivity entry.";
      case otn {
        uses l1-types:otn-label-start-end;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:tunnel-termination-point/"
          + "tet:local-link-connectivities/"
          + "tet:local-link-connectivity/"
          + "tet:label-restrictions/tet:label-restriction/"
          + "tet:label-step/tet:technology" {
      when "../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range step for the TTP
         Local Link Connectivity entry.";
      case otn {
        uses l1-types:otn-label-step;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:tunnel-termination-point/"
          + "tet:local-link-connectivities/"
          + "tet:local-link-connectivity/"
          + "tet:underlay/tet:primary-path/tet:path-element/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
```

```
        "Augment TE label hop for the underlay primary path
         of the TTP Local Link Connectivity entry.";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:tunnel-termination-point/"
          + "tet:local-link-connectivities/"
          + "tet:local-link-connectivity/"
          + "tet:underlay/tet:backup-path/tet:path-element/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the underlay backup path
         of the TTP Local Link Connectivity entry.";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:tunnel-termination-point/"
          + "tet:local-link-connectivities/"
          + "tet:local-link-connectivity/"
          + "tet:optimizations/tet:algorithm/tet:metric/"
          + "tet:optimization-metric/"
          + "tet:explicit-route-exclude-objects/"
          + "tet:route-object-exclude-object/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      when "../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the explicit route objects excluded
         by the path computation of the TTP Local Link
         Connectivity entry.";
```

```
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:tunnel-termination-point/"
          + "tet:local-link-connectivities/"
          + "tet:local-link-connectivity/"
          + "tet:optimizations/tet:algorithm/tet:metric/"
          + "tet:optimization-metric/"
          + "tet:explicit-route-include-objects/"
          + "tet:route-object-include-object/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      when "../../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the explicit route objects included
         by the path computation of the TTP Local Link
         Connectivity entry.";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nw:node/tet:te/"
          + "tet:tunnel-termination-point/"
          + "tet:local-link-connectivities/"
          + "tet:local-link-connectivity/"
          + "tet:path-properties/tet:path-route-objects/"
          + "tet:path-route-object/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      when "../../../../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the computed path route objects
         of the TTP Local Link Connectivity entry.";
      case otn {
```

```
        uses l1-types:otn-label-hop;
      }
    }
    augment "/nw:networks/nw:network/nt:link/tet:te/"
          + "tet:te-link-attributes/"
          + "tet:underlay/tet:primary-path/tet:path-element/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      when "../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the underlay primary path
         of the TE link.";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nt:link/tet:te/"
          + "tet:te-link-attributes/"
          + "tet:underlay/tet:backup-path/tet:path-element/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      when "../../../../../../../../"
         + "nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label hop for the underlay backup path
         of the TE link.";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/nw:network/nt:link/tet:te/"
          + "tet:te-link-attributes/"
          + "tet:label-restrictions/tet:label-restriction/"
          + "tet:label-start/tet:te-label/tet:technology" {
      when "../../../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
```

```
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range start for the TE link.";
      case otn {
        uses l1-types:otn-label-start-end;
      }
    }

    augment "/nw:networks/nw:network/nt:link/tet:te/"
          + "tet:te-link-attributes/"
          + "tet:label-restrictions/tet:label-restriction/"
          + "tet:label-end/tet:te-label/tet:technology" {
      when "../../../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range end for the TE link.";
      case otn {
        uses l1-types:otn-label-start-end;
      }
    }

    augment "/nw:networks/nw:network/nt:link/tet:te/"
          + "tet:te-link-attributes/"
          + "tet:label-restrictions/tet:label-restriction/"
          + "tet:label-step/tet:technology" {
      when "../../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range step for the TE link.";
      case otn {
        uses l1-types:otn-label-step;
      }
    }

    augment "/nw:networks/nw:network/nt:link/tet:te/"
          + "tet:information-source-entry/"
          + "tet:label-restrictions/tet:label-restriction/"
          + "tet:label-start/tet:te-label/tet:technology" {
```

```
      when "../../../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range start for the TE link
         information source.";
      case otn {
        uses l1-types:otn-label-start-end;
      }
    }

    augment "/nw:networks/nw:network/nt:link/tet:te/"
          + "tet:information-source-entry/"
          + "tet:label-restrictions/tet:label-restriction/"
          + "tet:label-end/tet:te-label/tet:technology" {
      when "../../../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range end for the TE link
         information source.";
      case otn {
        uses l1-types:otn-label-start-end;
      }
    }

    augment "/nw:networks/nw:network/nt:link/tet:te/"
          + "tet:information-source-entry/"
          + "tet:label-restrictions/tet:label-restriction/"
          + "tet:label-step/tet:technology" {
      when "../../../../../../nw:network-types/tet:te-topology/"
         + "otntopo:otn-topology" {
        description
          "Augmentation parameters apply only for networks with
           OTN topology type.";
      }
      description
        "Augment TE label range step for the TE link
         information source.";
      case otn {
        uses l1-types:otn-label-step;
      }
```

```
    }

    augment "/nw:networks/tet:te/tet:templates/"
          + "tet:link-template/tet:te-link-attributes/"
          + "tet:underlay/tet:primary-path/tet:path-element/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      description
        "Augment TE label hop for the underlay primary path
         of the TE link template.";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/tet:te/tet:templates/"
          + "tet:link-template/tet:te-link-attributes/"
          + "tet:underlay/tet:backup-path/tet:path-element/tet:type/"
          + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
      description
        "Augment TE label hop for the underlay backup path
         of the TE link template.";
      case otn {
        uses l1-types:otn-label-hop;
      }
    }

    augment "/nw:networks/tet:te/tet:templates/"
          + "tet:link-template/tet:te-link-attributes/"
          + "tet:label-restrictions/tet:label-restriction/"
          + "tet:label-start/tet:te-label/tet:technology" {
      description
        "Augment TE label range start for the TE link template.";
      case otn {
        uses l1-types:otn-label-start-end;
      }
    }

    augment "/nw:networks/tet:te/tet:templates/"
          + "tet:link-template/tet:te-link-attributes/"
          + "tet:label-restrictions/tet:label-restriction/"
          + "tet:label-end/tet:te-label/tet:technology" {
      description
        "Augment TE label range end for the TE link template.";
      case otn {
        uses l1-types:otn-label-start-end;
      }
    }
```

```
    augment "/nw:networks/tet:te/tet:templates/"
          + "tet:link-template/tet:te-link-attributes/"
          + "tet:label-restrictions/tet:label-restriction/"
          + "tet:label-step/tet:technology" {
      description
        "Augment TE label range step for the TE link template.";
      case otn {
        uses l1-types:otn-label-step;
      }
    }
  }
```

<CODE ENDS>

5. IANA Considerations

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

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

This document registers a YANG module in the YANG Module Names registry [RFC7950].

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

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:

/nw:networks/nw:network/nw:network-types/tet:te-topology
/nw:networks/nw:network/nt:link/tet:te/tet:te-link-attributes
/nw:networks/nw:network/nw:node/nt:termination-point/tet:te
/nw:networks/nw:network/.../tet:te-bandwidth/tet:technology
/nw:networks/nw:network/nw:node/tet:te/.../tet:label-restriction
/nw:networks/nw:network/nw:node/.../tet:te-label/tet:technology
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:

Editors note: Currently there is no such data nodes, temporarily kept for review.

7. Acknowledgements

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8. Contributors

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9. References

9.1. Normative References

[I-D.ietf-ccamp-layer1-types]
Zheng, H. and I. Busi, "A YANG Data Model for Layer 1 Types", draft-ietf-ccamp-layer1-types-06 (work in progress), May 2020.

[I-D.ietf-ccamp-otn-tunnel-model]
Zheng, H., Busi, I., Belotti, S., Lopez, V., and Y. Xu, "OTN Tunnel YANG Model", draft-ietf-ccamp-otn-tunnel-model-11 (work in progress), September 2020.

[ITU-Tg709] ITU-, T., "SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS; Digital networks; Interfaces for the optical transport network", ITU-T Rec. G.709 , March 2020.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <https://www.rfc-editor.org/info/rfc2119>.

[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>.

[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>.

[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>.

[RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <https://www.rfc-editor.org/info/rfc8174>.

[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>.

[RFC8345] Clemm, A., Medved, J., Varga, R., Bahadur, N., Ananthakrishnan, H., and X. Liu, "A YANG Data Model for Network Topologies", RFC 8345, DOI 10.17487/RFC8345, March 2018, <https://www.rfc-editor.org/info/rfc8345>.

[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>.

[RFC8795] Liu, X., Bryskin, I., Beeram, V., Saad, T., Shah, H., and O. Gonzalez de Dios, "YANG Data Model for Traffic Engineering (TE) Topologies", RFC 8795, DOI 10.17487/RFC8795, August 2020, <https://www.rfc-editor.org/info/rfc8795>.

9.2. Informative References

[I-D.ietf-ccamp-flexigrid-yang]
Madrid, U., Perdices, D., King, D., Lee, Y., and H. Zheng, "YANG data model for Flexi-Grid Optical Networks", draft-ietf-ccamp-flexigrid-yang-06 (work in progress), July 2020.

[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-11 (work in progress), July 2020.

[I-D.ietf-ccamp-wson-yang]
Zheng, H., Lee, Y., Guo, A., Lopez, V., and D. King, "A YANG Data Model for WSON (Wavelength Switched Optical Networks)", draft-ietf-ccamp-wson-yang-25 (work in progress), May 2020.

[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-06 (work in progress), August 2020.

[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>.

[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>.

[RFC8453] Ceccarelli, D., Ed. and Y. Lee, Ed., "Framework for Abstraction and Control of TE Networks (ACTN)", RFC 8453, DOI 10.17487/RFC8453, August 2018, <https://www.rfc-editor.org/info/rfc8453>.

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