TEAS Working Group   T. Saad
Internet-Draft   Juniper Networks
Intended status: Standards Track   R. Gandhi
Expires: January 28, 2021   Cisco Systems Inc
                                                           X. Liu
                                                   Volta Networks
                                                         V. Beeram
                                                 Juniper Networks
                                                       I. Bryskin
                                                       Individual
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       A YANG Data Model for Traffic Engineering Tunnels, Label Switched Paths
                            and Interfaces
                       draft-ietf-teas-yang-te-25

Abstract

   This document defines a YANG data model for the configuration and
   management of Traffic Engineering (TE) tunnels, Label Switched Paths
   (LSPs). and interfaces. The model is divided into YANG modules that
   classify data into generic, device-specific, technology agnostic, and
   technology-specific elements.

   This model covers data for configuration, operational state, remote
   procedural calls, and event notifications.

Status of This Memo

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1. Introduction

   YANG [RFC6020] and [RFC7950] is a data modeling language that was
   introduced to define the contents of a conceptual data store that
   allows networked devices to be managed using NETCONF [RFC6241]. YANG
   has proved relevant beyond its initial confines, as bindings to other
   interfaces (e.g. RESTCONF [RFC8040]) and encoding other than XML
   (e.g. JSON) are being defined. Furthermore, YANG data models can be
   used as the basis of implementation for other interfaces, such as CLI
   and programmatic APIs.

   This document describes YANG data model for Traffic Engineering (TE)
   tunnels, Label Switched Paths (LSPs), and interfaces. The model
   covers data applicable to generic or device-independent, device-
   specific, and Multiprotocol Label Switching (MPLS) technology
   specific.

   The document describes a high-level relationship between the modules
   defined in this document, as well as other external protocol YANG
   modules. The TE generic YANG data model does not include any data
   specific to a signaling protocol. It is expected other data plane
   technology model(s) will augment the TE generic YANG data model.

   Also, it is expected other YANG module(s) that model TE signaling
   protocols, such as RSVP-TE ([RFC3209], [RFC3473]), or Segment-Routing
   TE (SR-TE) will augment the generic TE YANG module.

2. Requirements Language

   The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
   "SHOULD", "SHOULD NOT", "RECOMMENDED", "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.

   The terminology for describing YANG data models is found in
   [RFC7950].

2.1. Prefixes in Data Node Names

   In this document, names of data nodes and other data model objects
   are prefixed using the standard prefix associated with the
   corresponding YANG imported modules, as shown in Table 1.

```
+-----------------+----------------------+---------------+
| Prefix          | YANG module          | Reference     |
+-----------------+----------------------+---------------+
| yang            | ietf-yang-types      | [RFC6991]     |
|                 |                      |               |
| inet            | ietf-inet-types      | [RFC6991]     |
|                 |                      |               |
| rt-types        | ietf-routing-types   | [RFC8294]     |
|                 |                      |               |
| te-types        | ietf-te-types        | [RFC8776]     |
|                 |                      |               |
| te-packet-types | ietf-te-packet-types | [RFC8776]     |
|                 |                      |               |
| te              | ietf-te              | this document |
|                 |                      |               |
| te-dev          | ietf-te-device       | this document |
+-----------------+----------------------+---------------+
```

Table 1: Prefixes and corresponding YANG modules

2.2. Model Tree Diagrams

The tree diagrams extracted from the module(s) defined in this
document are given in subsequent sections as per the syntax defined
in [RFC8340].

3. Design Considerations

This document describes a generic TE YANG data model that is
independent of any dataplane technology. One of the design
objectives is to allow specific data plane technology models to reuse
the TE generic data model and possibly augment it with technology
specific data.

The elements of the generic TE YANG data model, including TE tunnels,
LSPs, and interfaces have leaf(s) that identify the technology layer
where they reside. For example, the LSP encoding type can identify
the technology associated with a TE tunnel or LSP.

Also, the generic TE YANG data model does not cover signaling
protocol data. The signaling protocol used to instantiate TE LSPs
are outside the scope of this document and expected to be covered by
augmentations defined in other document(s).

The following other design considerations are taken into account with
respect data organization:

o The generic TE YANG data model 'ietf-te' contains device
   independent data and can be used to model data off a device (e.g.
   on a TE controller). The device-specific TE data is defined in
   module 'ietf-te-device' as shown in Figure 1,

o In general, minimal elements in the model are designated as
   "mandatory" to allow freedom to vendors to adapt the data model to
   their specific product implementation.

o Suitable defaults are specified for all configurable elements.

o The model declares a number of TE functions as features that can
   be optionally supported.

3.1. State Data Organization

The Network Management Datastore Architecture (NMDA) [RFC8342]
addresses modeling state data for ephemeral objects. This document
adopts the NMDA model for configuration and state data representation
as per IETF guidelines for new IETF YANG models.

4. Model Overview

The data models defined in this document cover the core TE features
that are commonly supported by different vendor implementations. The
support of extended or vendor specific TE feature(s) is expected to
be in either augmentations, or deviations to the model defined in
this document.

4.1. Module Relationship

The generic TE YANG data model that is defined in "ietf-te.yang"
covers the building blocks that are device independent and agnostic
of any specific technology or control plane instances. The TE device
model defined in "ietf-te-device.yang" augments the generic TE YANG
data model and covers data that is specific to a device - for
example, attributes of TE interfaces, or TE timers that are local to
a TE node.

The TE data model for specific instances of data plane technology
exist in a separate YANG module(s) that augment the generic TE YANG
data model. For example, the MPLS-TE module "ietf-te-mpls.yang" is
defined in another document and augments the TE generic model as
shown in Figure 1.

The TE data model for specific instances of signaling protocol are
outside the scope of this document and are defined in other

documents. For example, the RSVP-TE YANG model augmentation of the
TE model is covered in [I-D.ietf-teas-yang-rsvp].

```
   TE generic      +---------+          o: augment
   module          | ietf-te |o-------------+
                   +---------+              \
                        o                    \
                        |\                     \
                        | \                      \
                        |  +----------------+     \
                        |  | ietf-te-device | TE device module
                        |  +----------------+       \
                        |        o        o          \
                        |       /          \          \
                        |      /            \           \
                   +--------------+          +---------------+
   RSVP-TE module  | ietf-rsvp-te |o .       | ietf-te-mpls^ |
                   +--------------+   \      +---------------+
                        |              \
                        |               \
                        |                \
                        |                 \
                        |                  \
                        o                   +-------------------+
                   +-----------+            | ietf-rsvp-otn-te^ |
   RSVP module     | ietf-rsvp |            +-------------------+
                   +-----------+               RSVP-TE with OTN
                                                  extensions


                       ^ shown for illustration
                         (not in this document)
```

       Figure 1: Relationship of TE module(s) with other signaling protocol
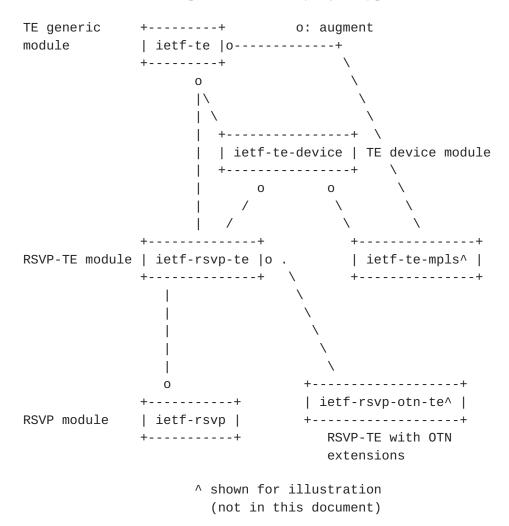   modules

5. TE YANG Model

The generic TE YANG module ('ietf-te') is meant to manage and operate
a TE network. This includes creating, modifying and retrieving TE
tunnels, LSPs, and interfaces and their associated attributes (e.g.
Administrative-Groups, SRLGs, etc.).

The detailed tree structure is provided in Figure 2..

5.1. Module Structure

The 'ietf-te' uses three main containers grouped under the main 'te' container (see Figure 2).

The 'te' container is the top level container in the data model. The presence of this container enables TE function system wide.

The 'globals' container maintains the set of global TE attributes that can be applicable to TE tunnel(s) and interface(s).

The 'tunnels' container includes the list of TE tunnels that are instantiated.

The 'lsps' container includes the list of TE LSP(s) that are instantiated.

```
module: ietf-te
   +--rw te!
      +--rw globals
         .
         .

      +--rw tunnels
         .
         .

      +-- lsps

rpcs:
   +---x tunnels-path-compute
   +---x tunnels-action
```

Figure 2: TE generic highlevel model view

5.1.1. TE Globals

The 'globals' container covers properties that control TE features behavior system-wide, and its respective state (see Figure 3). The TE globals configuration include:

o Table of named (extended) administrative groups mappings

o Table of named SRLG mappings

o Table of named path-constraints sets

o System-wide capabilities for LSP reoptimization

        * Reoptimization timers (periodic interval, LSP installation and
           cleanup)

        * Link state flooding thresholds

        * Periodic flooding interval

     o Global capabilities that affect originating, transiting and
        terminating LSPs. For example:

        * Path selection parameters (e.g. metric to optimize, etc.)

        * Path or segment protection parameters

           +--rw globals
           | +--rw named-admin-groups
           | | +--rw named-admin-group* [name]
           ..
           | +--rw named-srlgs
           | | +--rw named-srlg* [name] {te-types:named-srlg-groups}?
           ..
           | +--rw named-path-constraints
           | | +--rw named-path-constraint* [name]
           ..

                     Figure 3: TE globals tree structure

5.1.2. TE Tunnels

   The set of TE tunnels are provisioned under the 'tunnels' container
   (see Figure 4). A TE tunnel in the list is uniquely identified by a
   name. When the model is used to manage a specific device, the
   'tunnels' list contains the TE tunnels originating from the specific
   device. When the model is used to manage a TE controller, the
   'tunnels' list contains all TE tunnels originating from device(s)
   that the TE controller manages.

   The TE tunnel has a number of attributes that are set directly under
   the tunnel. The 'encoding' and 'switching-type' nodes define the
   specific technology that the tunnel operates in.

```
   +--rw tunnels
   |  +--rw tunnel* [name]
   |     +--ro operational-state?         identityref
   |     +--rw name                       string
   |     +--rw identifier?                uint32
   |     +--rw description?               string
   |     +--rw encoding?                  identityref
   |     +--rw switching-type?            identityref
   |     +--rw admin-state?               identityref
   |     +--rw reoptimize-timer?          uint16
   |     +--rw source?                    te-types:te-node-id
   |     +--rw destination?               te-types:te-node-id
   |     +--rw src-tunnel-tp-id?          binary
   |     +--rw dst-tunnel-tp-id?          binary
   |     +--rw bidirectional?             boolean
```

                   Figure 4: TE tunnel list structure

   The TE tunnel has the following main attributes:

   association-objects:

      A container that includes the set of associations of the TE tunnel
      with other TE tunnels.

   protection:

      A container that includes the TE tunnel protection properties.

   restoration:

      A container that includes the TE tunnel restoration properties.

   primary-paths:

      A container that includes the set of primary paths (see Figure 5).
      A primary path is identified by 'name'. A primary path is
      selected from the list to instantiate an LSP for the tunnel. The
      list of primary paths is visited by order of preference. A
      primary path has the following attributes:

      * primary-reverse-path: A container that includes properties of
         the primary reverse path. The reverse path is applicable to
         bidirectional TE tunnels.

    *   candidate-secondary-paths: A container that includes a list of
        candidate secondary paths which may be used for the primary
        path. The candidate secondary path(s) reference path(s)m from
        the secondary paths list. The preference of the secondary
        paths is specified within the list and dictates the order of
        visiting the secondary path from the list.

    *   compute-only: A primary path of TE tunnel is, by default,
        provisioned so that it can is instantiated in forwarding to
        carry traffic as soon as a valid path is compute. In some
        cases, a TE tunnel may be provisioned for the only purpose of
        computing a path and reporting it without the need to
        instantiate the LSP or commit any resources. In such a case,
        the primary-path is configured in 'compute-only' mode to
        distinguish it from default behavior. A 'compute-only' primary
        path is configured as a usual TE tunnel with associated per
        path constraint(s) and properties on a device or controller.
        The device or controller computes the feasible path(s) subject
        to configured constraints. A client may query the 'compute-
        only' computed path properties 'on-demand', or alternatively,
        can subscribe notified of computed path(s) and whenever the
        path properties change.

```
     +--rw primary-paths
     |  +--rw primary-path* [name]
     |     +--rw name                           string
     |     +--rw path-computation-method?       identityref
     |     +--rw path-computation-server
     |     |  +--rw id?      te-generic-node-id
     |     |  +--rw type?    enumeration
     |     +--rw compute-only?                  empty
     |     +--rw use-path-computation?          boolean
     |     +--rw lockdown?                      empty
     |     +--ro path-scope?                    identityref
     |     +--rw preference?                    uint8
     |     +--rw k-requested-paths?             uint8
```

                  Figure 5: TE tunnel primary paths.

   secondary-paths:

      A container that includes the set of secondary paths. The
      secondary paths are identified by 'name'. A secondary path can be
      reference by a TE tunnel's 'candidate-secondary-path'. A
      secondary path contains attributes similar to a primary path.

hierarchy:

   A container that includes hierarchy related properties of the
tunnel (see Figure 6. A TE LSP can be set up in MPLS or
Generalized MPLS (GMPLS) networks to be used as a TE links to
carry traffic in other (client) networks [RFC6107]. In this case,
the model introduces the TE tunnel hierarchical link endpoint
parameters to identify the specific link in the client layer that
the underlying TE tunnel is associated with. The hierarchy
container includes the following:

* dependency-tunnels: a hierarchical TE tunnel provisioned or to
  be provisioned in an immediately adjacent server layer a given
  client layer TE tunnel depends on for multi-layer path
  computation. A dependency TE tunnel is provisioned if and only
  if it is used (selected by path computation) at least by one
  client layer TE tunnel. The TE link in the client layer
  network topology supported by a dependent TE tunnel is
  dynamically created only when the dependency TE tunnel is
  actually provisioned.

* hierarchical-link: A container that includes the identity of a
  hierarchical link (in client layer) that this tunnel is
  associated with.

* te-topology-identifier: A container that includes the topology
  identifier associated with the tunnel.

```
    +--rw hierarchy
    |  +--rw dependency-tunnels
    |  |  +--rw dependency-tunnel* [name]
    |  |     +--rw name
    |  |     |         -> ../../../../../../tunnels/tunnel/name
    |  |     +--rw encoding?         identityref
    |  |     +--rw switching-type?   identityref
    |  +--rw hierarchical-link
    |     +--rw local-te-node-id?        te-types:te-node-id
    |     +--rw local-te-link-tp-id?     te-types:te-tp-id
    |     +--rw remote-te-node-id?       te-types:te-node-id
    |     +--rw te-topology-identifier
    |        +--rw provider-id?   te-global-id
    |        +--rw client-id?     te-global-id
    |        +--rw topology-id?   te-topology-id
```

                 Figure 6: TE tunnel primary paths.

5.1.3. TE LSPs

   The 'lsps' container includes the set of TE LSP(s) that are
   instantiated. A TE LSP is identified by a 3-tuple ('tunnel-name',
   'node', 'lsp-id'). When the model is used to manage a specific
   device, the 'lsps' list contains all TE LSP(s) that traverse the
   device (including ingressing, transiting and egressing the device).

5.2. Tree Diagram

   Figure 7 shows the tree diagram of the generic TE YANG model defined
   in modules 'ietf-te.yang'.

```
 module: ietf-te
   +--rw te!
      +--rw globals
      |  +--rw named-admin-groups
      |  |  +--rw named-admin-group* [name]
      |  |          {te-types:extended-admin-groups,
      |  |           te-types:named-extended-admin-groups}?
      |  |     +--rw name            string
      |  |     +--rw bit-position?   uint32
      |  +--rw named-srlgs
      |  |  +--rw named-srlg* [name] {te-types:named-srlg-groups}?
      |  |     +--rw name     string
      |  |     +--rw group?   te-types:srlg
      |  |     +--rw cost?    uint32
      |  +--rw named-path-constraints
      |     +--rw named-path-constraint* [name]
      |             {te-types:named-path-constraints}?
```

```
|             +--rw name                              string
|             +--rw te-bandwidth
|             |  +--rw (technology)?
|             |     +--:(generic)
|             |        +--rw generic?   te-bandwidth
|             +--rw link-protection?                  identityref
|             +--rw setup-priority?                   uint8
|             +--rw hold-priority?                    uint8
|             +--rw signaling-type?                   identityref
|             +--rw path-metric-bounds
|             |  +--rw path-metric-bound* [metric-type]
|             |     +--rw metric-type    identityref
|             |     +--rw upper-bound?   uint64
|             +--rw path-affinities-values
|             |  +--rw path-affinities-value* [usage]
|             |     +--rw usage    identityref
|             |     +--rw value?   admin-groups
|             +--rw path-affinity-names
|             |  +--rw path-affinity-name* [usage]
|             |     +--rw usage            identityref
|             |     +--rw affinity-name* [name]
|             |        +--rw name    string
|             +--rw path-srlgs-lists
|             |  +--rw path-srlgs-list* [usage]
|             |     +--rw usage    identityref
|             |     +--rw values*    srlg
|             +--rw path-srlgs-names
|             |  +--rw path-srlgs-name* [usage]
|             |     +--rw usage    identityref
|             |     +--rw names*    string
|             +--rw disjointness?
|             |        te-path-disjointness
|             +--rw explicit-route-objects-always
|             |  +--rw route-object-exclude-always* [index]
|             |  |  +--rw index                      uint32
|             |  |  +--rw (type)?
|             |  |     +--:(numbered-node-hop)
|             |  |     |  +--rw numbered-node-hop
|             |  |     |     +--rw node-id     te-node-id
|             |  |     |     +--rw hop-type?   te-hop-type
|             |  |     +--:(numbered-link-hop)
|             |  |     |  +--rw numbered-link-hop
|             |  |     |     +--rw link-tp-id    te-tp-id
|             |  |     |     +--rw hop-type?     te-hop-type
|             |  |     |     +--rw direction?   te-link-direction
|             |  |     +--:(unnumbered-link-hop)
|             |  |     |  +--rw unnumbered-link-hop
|             |  |     |     +--rw link-tp-id     te-tp-id
```

```
    |        |  |      |    +--rw node-id       te-node-id
    |        |  |      |    +--rw hop-type?     te-hop-type
    |        |  |      |    +--rw direction?   te-link-direction
    |        |  |    +--:(as-number)
    |        |  |    |  +--rw as-number-hop
    |        |  |    |     +--rw as-number     inet:as-number
    |        |  |    |     +--rw hop-type?    te-hop-type
    |        |  |    +--:(label)
    |        |  |       +--rw label-hop
    |        |  |          +--rw te-label
    |        |  |             +--rw (technology)?
    |        |  |             |  +--:(generic)
    |        |  |             |     +--rw generic?
    |        |  |             |rt-types:generalized-label
    |        |  |             +--rw direction?
    |        |  |                    te-label-direction
    |        |  +--rw route-object-include-exclude* [index]
    |        |     +--rw explicit-route-usage?       identityref
    |        |     +--rw index                       uint32
    |        |     +--rw (type)?
    |        |        +--:(numbered-node-hop)
    |        |        |  +--rw numbered-node-hop
    |        |        |     +--rw node-id       te-node-id
    |        |        |     +--rw hop-type?    te-hop-type
    |        |        +--:(numbered-link-hop)
    |        |        |  +--rw numbered-link-hop
    |        |        |     +--rw link-tp-id     te-tp-id
    |        |        |     +--rw hop-type?      te-hop-type
    |        |        |     +--rw direction?    te-link-direction
    |        |        +--:(unnumbered-link-hop)
    |        |        |  +--rw unnumbered-link-hop
    |        |        |     +--rw link-tp-id     te-tp-id
    |        |        |     +--rw node-id        te-node-id
    |        |        |     +--rw hop-type?      te-hop-type
    |        |        |     +--rw direction?    te-link-direction
    |        |        +--:(as-number)
    |        |        |  +--rw as-number-hop
    |        |        |     +--rw as-number     inet:as-number
    |        |        |     +--rw hop-type?    te-hop-type
    |        |        +--:(label)
    |        |        |  +--rw label-hop
    |        |        |     +--rw te-label
    |        |        |        +--rw (technology)?
    |        |        |        |  +--:(generic)
    |        |        |        |     +--rw generic?
    |        |        |     |rt-types:generalized-label
    |        |        |        +--rw direction?
    |        |        |           te-label-direction
```

```
|           |             +--:(srlg)
|           |                +--rw srlg
|           |                   +--rw srlg?   uint32
|           +--rw path-in-segment!
|           |  +--rw label-restrictions
|           |     +--rw label-restriction* [index]
|           |        +--rw restriction?    enumeration
|           |        +--rw index           uint32
|           |        +--rw label-start
|           |        |  +--rw te-label
|           |        |     +--rw (technology)?
|           |        |     |  +--:(generic)
|           |        |     |     +--rw generic?
|           |        |     |rt-types:generalized-label
|           |        |     +--rw direction?
|           |        |           te-label-direction
|           |        +--rw label-end
|           |        |  +--rw te-label
|           |        |     +--rw (technology)?
|           |        |     |  +--:(generic)
|           |        |     |     +--rw generic?
|           |        |     |rt-types:generalized-label
|           |        |     +--rw direction?
|           |        |           te-label-direction
|           |        +--rw label-step
|           |        |  +--rw (technology)?
|           |        |     +--:(generic)
|           |        |        +--rw generic?   int32
|           |        +--rw range-bitmap?   yang:hex-string
|           +--rw path-out-segment!
|              +--rw label-restrictions
|                 +--rw label-restriction* [index]
|                    +--rw restriction?    enumeration
|                    +--rw index           uint32
|                    +--rw label-start
|                    |  +--rw te-label
|                    |     +--rw (technology)?
|                    |     |  +--:(generic)
|                    |     |     +--rw generic?
|                    |     |rt-types:generalized-label
|                    |     +--rw direction?
|                    |           te-label-direction
|                    +--rw label-end
|                    |  +--rw te-label
|                    |     +--rw (technology)?
|                    |     |  +--:(generic)
|                    |     |     +--rw generic?
|                    |     |rt-types:generalized-label
```

```
         |                  |       +--rw direction?
         |                  |             te-label-direction
         |                  +--rw label-step
         |                  |  +--rw (technology)?
         |                  |       +--:(generic)
         |                  |          +--rw generic?   int32
         |                  +--rw range-bitmap?   yang:hex-string
         +--rw tunnels
         |  +--rw tunnel* [name]
         |     +--ro operational-state?            identityref
         |     +--rw name                          string
         |     +--rw identifier?                   uint32
         |     +--rw description?                  string
         |     +--rw encoding?                     identityref
         |     +--rw switching-type?               identityref
         |     +--rw admin-state?                  identityref
         |     +--rw reoptimize-timer?             uint16
         |     +--rw source?                       te-types:te-node-id
         |     +--rw destination?                  te-types:te-node-id
         |     +--rw src-tunnel-tp-id?             binary
         |     +--rw dst-tunnel-tp-id?             binary
         |     +--rw bidirectional?                boolean
         |     +--rw association-objects
         |     |  +--rw association-object* [association-key]
         |     |  |  +--rw association-key    string
         |     |  |  +--rw type?              identityref
         |     |  |  +--rw id?                uint16
         |     |  |  +--rw source
         |     |  |     +--rw id?      te-generic-node-id
         |     |  |     +--rw type?    enumeration
         |     |  +--rw association-object-extended* [association-key]
         |     |     +--rw association-key    string
         |     |     +--rw type?              identityref
         |     |     +--rw id?                uint16
         |     |     +--rw source
         |     |     |  +--rw id?      te-generic-node-id
         |     |     |  +--rw type?    enumeration
         |     |     +--rw global-source?     uint32
         |     |     +--rw extended-id?       yang:hex-string
         |     +--rw protection
         |     |  +--rw enable?                       boolean
         |     |  +--rw protection-type?              identityref
         |     |  +--rw protection-reversion-disable?   boolean
         |     |  +--rw hold-off-time?                uint32
         |     |  +--rw wait-to-revert?               uint16
         |     |  +--rw aps-signal-id?                uint8
         |     +--rw restoration
         |     |  +--rw enable?                        boolean
```

```
|       |  +--rw restoration-type?             identityref
|       |  +--rw restoration-scheme?           identityref
|       |  +--rw restoration-reversion-disable?   boolean
|       |  +--rw hold-off-time?                uint32
|       |  +--rw wait-to-restore?              uint16
|       |  +--rw wait-to-revert?               uint16
|     +--rw te-topology-identifier
|     |  +--rw provider-id?   te-global-id
|     |  +--rw client-id?     te-global-id
|     |  +--rw topology-id?   te-topology-id
|     +--rw te-bandwidth
|     |  +--rw (technology)?
|     |     +--:(generic)
|     |        +--rw generic?   te-bandwidth
|     +--rw link-protection?                identityref
|     +--rw setup-priority?                 uint8
|     +--rw hold-priority?                  uint8
|     +--rw signaling-type?                 identityref
|     +--rw hierarchy
|     |  +--rw dependency-tunnels
|     |  |  +--rw dependency-tunnel* [name]
|     |  |     +--rw name
|     |  |     |        -> ../../../../../../tunnels/tunnel/name
|     |  |     +--rw encoding?         identityref
|     |  |     +--rw switching-type?   identityref
|     |  +--rw hierarchical-link
|     |     +--rw local-te-node-id?        te-types:te-node-id
|     |     +--rw local-te-link-tp-id?     te-types:te-tp-id
|     |     +--rw remote-te-node-id?       te-types:te-node-id
|     |     +--rw te-topology-identifier
|     |        +--rw provider-id?   te-global-id
|     |        +--rw client-id?     te-global-id
|     |        +--rw topology-id?   te-topology-id
|     +--rw primary-paths
|     |  +--rw primary-path* [name]
|     |     +--rw name                         string
|     |     +--rw path-computation-method?     identityref
|     |     +--rw path-computation-server
|     |     |  +--rw id?      te-generic-node-id
|     |     |  +--rw type?    enumeration
|     |     +--rw compute-only?                empty
|     |     +--rw use-path-computation?        boolean
|     |     +--rw lockdown?                    empty
|     |     +--ro path-scope?                  identityref
|     |     +--rw preference?                  uint8
|     |     +--rw k-requested-paths?           uint8
|     |     +--rw association-objects
|     |     |  +--rw association-object* [association-key]
```

```
|       |       |   |  +--rw association-key    string
|       |       |   |  +--rw type?              identityref
|       |       |   |  +--rw id?                uint16
|       |       |   |  +--rw source
|       |       |   |     +--rw id?    te-generic-node-id
|       |       |   |     +--rw type?  enumeration
|       |       |   +--rw association-object-extended*
|       |       |           [association-key]
|       |       |      +--rw association-key    string
|       |       |      +--rw type?              identityref
|       |       |      +--rw id?                uint16
|       |       |      +--rw source
|       |       |      |  +--rw id?    te-generic-node-id
|       |       |      |  +--rw type?  enumeration
|       |       |      +--rw global-source?     uint32
|       |       |      +--rw extended-id?       yang:hex-string
|       |       +--rw optimizations
|       |       |  +--rw (algorithm)?
|       |       |     +--:(metric) {path-optimization-metric}?
|       |       |     |  +--rw optimization-metric* [metric-type]
|       |       |     |  |  +--rw metric-type
|       |       |     |  |  |       identityref
|       |       |     |  |  +--rw weight?
|       |       |     |  |  |       uint8
|       |       |     |  |  +--rw explicit-route-exclude-objects
|       |       |     |  |  |  +--rw route-object-exclude-object*
|       |       |     |  |  |          [index]
|       |       |     |  |  |     +--rw index
|       |       |     |  |  |     |       uint32
|       |       |     |  |  |     +--rw (type)?
|       |       |     |  |  |        +--:(numbered-node-hop)
|       |       |     |  |  |        |  +--rw numbered-node-hop
|       |       |     |  |  |        |     +--rw node-id
|       |       |     |  |  |        |     |       te-node-id
|       |       |     |  |  |        |     +--rw hop-type?
|       |       |     |  |  |        |             te-hop-type
|       |       |     |  |  |        +--:(numbered-link-hop)
|       |       |     |  |  |        |  +--rw numbered-link-hop
|       |       |     |  |  |        |     +--rw link-tp-id
|       |       |     |  |  |        |     |       te-tp-id
|       |       |     |  |  |        |     +--rw hop-type?
|       |       |     |  |  |        |     |       te-hop-type
|       |       |     |  |  |        |     +--rw direction?
|       |       |     |  |  |        |             te-link-direction
|       |       |     |  |  |        +--:(unnumbered-link-hop)
|       |       |     |  |  |        |  +--rw unnumbered-link-hop
|       |       |     |  |  |        |     +--rw link-tp-id
|       |       |     |  |  |        |     |       te-tp-id
```

```
|    |    |    |    | | |           |       +--rw node-id
|    |    |    |    | | |           |       |      te-node-id
|    |    |    |    | | |           |       +--rw hop-type?
|    |    |    |    | | |           |       |      te-hop-type
|    |    |    |    | | |           |       +--rw direction?
|    |    |    |    | | |           |              te-link-direction
|    |    |    |    | | |           +--:(as-number)
|    |    |    |    | | |           |  +--rw as-number-hop
|    |    |    |    | | |           |     +--rw as-number
|    |    |    |    | | |           |     |      inet:as-number
|    |    |    |    | | |           |     +--rw hop-type?
|    |    |    |    | | |           |            te-hop-type
|    |    |    |    | | |           +--:(label)
|    |    |    |    | | |           |  +--rw label-hop
|    |    |    |    | | |           |     +--rw te-label
|    |    |    |    | | |           |        +--rw (technology)?
|    |    |    |    | | |           |        |  +--:(generic)
|    |    |    |    | | |           |        |     +--rw generic?
|    |    |    |    | | |           |       |rt-types:generalized-label
|    |    |    |    | | |           |        +--rw direction?
|    |    |    |    | | |           |               te-label-direction
|    |    |    |    | | |           +--:(srlg)
|    |    |    |    | | |              +--rw srlg
|    |    |    |    | | |                 +--rw srlg?   uint32
|    |    |    |    | |  +--rw explicit-route-include-objects
|    |    |    |    | |     +--rw route-object-include-object*
|    |    |    |    | |            [index]
|    |    |    |    | |        +--rw index
|    |    |    |    | |        |      uint32
|    |    |    |    | |        +--rw (type)?
|    |    |    |    | |           +--:(numbered-node-hop)
|    |    |    |    | |           |  +--rw numbered-node-hop
|    |    |    |    | |           |     +--rw node-id
|    |    |    |    | |           |     |      te-node-id
|    |    |    |    | |           |     +--rw hop-type?
|    |    |    |    | |           |            te-hop-type
|    |    |    |    | |           +--:(numbered-link-hop)
|    |    |    |    | |           |  +--rw numbered-link-hop
|    |    |    |    | |           |     +--rw link-tp-id
|    |    |    |    | |           |     |      te-tp-id
|    |    |    |    | |           |     +--rw hop-type?
|    |    |    |    | |           |     |      te-hop-type
|    |    |    |    | |           |     +--rw direction?
|    |    |    |    | |           |             te-link-direction
|    |    |    |    | |           +--:(unnumbered-link-hop)
|    |    |    |    | |           |  +--rw unnumbered-link-hop
|    |    |    |    | |           |     +--rw link-tp-id
|    |    |    |    | |           |     |      te-tp-id
```

```
|     |     |     |     |  |                 |     +--rw node-id
|     |     |     |     |  |                 |     |      te-node-id
|     |     |     |     |  |                 |     +--rw hop-type?
|     |     |     |     |  |                 |     |      te-hop-type
|     |     |     |     |  |                 |     +--rw direction?
|     |     |     |     |  |                 |            te-link-direction
|     |     |     |     |  |           +--:(as-number)
|     |     |     |     |  |           |  +--rw as-number-hop
|     |     |     |     |  |           |     +--rw as-number
|     |     |     |     |  |           |     |      inet:as-number
|     |     |     |     |  |           |     +--rw hop-type?
|     |     |     |     |  |           |            te-hop-type
|     |     |     |     |  |           +--:(label)
|     |     |     |     |  |              +--rw label-hop
|     |     |     |     |  |                 +--rw te-label
|     |     |     |     |  |                    +--rw (technology)?
|     |     |     |     |  |                    |  +--:(generic)
|     |     |     |     |  |                    |     +--rw generic?
|     |     |     |     |  |                    |rt-types:generalized-label
|     |     |     |     |  |                    +--rw direction?
|     |     |     |     |  |                           te-label-direction
|     |     |     |     |  +--rw tiebreakers
|     |     |     |     |     +--rw tiebreaker* [tiebreaker-type]
|     |     |     |     |        +--rw tiebreaker-type    identityref
|     |     |     |  +--:(objective-function)
|     |     |     |            {path-optimization-objective-function}?
|     |     |     |     +--rw objective-function
|     |     |     |        +--rw objective-function-type?
|     |     |     |               identityref
|     |     +--rw named-path-constraint?            leafref
|     |     |         {te-types:named-path-constraints}?
|     |     +--rw te-bandwidth
|     |     |  +--rw (technology)?
|     |     |     +--:(generic)
|     |     |        +--rw generic?   te-bandwidth
|     |     +--rw link-protection?                  identityref
|     |     +--rw setup-priority?                   uint8
|     |     +--rw hold-priority?                    uint8
|     |     +--rw signaling-type?                   identityref
|     |     +--rw path-metric-bounds
|     |     |  +--rw path-metric-bound* [metric-type]
|     |     |     +--rw metric-type    identityref
|     |     |     +--rw upper-bound?   uint64
|     |     +--rw path-affinities-values
|     |     |  +--rw path-affinities-value* [usage]
|     |     |     +--rw usage    identityref
|     |     |     +--rw value?   admin-groups
|     |     +--rw path-affinity-names
```

```
|      |      |  +--rw path-affinity-name* [usage]
|      |      |     +--rw usage              identityref
|      |      |     +--rw affinity-name* [name]
|      |      |        +--rw name    string
|      |      +--rw path-srlgs-lists
|      |      |  +--rw path-srlgs-list* [usage]
|      |      |     +--rw usage    identityref
|      |      |     +--rw values*   srlg
|      |      +--rw path-srlgs-names
|      |      |  +--rw path-srlgs-name* [usage]
|      |      |     +--rw usage    identityref
|      |      |     +--rw names*    string
|      |      +--rw disjointness?
|      |      |       te-path-disjointness
|      |      +--rw explicit-route-objects-always
|      |      |  +--rw route-object-exclude-always* [index]
|      |      |  |  +--rw index                      uint32
|      |      |  |  +--rw (type)?
|      |      |  |     +--:(numbered-node-hop)
|      |      |  |     |  +--rw numbered-node-hop
|      |      |  |     |     +--rw node-id    te-node-id
|      |      |  |     |     +--rw hop-type?  te-hop-type
|      |      |  |     +--:(numbered-link-hop)
|      |      |  |     |  +--rw numbered-link-hop
|      |      |  |     |     +--rw link-tp-id    te-tp-id
|      |      |  |     |     +--rw hop-type?     te-hop-type
|      |      |  |     |     +--rw direction?   te-link-direction
|      |      |  |     +--:(unnumbered-link-hop)
|      |      |  |     |  +--rw unnumbered-link-hop
|      |      |  |     |     +--rw link-tp-id    te-tp-id
|      |      |  |     |     +--rw node-id       te-node-id
|      |      |  |     |     +--rw hop-type?     te-hop-type
|      |      |  |     |     +--rw direction?   te-link-direction
|      |      |  |     +--:(as-number)
|      |      |  |     |  +--rw as-number-hop
|      |      |  |     |     +--rw as-number     inet:as-number
|      |      |  |     |     +--rw hop-type?     te-hop-type
|      |      |  |     +--:(label)
|      |      |  |        +--rw label-hop
|      |      |  |           +--rw te-label
|      |      |  |              +--rw (technology)?
|      |      |  |              |  +--:(generic)
|      |      |  |              |     +--rw generic?
|      |      |  |              |rt-types:generalized-label
|      |      |  |              +--rw direction?
|      |      |  |                    te-label-direction
|      |      |  +--rw route-object-include-exclude* [index]
|      |      |     +--rw explicit-route-usage?        identityref
```

```
|     |     |           +--rw index                          uint32
|     |     |           +--rw (type)?
|     |     |              +--:(numbered-node-hop)
|     |     |              |  +--rw numbered-node-hop
|     |     |              |     +--rw node-id      te-node-id
|     |     |              |     +--rw hop-type?   te-hop-type
|     |     |              +--:(numbered-link-hop)
|     |     |              |  +--rw numbered-link-hop
|     |     |              |     +--rw link-tp-id    te-tp-id
|     |     |              |     +--rw hop-type?     te-hop-type
|     |     |              |     +--rw direction?   te-link-direction
|     |     |              +--:(unnumbered-link-hop)
|     |     |              |  +--rw unnumbered-link-hop
|     |     |              |     +--rw link-tp-id    te-tp-id
|     |     |              |     +--rw node-id       te-node-id
|     |     |              |     +--rw hop-type?     te-hop-type
|     |     |              |     +--rw direction?   te-link-direction
|     |     |              +--:(as-number)
|     |     |              |  +--rw as-number-hop
|     |     |              |     +--rw as-number     inet:as-number
|     |     |              |     +--rw hop-type?    te-hop-type
|     |     |              +--:(label)
|     |     |              |  +--rw label-hop
|     |     |              |     +--rw te-label
|     |     |              |        +--rw (technology)?
|     |     |              |        |  +--:(generic)
|     |     |              |        |     +--rw generic?
|     |     |              |     |rt-types:generalized-label
|     |     |              |        +--rw direction?
|     |     |              |              te-label-direction
|     |     |              +--:(srlg)
|     |     |                 +--rw srlg
|     |     |                    +--rw srlg?   uint32
|     |          +--rw path-in-segment!
|     |          |  +--rw label-restrictions
|     |          |     +--rw label-restriction* [index]
|     |          |        +--rw restriction?    enumeration
|     |          |        +--rw index           uint32
|     |          |        +--rw label-start
|     |          |        |  +--rw te-label
|     |          |        |     +--rw (technology)?
|     |          |        |     |  +--:(generic)
|     |          |        |     |     +--rw generic?
|     |          |        |     |rt-types:generalized-label
|     |          |        |     +--rw direction?
|     |          |        |           te-label-direction
|     |          |        +--rw label-end
|     |          |        |  +--rw te-label
```

```
|    |    |          |       +--rw (technology)?
|    |    |          |       |  +--:(generic)
|    |    |          |       |     +--rw generic?
|    |    |          |       |rt-types:generalized-label
|    |    |          |       +--rw direction?
|    |    |          |             te-label-direction
|    |    |       +--rw label-step
|    |    |       |  +--rw (technology)?
|    |    |       |     +--:(generic)
|    |    |       |        +--rw generic?    int32
|    |    |       +--rw range-bitmap?   yang:hex-string
|    |    +--rw path-out-segment!
|    |    |  +--rw label-restrictions
|    |    |     +--rw label-restriction* [index]
|    |    |        +--rw restriction?    enumeration
|    |    |        +--rw index           uint32
|    |    |        +--rw label-start
|    |    |        |  +--rw te-label
|    |    |        |     +--rw (technology)?
|    |    |        |     |  +--:(generic)
|    |    |        |     |     +--rw generic?
|    |    |        |     |rt-types:generalized-label
|    |    |        |     +--rw direction?
|    |    |        |           te-label-direction
|    |    |        +--rw label-end
|    |    |        |  +--rw te-label
|    |    |        |     +--rw (technology)?
|    |    |        |     |  +--:(generic)
|    |    |        |     |     +--rw generic?
|    |    |        |     |rt-types:generalized-label
|    |    |        |     +--rw direction?
|    |    |        |           te-label-direction
|    |    |        +--rw label-step
|    |    |        |  +--rw (technology)?
|    |    |        |     +--:(generic)
|    |    |        |        +--rw generic?    int32
|    |    |        +--rw range-bitmap?   yang:hex-string
|    |    +--ro computed-paths-properties
|    |    |  +--ro computed-path-properties* [k-index]
|    |    |     +--ro k-index           uint8
|    |    |     +--ro path-properties
|    |    |        +--ro path-metric* [metric-type]
|    |    |        |  +--ro metric-type          identityref
|    |    |        |  +--ro accumulative-value?   uint64
|    |    |        +--ro path-affinities-values
|    |    |        |  +--ro path-affinities-value* [usage]
|    |    |        |     +--ro usage     identityref
|    |    |        |     +--ro value?    admin-groups
```

```
|     |     |                  +--ro path-affinity-names
|     |     |                  |  +--ro path-affinity-name* [usage]
|     |     |                  |     +--ro usage            identityref
|     |     |                  |     +--ro affinity-name* [name]
|     |     |                  |        +--ro name    string
|     |     |                  +--ro path-srlgs-lists
|     |     |                  |  +--ro path-srlgs-list* [usage]
|     |     |                  |     +--ro usage     identityref
|     |     |                  |     +--ro values*   srlg
|     |     |                  +--ro path-srlgs-names
|     |     |                  |  +--ro path-srlgs-name* [usage]
|     |     |                  |     +--ro usage     identityref
|     |     |                  |     +--ro names*    string
|     |     |                  +--ro path-route-objects
|     |     |                  |  +--ro path-route-object* [index]
|     |     |                  |     +--ro index
|     |     |                  |     |       uint32
|     |     |                  |     +--ro (type)?
|     |     |                  |        +--:(numbered-node-hop)
|     |     |                  |        |  +--ro numbered-node-hop
|     |     |                  |        |     +--ro node-id    te-node-id
|     |     |                  |        |     +--ro hop-type?
|     |     |                  |        |             te-hop-type
|     |     |                  |        +--:(numbered-link-hop)
|     |     |                  |        |  +--ro numbered-link-hop
|     |     |                  |        |     +--ro link-tp-id    te-tp-id
|     |     |                  |        |     +--ro hop-type?
|     |     |                  |        |     |       te-hop-type
|     |     |                  |        |     +--ro direction?
|     |     |                  |        |             te-link-direction
|     |     |                  |        +--:(unnumbered-link-hop)
|     |     |                  |        |  +--ro unnumbered-link-hop
|     |     |                  |        |     +--ro link-tp-id    te-tp-id
|     |     |                  |        |     +--ro node-id
|     |     |                  |        |     |       te-node-id
|     |     |                  |        |     +--ro hop-type?
|     |     |                  |        |     |       te-hop-type
|     |     |                  |        |     +--ro direction?
|     |     |                  |        |             te-link-direction
|     |     |                  |        +--:(as-number)
|     |     |                  |        |  +--ro as-number-hop
|     |     |                  |        |     +--ro as-number
|     |     |                  |        |     |       inet:as-number
|     |     |                  |        |     +--ro hop-type?
|     |     |                  |        |             te-hop-type
|     |     |                  |        +--:(label)
|     |     |                  |           +--ro label-hop
|     |     |                  |              +--ro te-label
```

```
|     |     |           |                       +--ro (technology)?
|     |     |           |                       |  +--:(generic)
|     |     |           |                       |     +--ro generic?
|     |     |           |                       |rt-types:generalized-label
|     |     |           |                       +--ro direction?
|     |     |           |                             te-label-direction
|     |     |           +--ro te-bandwidth
|     |     |           |  +--ro (technology)?
|     |     |           |     +--:(generic)
|     |     |           |         +--ro generic?   te-bandwidth
|     |     |           +--ro disjointness-type?
|     |     |                    te-types:te-path-disjointness
|     |     +--ro computed-path-error-infos
|     |     |  +--ro computed-path-error-info* []
|     |     |     +--ro error-description?   string
|     |     |     +--ro error-timestamp?     yang:date-and-time
|     |     |     +--ro error-reason?        identityref
|     |     +--ro lsp-provisioning-error-infos
|     |     |  +--ro lsp-provisioning-error-info* []
|     |     |     +--ro error-description?   string
|     |     |     +--ro error-timestamp?     yang:date-and-time
|     |     |     +--ro error-node-id?       te-types:te-node-id
|     |     |     +--ro error-link-id?       te-types:te-tp-id
|     |     |     +--ro lsp-id?              uint16
|     |     +--ro lsps
|     |     |  +--ro lsp* [node lsp-id]
|     |     |     +--ro tunnel-name?
|     |     |     |        -> /te/lsps/lsp/tunnel-name
|     |     |     +--ro node
|     |     |     |        -> /te/lsps/lsp/node
|     |     |     +--ro lsp-id
|     |     |     |        -> /te/lsps/lsp/lsp-id
|     |     |     +--ro lsp-provisioning-error-infos
|     |     |     |  +--ro lsp-provisioning-error-info* []
|     |     |     |     +--ro error-description?   string
|     |     |     |     +--ro error-timestamp?
|     |     |     |     |        yang:date-and-time
|     |     |     |     +--ro error-node-id?
|     |     |     |     |        te-types:te-node-id
|     |     |     |     +--ro error-link-id?
|     |     |     |     |        te-types:te-tp-id
|     |     |     +--ro path-properties
|     |     |        +--ro path-metric* [metric-type]
|     |     |        |  +--ro metric-type         identityref
|     |     |        |  +--ro accumulative-value?   uint64
|     |     |        +--ro path-affinities-values
|     |     |        |  +--ro path-affinities-value* [usage]
|     |     |        |     +--ro usage    identityref
```

```
|     |     |                 |        +--ro value?   admin-groups
|     |     |            +--ro path-affinity-names
|     |     |            |  +--ro path-affinity-name* [usage]
|     |     |            |     +--ro usage              identityref
|     |     |            |     +--ro affinity-name* [name]
|     |     |            |        +--ro name    string
|     |     |            +--ro path-srlgs-lists
|     |     |            |  +--ro path-srlgs-list* [usage]
|     |     |            |     +--ro usage     identityref
|     |     |            |     +--ro values*   srlg
|     |     |            +--ro path-srlgs-names
|     |     |            |  +--ro path-srlgs-name* [usage]
|     |     |            |     +--ro usage    identityref
|     |     |            |     +--ro names*   string
|     |     |            +--ro path-route-objects
|     |     |            |  +--ro path-route-object* [index]
|     |     |            |     +--ro index
|     |     |            |     |       uint32
|     |     |            |     +--ro (type)?
|     |     |            |        +--:(numbered-node-hop)
|     |     |            |        |  +--ro numbered-node-hop
|     |     |            |        |     +--ro node-id      te-node-id
|     |     |            |        |     +--ro hop-type?
|     |     |            |        |             te-hop-type
|     |     |            |        +--:(numbered-link-hop)
|     |     |            |        |  +--ro numbered-link-hop
|     |     |            |        |     +--ro link-tp-id    te-tp-id
|     |     |            |        |     +--ro hop-type?
|     |     |            |        |     |       te-hop-type
|     |     |            |        |     +--ro direction?
|     |     |            |        |             te-link-direction
|     |     |            |        +--:(unnumbered-link-hop)
|     |     |            |        |  +--ro unnumbered-link-hop
|     |     |            |        |     +--ro link-tp-id    te-tp-id
|     |     |            |        |     +--ro node-id
|     |     |            |        |     |       te-node-id
|     |     |            |        |     +--ro hop-type?
|     |     |            |        |     |       te-hop-type
|     |     |            |        |     +--ro direction?
|     |     |            |        |             te-link-direction
|     |     |            |        +--:(as-number)
|     |     |            |        |  +--ro as-number-hop
|     |     |            |        |     +--ro as-number
|     |     |            |        |     |       inet:as-number
|     |     |            |        |     +--ro hop-type?
|     |     |            |        |             te-hop-type
|     |     |            |        +--:(label)
|     |     |            |           +--ro label-hop
```

```
|    |    |         |                       +--ro te-label
|    |    |         |                          +--ro (technology)?
|    |    |         |                          |  +--:(generic)
|    |    |         |                          |     +--ro generic?
|    |    |         |                          |rt-types:generalized-label
|    |    |         |                          +--ro direction?
|    |    |         |                                   te-label-direction
|    |    |              +--ro te-bandwidth
|    |    |              |  +--ro (technology)?
|    |    |              |     +--:(generic)
|    |    |              |        +--ro generic?   te-bandwidth
|    |    |              +--ro disjointness-type?
|    |    |                      te-types:te-path-disjointness
|    |    +--rw primary-reverse-path
|    |    |  +--rw name?                                  string
|    |    |  +--rw path-computation-method?
|    |    |  |       identityref
|    |    |  +--rw path-computation-server
|    |    |  |  +--rw id?      te-generic-node-id
|    |    |  |  +--rw type?   enumeration
|    |    |  +--rw compute-only?                          empty
|    |    |  +--rw use-path-computation?
|    |    |  |       boolean
|    |    |  +--rw lockdown?                              empty
|    |    |  +--ro path-scope?
|    |    |  |       identityref
|    |    |  +--rw association-objects
|    |    |  |  +--rw association-object* [association-key]
|    |    |  |  |  +--rw association-key    string
|    |    |  |  |  +--rw type?              identityref
|    |    |  |  |  +--rw id?                uint16
|    |    |  |  |  +--rw source
|    |    |  |  |     +--rw id?      te-generic-node-id
|    |    |  |  |     +--rw type?   enumeration
|    |    |  |  +--rw association-object-extended*
|    |    |  |  |        [association-key]
|    |    |  |  |     +--rw association-key    string
|    |    |  |  |     +--rw type?              identityref
|    |    |  |  |     +--rw id?                uint16
|    |    |  |  |     +--rw source
|    |    |  |  |     |  +--rw id?      te-generic-node-id
|    |    |  |  |     |  +--rw type?   enumeration
|    |    |  |  |     +--rw global-source?     uint32
|    |    |  |  |     +--rw extended-id?       yang:hex-string
|    |    |  +--rw optimizations
|    |    |  |  +--rw (algorithm)?
|    |    |  |     +--:(metric) {path-optimization-metric}?
|    |    |  |     |  +--rw optimization-metric* [metric-type]
```

```
|    |    |  |       |  | +--rw metric-type
|    |    |  |       |  | |      identityref
|    |    |  |       |  | +--rw weight?
|    |    |  |       |  | |      uint8
|    |    |  |       |  | +--rw explicit-route-exclude-objects
|    |    |  |       |  |   +--rw route-object-exclude-object*
|    |    |  |       |  |   |      [index]
|    |    |  |       |  |   +--rw index
|    |    |  |       |  |   |      uint32
|    |    |  |       |  |   +--rw (type)?
|    |    |  |       |  |      +--:(numbered-node-hop)
|    |    |  |       |  |      |  +--rw numbered-node-hop
|    |    |  |       |  |      |     +--rw node-id
|    |    |  |       |  |      |     |      te-node-id
|    |    |  |       |  |      |     +--rw hop-type?
|    |    |  |       |  |      |            te-hop-type
|    |    |  |       |  |      +--:(numbered-link-hop)
|    |    |  |       |  |      |  +--rw numbered-link-hop
|    |    |  |       |  |      |     +--rw link-tp-id
|    |    |  |       |  |      |     |      te-tp-id
|    |    |  |       |  |      |     +--rw hop-type?
|    |    |  |       |  |      |     |      te-hop-type
|    |    |  |       |  |      |     +--rw direction?
|    |    |  |       |  |      |            te-link-direction
|    |    |  |       |  |      +--:(unnumbered-link-hop)
|    |    |  |       |  |      |  +--rw unnumbered-link-hop
|    |    |  |       |  |      |     +--rw link-tp-id
|    |    |  |       |  |      |     |      te-tp-id
|    |    |  |       |  |      |     +--rw node-id
|    |    |  |       |  |      |     |      te-node-id
|    |    |  |       |  |      |     +--rw hop-type?
|    |    |  |       |  |      |     |      te-hop-type
|    |    |  |       |  |      |     +--rw direction?
|    |    |  |       |  |      |            te-link-direction
|    |    |  |       |  |      +--:(as-number)
|    |    |  |       |  |      |  +--rw as-number-hop
|    |    |  |       |  |      |     +--rw as-number
|    |    |  |       |  |      |     |      inet:as-number
|    |    |  |       |  |      |     +--rw hop-type?
|    |    |  |       |  |      |            te-hop-type
|    |    |  |       |  |      +--:(label)
|    |    |  |       |  |      |  +--rw label-hop
|    |    |  |       |  |      |     +--rw te-label
|    |    |  |       |  |      |        +--rw (technology)?
|    |    |  |       |  |      |        |  +--:(generic)
|    |    |  |       |  |      |        |     +--rw generic?
|    |    |  |       |  |      |        |rt-types:generalized-label
|    |    |  |       |  |      |        +--rw direction?
```

```
|    |    |  |  |    |  |  |           |        te-label-direction
|    |    |  |  |    |  |  |        +--:(srlg)
|    |    |  |  |    |  |  |           +--rw srlg
|    |    |  |  |    |  |  |              +--rw srlg?   uint32
|    |    |  |  |    |  +--rw explicit-route-include-objects
|    |    |  |  |    |     +--rw route-object-include-object*
|    |    |  |  |    |  |           [index]
|    |    |  |  |    |  |     +--rw index
|    |    |  |  |    |  |     |      uint32
|    |    |  |  |    |  |     +--rw (type)?
|    |    |  |  |    |  |        +--:(numbered-node-hop)
|    |    |  |  |    |  |        |  +--rw numbered-node-hop
|    |    |  |  |    |  |        |     +--rw node-id
|    |    |  |  |    |  |        |     |      te-node-id
|    |    |  |  |    |  |        |     +--rw hop-type?
|    |    |  |  |    |  |        |            te-hop-type
|    |    |  |  |    |  |        +--:(numbered-link-hop)
|    |    |  |  |    |  |        |  +--rw numbered-link-hop
|    |    |  |  |    |  |        |     +--rw link-tp-id
|    |    |  |  |    |  |        |     |      te-tp-id
|    |    |  |  |    |  |        |     +--rw hop-type?
|    |    |  |  |    |  |        |     |      te-hop-type
|    |    |  |  |    |  |        |     +--rw direction?
|    |    |  |  |    |  |        |            te-link-direction
|    |    |  |  |    |  |        +--:(unnumbered-link-hop)
|    |    |  |  |    |  |        |  +--rw unnumbered-link-hop
|    |    |  |  |    |  |        |     +--rw link-tp-id
|    |    |  |  |    |  |        |     |      te-tp-id
|    |    |  |  |    |  |        |     +--rw node-id
|    |    |  |  |    |  |        |     |      te-node-id
|    |    |  |  |    |  |        |     +--rw hop-type?
|    |    |  |  |    |  |        |     |      te-hop-type
|    |    |  |  |    |  |        |     +--rw direction?
|    |    |  |  |    |  |        |            te-link-direction
|    |    |  |  |    |  |        +--:(as-number)
|    |    |  |  |    |  |        |  +--rw as-number-hop
|    |    |  |  |    |  |        |     +--rw as-number
|    |    |  |  |    |  |        |     |      inet:as-number
|    |    |  |  |    |  |        |     +--rw hop-type?
|    |    |  |  |    |  |        |            te-hop-type
|    |    |  |  |    |  |        +--:(label)
|    |    |  |  |    |  |           +--rw label-hop
|    |    |  |  |    |  |              +--rw te-label
|    |    |  |  |    |  |                 +--rw (technology)?
|    |    |  |  |    |  |                 |  +--:(generic)
|    |    |  |  |    |  |                 |     +--rw generic?
|    |    |  |  |    |  |                 |rt-types:generalized-label
|    |    |  |  |    |  |                 +--rw direction?
```

```
  |      |      |  |       |   |                           te-label-direction
  |      |      |  |       |   +--rw tiebreakers
  |      |      |  |       |      +--rw tiebreaker* [tiebreaker-type]
  |      |      |  |       |         +--rw tiebreaker-type
  |      |      |  |       |                    identityref
  |      |      |  |       +--:(objective-function)
  |      |      |  |              {path-optimization-objective-function}?
  |      |      |  |          +--rw objective-function
  |      |      |  |             +--rw objective-function-type?
  |      |      |  |                     identityref
  |      |      |  +--rw named-path-constraint?                  leafref
  |      |      |  |       {te-types:named-path-constraints}?
  |      |      |  +--rw te-bandwidth
  |      |      |  |  +--rw (technology)?
  |      |      |  |     +--:(generic)
  |      |      |  |        +--rw generic?   te-bandwidth
  |      |      |  +--rw link-protection?
  |      |      |  |       identityref
  |      |      |  +--rw setup-priority?                         uint8
  |      |      |  +--rw hold-priority?                          uint8
  |      |      |  +--rw signaling-type?
  |      |      |  |       identityref
  |      |      |  +--rw path-metric-bounds
  |      |      |  |  +--rw path-metric-bound* [metric-type]
  |      |      |  |     +--rw metric-type    identityref
  |      |      |  |     +--rw upper-bound?   uint64
  |      |      |  +--rw path-affinities-values
  |      |      |  |  +--rw path-affinities-value* [usage]
  |      |      |  |     +--rw usage    identityref
  |      |      |  |     +--rw value?   admin-groups
  |      |      |  +--rw path-affinity-names
  |      |      |  |  +--rw path-affinity-name* [usage]
  |      |      |  |     +--rw usage             identityref
  |      |      |  |     +--rw affinity-name* [name]
  |      |      |  |        +--rw name    string
  |      |      |  +--rw path-srlgs-lists
  |      |      |  |  +--rw path-srlgs-list* [usage]
  |      |      |  |     +--rw usage     identityref
  |      |      |  |     +--rw values*   srlg
  |      |      |  +--rw path-srlgs-names
  |      |      |  |  +--rw path-srlgs-name* [usage]
  |      |      |  |     +--rw usage    identityref
  |      |      |  |     +--rw names*   string
  |      |      |  +--rw disjointness?
  |      |      |  |       te-path-disjointness
  |      |      |  +--rw explicit-route-objects-always
  |      |      |  |  +--rw route-object-exclude-always* [index]
  |      |      |  |  |  +--rw index                      uint32
```

```
|     |     |  |  |  +--rw (type)?
|     |     |  |  |     +--:(numbered-node-hop)
|     |     |  |  |     |  +--rw numbered-node-hop
|     |     |  |  |     |     +--rw node-id      te-node-id
|     |     |  |  |     |     +--rw hop-type?    te-hop-type
|     |     |  |  |     +--:(numbered-link-hop)
|     |     |  |  |     |  +--rw numbered-link-hop
|     |     |  |  |     |     +--rw link-tp-id    te-tp-id
|     |     |  |  |     |     +--rw hop-type?     te-hop-type
|     |     |  |  |     |     +--rw direction?
|     |     |  |  |     |           te-link-direction
|     |     |  |  |     +--:(unnumbered-link-hop)
|     |     |  |  |     |  +--rw unnumbered-link-hop
|     |     |  |  |     |     +--rw link-tp-id    te-tp-id
|     |     |  |  |     |     +--rw node-id       te-node-id
|     |     |  |  |     |     +--rw hop-type?     te-hop-type
|     |     |  |  |     |     +--rw direction?
|     |     |  |  |     |           te-link-direction
|     |     |  |  |     +--:(as-number)
|     |     |  |  |     |  +--rw as-number-hop
|     |     |  |  |     |     +--rw as-number     inet:as-number
|     |     |  |  |     |     +--rw hop-type?     te-hop-type
|     |     |  |  |     +--:(label)
|     |     |  |  |        +--rw label-hop
|     |     |  |  |           +--rw te-label
|     |     |  |  |              +--rw (technology)?
|     |     |  |  |              |  +--:(generic)
|     |     |  |  |              |     +--rw generic?
|     |     |  |  |              |rt-types:generalized-label
|     |     |  |  |              +--rw direction?
|     |     |  |  |                    te-label-direction
|     |     |  |  +--rw route-object-include-exclude* [index]
|     |     |  |     +--rw explicit-route-usage?
|     |     |  |     |      identityref
|     |     |  |     +--rw index                      uint32
|     |     |  |     +--rw (type)?
|     |     |  |        +--:(numbered-node-hop)
|     |     |  |        |  +--rw numbered-node-hop
|     |     |  |        |     +--rw node-id      te-node-id
|     |     |  |        |     +--rw hop-type?    te-hop-type
|     |     |  |        +--:(numbered-link-hop)
|     |     |  |        |  +--rw numbered-link-hop
|     |     |  |        |     +--rw link-tp-id    te-tp-id
|     |     |  |        |     +--rw hop-type?     te-hop-type
|     |     |  |        |     +--rw direction?
|     |     |  |        |           te-link-direction
|     |     |  |        +--:(unnumbered-link-hop)
|     |     |  |        |  +--rw unnumbered-link-hop
```

```
 |     |     |   |   |          |     +--rw link-tp-id     te-tp-id
 |     |     |   |   |          |     +--rw node-id        te-node-id
 |     |     |   |   |          |     +--rw hop-type?      te-hop-type
 |     |     |   |   |          |     +--rw direction?
 |     |     |   |   |          |             te-link-direction
 |     |     |   |   +--:(as-number)
 |     |     |   |   |  +--rw as-number-hop
 |     |     |   |   |     +--rw as-number     inet:as-number
 |     |     |   |   |     +--rw hop-type?     te-hop-type
 |     |     |   |   +--:(label)
 |     |     |   |   |  +--rw label-hop
 |     |     |   |   |     +--rw te-label
 |     |     |   |   |         +--rw (technology)?
 |     |     |   |   |         |  +--:(generic)
 |     |     |   |   |         |      +--rw generic?
 |     |     |   |   |       |rt-types:generalized-label
 |     |     |   |   |         +--rw direction?
 |     |     |   |   |              te-label-direction
 |     |     |   |   +--:(srlg)
 |     |     |   |      +--rw srlg
 |     |     |   |         +--rw srlg?    uint32
 |     |     |   +--rw path-in-segment!
 |     |     |   |  +--rw label-restrictions
 |     |     |   |     +--rw label-restriction* [index]
 |     |     |   |        +--rw restriction?    enumeration
 |     |     |   |        +--rw index           uint32
 |     |     |   |        +--rw label-start
 |     |     |   |        |  +--rw te-label
 |     |     |   |        |     +--rw (technology)?
 |     |     |   |        |     |  +--:(generic)
 |     |     |   |        |     |      +--rw generic?
 |     |     |   |        |     |rt-types:generalized-label
 |     |     |   |        |     +--rw direction?
 |     |     |   |        |          te-label-direction
 |     |     |   |        +--rw label-end
 |     |     |   |        |  +--rw te-label
 |     |     |   |        |     +--rw (technology)?
 |     |     |   |        |     |  +--:(generic)
 |     |     |   |        |     |      +--rw generic?
 |     |     |   |        |     |rt-types:generalized-label
 |     |     |   |        |     +--rw direction?
 |     |     |   |        |          te-label-direction
 |     |     |   |        +--rw label-step
 |     |     |   |        |  +--rw (technology)?
 |     |     |   |        |     +--:(generic)
 |     |     |   |        |         +--rw generic?   int32
 |     |     |   |        +--rw range-bitmap?   yang:hex-string
 |     |     |   +--rw path-out-segment!
```

```
|      |       |  |   +--rw label-restrictions
|      |       |  |      +--rw label-restriction* [index]
|      |       |  |         +--rw restriction?    enumeration
|      |       |  |         +--rw index           uint32
|      |       |  |         +--rw label-start
|      |       |  |         |  +--rw te-label
|      |       |  |         |     +--rw (technology)?
|      |       |  |         |     |  +--:(generic)
|      |       |  |         |     |     +--rw generic?
|      |       |  |         |     |rt-types:generalized-label
|      |       |  |         |     +--rw direction?
|      |       |  |         |           te-label-direction
|      |       |  |         +--rw label-end
|      |       |  |         |  +--rw te-label
|      |       |  |         |     +--rw (technology)?
|      |       |  |         |     |  +--:(generic)
|      |       |  |         |     |     +--rw generic?
|      |       |  |         |     |rt-types:generalized-label
|      |       |  |         |     +--rw direction?
|      |       |  |         |           te-label-direction
|      |       |  |         +--rw label-step
|      |       |  |         |  +--rw (technology)?
|      |       |  |         |     +--:(generic)
|      |       |  |         |        +--rw generic?    int32
|      |       |  |         +--rw range-bitmap?    yang:hex-string
|      |       |  +--ro computed-paths-properties
|      |       |  |  +--ro computed-path-properties* [k-index]
|      |       |  |     +--ro k-index              uint8
|      |       |  |     +--ro path-properties
|      |       |  |        +--ro path-metric* [metric-type]
|      |       |  |        |  +--ro metric-type
|      |       |  |        |  |       identityref
|      |       |  |        |  +--ro accumulative-value?    uint64
|      |       |  |        +--ro path-affinities-values
|      |       |  |        |  +--ro path-affinities-value* [usage]
|      |       |  |        |     +--ro usage     identityref
|      |       |  |        |     +--ro value?    admin-groups
|      |       |  |        +--ro path-affinity-names
|      |       |  |        |  +--ro path-affinity-name* [usage]
|      |       |  |        |     +--ro usage            identityref
|      |       |  |        |     +--ro affinity-name* [name]
|      |       |  |        |        +--ro name     string
|      |       |  |        +--ro path-srlgs-lists
|      |       |  |        |  +--ro path-srlgs-list* [usage]
|      |       |  |        |     +--ro usage     identityref
|      |       |  |        |     +--ro values*    srlg
|      |       |  |        +--ro path-srlgs-names
|      |       |  |        |  +--ro path-srlgs-name* [usage]
```

```
|     |     |  |  |                 |       +--ro usage     identityref
|     |     |  |  |                 |       +--ro names*    string
|     |     |  |  |              +--ro path-route-objects
|     |     |  |  |                 |  +--ro path-route-object* [index]
|     |     |  |  |                 |     +--ro index
|     |     |  |  |                 |     |      uint32
|     |     |  |  |                 |     +--ro (type)?
|     |     |  |  |                 |        +--:(numbered-node-hop)
|     |     |  |  |                 |        |  +--ro numbered-node-hop
|     |     |  |  |                 |        |     +--ro node-id
|     |     |  |  |                 |        |     |      te-node-id
|     |     |  |  |                 |        |     +--ro hop-type?
|     |     |  |  |                 |        |            te-hop-type
|     |     |  |  |                 |        +--:(numbered-link-hop)
|     |     |  |  |                 |        |  +--ro numbered-link-hop
|     |     |  |  |                 |        |     +--ro link-tp-id
|     |     |  |  |                 |        |     |      te-tp-id
|     |     |  |  |                 |        |     +--ro hop-type?
|     |     |  |  |                 |        |     |      te-hop-type
|     |     |  |  |                 |        |     +--ro direction?
|     |     |  |  |                 |        |            te-link-direction
|     |     |  |  |                 |        +--:(unnumbered-link-hop)
|     |     |  |  |                 |        |  +--ro unnumbered-link-hop
|     |     |  |  |                 |        |     +--ro link-tp-id
|     |     |  |  |                 |        |     |      te-tp-id
|     |     |  |  |                 |        |     +--ro node-id
|     |     |  |  |                 |        |     |      te-node-id
|     |     |  |  |                 |        |     +--ro hop-type?
|     |     |  |  |                 |        |     |      te-hop-type
|     |     |  |  |                 |        |     +--ro direction?
|     |     |  |  |                 |        |            te-link-direction
|     |     |  |  |                 |        +--:(as-number)
|     |     |  |  |                 |        |  +--ro as-number-hop
|     |     |  |  |                 |        |     +--ro as-number
|     |     |  |  |                 |        |     |      inet:as-number
|     |     |  |  |                 |        |     +--ro hop-type?
|     |     |  |  |                 |        |            te-hop-type
|     |     |  |  |                 |        +--:(label)
|     |     |  |  |                 |           +--ro label-hop
|     |     |  |  |                 |              +--ro te-label
|     |     |  |  |                 |                 +--ro (technology)?
|     |     |  |  |                 |                 |  +--:(generic)
|     |     |  |  |                 |                 |     +--ro generic?
|     |     |  |  |                 |                 |rt-types:generalized-label
|     |     |  |  |                 |                 +--ro direction?
|     |     |  |  |                 |                        te-label-direction
|     |     |  |  |              +--ro te-bandwidth
|     |     |  |  |                 |  +--ro (technology)?
```

```
|     |     |   |   |         |      +--:(generic)
|     |     |   |   |         |         +--ro generic?   te-bandwidth
|     |     |   |   |             +--ro disjointness-type?
|     |     |   |   |                     te-types:te-path-disjointness
|     |     |   +--ro computed-path-error-infos
|     |     |   |   +--ro computed-path-error-info* []
|     |     |   |      +--ro error-description?   string
|     |     |   |      +--ro error-timestamp?
|     |     |   |      |      yang:date-and-time
|     |     |   |      +--ro error-reason?        identityref
|     |     |   +--ro lsp-provisioning-error-infos
|     |     |   |   +--ro lsp-provisioning-error-info* []
|     |     |   |      +--ro error-description?   string
|     |     |   |      +--ro error-timestamp?
|     |     |   |      |      yang:date-and-time
|     |     |   |      +--ro error-node-id?
|     |     |   |      |      te-types:te-node-id
|     |     |   |      +--ro error-link-id?
|     |     |   |      |      te-types:te-tp-id
|     |     |   |      +--ro lsp-id?              uint16
|     |     |   +--ro lsps
|     |     |   |   +--ro lsp* [node lsp-id]
|     |     |   |      +--ro tunnel-name?
|     |     |   |      |      -> /te/lsps/lsp/tunnel-name
|     |     |   |      +--ro node
|     |     |   |      |      -> /te/lsps/lsp/node
|     |     |   |      +--ro lsp-id
|     |     |   |      |      -> /te/lsps/lsp/lsp-id
|     |     |   |      +--ro lsp-provisioning-error-infos
|     |     |   |      |   +--ro lsp-provisioning-error-info* []
|     |     |   |      |      +--ro error-description?   string
|     |     |   |      |      +--ro error-timestamp?
|     |     |   |      |      |      yang:date-and-time
|     |     |   |      |      +--ro error-node-id?
|     |     |   |      |      |      te-types:te-node-id
|     |     |   |      |      +--ro error-link-id?
|     |     |   |      |             te-types:te-tp-id
|     |     |   |      +--ro path-properties
|     |     |   |         +--ro path-metric* [metric-type]
|     |     |   |         |  +--ro metric-type
|     |     |   |         |  |      identityref
|     |     |   |         |  +--ro accumulative-value?   uint64
|     |     |   |         +--ro path-affinities-values
|     |     |   |         |  +--ro path-affinities-value* [usage]
|     |     |   |         |     +--ro usage    identityref
|     |     |   |         |     +--ro value?   admin-groups
|     |     |   |         +--ro path-affinity-names
|     |     |   |         |  +--ro path-affinity-name* [usage]
```

```
|     |     |  |  |           |      +--ro usage              identityref
|     |     |  |  |           |      +--ro affinity-name* [name]
|     |     |  |  |           |         +--ro name    string
|     |     |  |  |        +--ro path-srlgs-lists
|     |     |  |  |        |  +--ro path-srlgs-list* [usage]
|     |     |  |  |        |     +--ro usage     identityref
|     |     |  |  |        |     +--ro values*   srlg
|     |     |  |  |        +--ro path-srlgs-names
|     |     |  |  |        |  +--ro path-srlgs-name* [usage]
|     |     |  |  |        |     +--ro usage     identityref
|     |     |  |  |        |     +--ro names*    string
|     |     |  |  |        +--ro path-route-objects
|     |     |  |  |        |  +--ro path-route-object* [index]
|     |     |  |  |        |     +--ro index
|     |     |  |  |        |     |       uint32
|     |     |  |  |        |     +--ro (type)?
|     |     |  |  |        |        +--:(numbered-node-hop)
|     |     |  |  |        |        |  +--ro numbered-node-hop
|     |     |  |  |        |        |     +--ro node-id
|     |     |  |  |        |        |     |       te-node-id
|     |     |  |  |        |        |     +--ro hop-type?
|     |     |  |  |        |        |             te-hop-type
|     |     |  |  |        |        +--:(numbered-link-hop)
|     |     |  |  |        |        |  +--ro numbered-link-hop
|     |     |  |  |        |        |     +--ro link-tp-id
|     |     |  |  |        |        |     |       te-tp-id
|     |     |  |  |        |        |     +--ro hop-type?
|     |     |  |  |        |        |     |       te-hop-type
|     |     |  |  |        |        |     +--ro direction?
|     |     |  |  |        |        |             te-link-direction
|     |     |  |  |        |        +--:(unnumbered-link-hop)
|     |     |  |  |        |        |  +--ro unnumbered-link-hop
|     |     |  |  |        |        |     +--ro link-tp-id
|     |     |  |  |        |        |     |       te-tp-id
|     |     |  |  |        |        |     +--ro node-id
|     |     |  |  |        |        |     |       te-node-id
|     |     |  |  |        |        |     +--ro hop-type?
|     |     |  |  |        |        |     |       te-hop-type
|     |     |  |  |        |        |     +--ro direction?
|     |     |  |  |        |        |             te-link-direction
|     |     |  |  |        |        +--:(as-number)
|     |     |  |  |        |        |  +--ro as-number-hop
|     |     |  |  |        |        |     +--ro as-number
|     |     |  |  |        |        |     |       inet:as-number
|     |     |  |  |        |        |     +--ro hop-type?
|     |     |  |  |        |        |             te-hop-type
|     |     |  |  |        |        +--:(label)
|     |     |  |  |        |           +--ro label-hop
```

```
|     |     |  |  |           |                    +--ro te-label
|     |     |  |  |           |                       +--ro (technology)?
|     |     |  |  |           |                       |  +--:(generic)
|     |     |  |  |           |                       |     +--ro generic?
|     |     |  |  |           |                    |rt-types:generalized-label
|     |     |  |  |           |                       +--ro direction?
|     |     |  |  |           |                             te-label-direction
|     |     |  |  |        +--ro te-bandwidth
|     |     |  |  |        |  +--ro (technology)?
|     |     |  |  |        |     +--:(generic)
|     |     |  |  |        |        +--ro generic?   te-bandwidth
|     |     |  |  |        +--ro disjointness-type?
|     |     |  |  |                  te-types:te-path-disjointness
|     |     |  +--rw candidate-secondary-reverse-paths
|     |     |     +--rw candidate-secondary-reverse-path*
|     |     |           [secondary-path]
|     |     |        +--rw secondary-path    leafref
|     |     +--rw candidate-secondary-paths
|     |        +--rw candidate-secondary-path* [secondary-path]
|     |           +--rw secondary-path    leafref
|     |           +--ro active?           boolean
|     +--rw secondary-paths
|     |  +--rw secondary-path* [name]
|     |     +--rw name                         string
|     |     +--rw path-computation-method?     identityref
|     |     +--rw path-computation-server
|     |     |  +--rw id?      te-generic-node-id
|     |     |  +--rw type?    enumeration
|     |     +--rw compute-only?                empty
|     |     +--rw use-path-computation?        boolean
|     |     +--rw lockdown?                    empty
|     |     +--ro path-scope?                  identityref
|     |     +--rw preference?                  uint8
|     |     +--rw association-objects
|     |     |  +--rw association-object* [association-key]
|     |     |  |  +--rw association-key    string
|     |     |  |  +--rw type?              identityref
|     |     |  |  +--rw id?                uint16
|     |     |  |  +--rw source
|     |     |  |     +--rw id?      te-generic-node-id
|     |     |  |     +--rw type?    enumeration
|     |     |  +--rw association-object-extended*
|     |     |        [association-key]
|     |     |     +--rw association-key    string
|     |     |     +--rw type?              identityref
|     |     |     +--rw id?                uint16
|     |     |     +--rw source
|     |     |     |  +--rw id?      te-generic-node-id
```

```
|     |     |        |  +--rw type?    enumeration
|     |     |     +--rw global-source?      uint32
|     |     |     +--rw extended-id?        yang:hex-string
|     |     +--rw optimizations
|     |     |  +--rw (algorithm)?
|     |     |     +--:(metric) {path-optimization-metric}?
|     |     |     |  +--rw optimization-metric* [metric-type]
|     |     |     |  |  +--rw metric-type
|     |     |     |  |  |     identityref
|     |     |     |  |  +--rw weight?
|     |     |     |  |  |     uint8
|     |     |     |  |  +--rw explicit-route-exclude-objects
|     |     |     |  |     +--rw route-object-exclude-object*
|     |     |     |  |     |       [index]
|     |     |     |  |     |  +--rw index
|     |     |     |  |     |  |     uint32
|     |     |     |  |     |  +--rw (type)?
|     |     |     |  |     |     +--:(numbered-node-hop)
|     |     |     |  |     |     |  +--rw numbered-node-hop
|     |     |     |  |     |     |     +--rw node-id
|     |     |     |  |     |     |     |     te-node-id
|     |     |     |  |     |     |     +--rw hop-type?
|     |     |     |  |     |     |           te-hop-type
|     |     |     |  |     |     +--:(numbered-link-hop)
|     |     |     |  |     |     |  +--rw numbered-link-hop
|     |     |     |  |     |     |     +--rw link-tp-id
|     |     |     |  |     |     |     |     te-tp-id
|     |     |     |  |     |     |     +--rw hop-type?
|     |     |     |  |     |     |     |     te-hop-type
|     |     |     |  |     |     |     +--rw direction?
|     |     |     |  |     |     |           te-link-direction
|     |     |     |  |     |     +--:(unnumbered-link-hop)
|     |     |     |  |     |     |  +--rw unnumbered-link-hop
|     |     |     |  |     |     |     +--rw link-tp-id
|     |     |     |  |     |     |     |     te-tp-id
|     |     |     |  |     |     |     +--rw node-id
|     |     |     |  |     |     |     |     te-node-id
|     |     |     |  |     |     |     +--rw hop-type?
|     |     |     |  |     |     |     |     te-hop-type
|     |     |     |  |     |     |     +--rw direction?
|     |     |     |  |     |     |           te-link-direction
|     |     |     |  |     |     +--:(as-number)
|     |     |     |  |     |     |  +--rw as-number-hop
|     |     |     |  |     |     |     +--rw as-number
|     |     |     |  |     |     |     |     inet:as-number
|     |     |     |  |     |     |     +--rw hop-type?
|     |     |     |  |     |     |           te-hop-type
|     |     |     |  |     |     +--:(label)
```

```
|     |     |     |   |   |                    |  +--rw label-hop
|     |     |     |   |   |                    |     +--rw te-label
|     |     |     |   |   |                    |        +--rw (technology)?
|     |     |     |   |   |                    |        |  +--:(generic)
|     |     |     |   |   |                    |        |     +--rw generic?
|     |     |     |   |   |                    |        |rt-types:generalized-label
|     |     |     |   |   |                    |        +--rw direction?
|     |     |     |   |   |                    |           te-label-direction
|     |     |     |   |   |                    +--:(srlg)
|     |     |     |   |   |                       +--rw srlg
|     |     |     |   |   |                          +--rw srlg?   uint32
|     |     |     |   |  +--rw explicit-route-include-objects
|     |     |     |   |     +--rw route-object-include-object*
|     |     |     |   |             [index]
|     |     |     |   |        +--rw index
|     |     |     |   |        |      uint32
|     |     |     |   |        +--rw (type)?
|     |     |     |   |           +--:(numbered-node-hop)
|     |     |     |   |           |  +--rw numbered-node-hop
|     |     |     |   |           |     +--rw node-id
|     |     |     |   |           |     |      te-node-id
|     |     |     |   |           |     +--rw hop-type?
|     |     |     |   |           |            te-hop-type
|     |     |     |   |           +--:(numbered-link-hop)
|     |     |     |   |           |  +--rw numbered-link-hop
|     |     |     |   |           |     +--rw link-tp-id
|     |     |     |   |           |     |      te-tp-id
|     |     |     |   |           |     +--rw hop-type?
|     |     |     |   |           |     |      te-hop-type
|     |     |     |   |           |     +--rw direction?
|     |     |     |   |           |            te-link-direction
|     |     |     |   |           +--:(unnumbered-link-hop)
|     |     |     |   |           |  +--rw unnumbered-link-hop
|     |     |     |   |           |     +--rw link-tp-id
|     |     |     |   |           |     |      te-tp-id
|     |     |     |   |           |     +--rw node-id
|     |     |     |   |           |     |      te-node-id
|     |     |     |   |           |     +--rw hop-type?
|     |     |     |   |           |     |      te-hop-type
|     |     |     |   |           |     +--rw direction?
|     |     |     |   |           |            te-link-direction
|     |     |     |   |           +--:(as-number)
|     |     |     |   |           |  +--rw as-number-hop
|     |     |     |   |           |     +--rw as-number
|     |     |     |   |           |     |      inet:as-number
|     |     |     |   |           |     +--rw hop-type?
|     |     |     |   |           |            te-hop-type
|     |     |     |   |           +--:(label)
```

```
|     |      |       |   |                        +--rw label-hop
|     |      |       |   |                           +--rw te-label
|     |      |       |   |                              +--rw (technology)?
|     |      |       |   |                              |  +--:(generic)
|     |      |       |   |                              |     +--rw generic?
|     |      |       |   |                            |rt-types:generalized-label
|     |      |       |   |                              +--rw direction?
|     |      |       |   |                                    te-label-direction
|     |      |       |   +--rw tiebreakers
|     |      |       |      +--rw tiebreaker* [tiebreaker-type]
|     |      |       |         +--rw tiebreaker-type    identityref
|     |      |       +--:(objective-function)
|     |      |               {path-optimization-objective-function}?
|     |      |          +--rw objective-function
|     |      |             +--rw objective-function-type?
|     |      |                     identityref
|     |      +--rw named-path-constraint?             leafref
|     |      |       {te-types:named-path-constraints}?
|     |      +--rw te-bandwidth
|     |      |  +--rw (technology)?
|     |      |     +--:(generic)
|     |      |        +--rw generic?    te-bandwidth
|     |      +--rw link-protection?                   identityref
|     |      +--rw setup-priority?                    uint8
|     |      +--rw hold-priority?                     uint8
|     |      +--rw signaling-type?                    identityref
|     |      +--rw path-metric-bounds
|     |      |  +--rw path-metric-bound* [metric-type]
|     |      |     +--rw metric-type    identityref
|     |      |     +--rw upper-bound?   uint64
|     |      +--rw path-affinities-values
|     |      |  +--rw path-affinities-value* [usage]
|     |      |     +--rw usage    identityref
|     |      |     +--rw value?   admin-groups
|     |      +--rw path-affinity-names
|     |      |  +--rw path-affinity-name* [usage]
|     |      |     +--rw usage            identityref
|     |      |     +--rw affinity-name* [name]
|     |      |        +--rw name    string
|     |      +--rw path-srlgs-lists
|     |      |  +--rw path-srlgs-list* [usage]
|     |      |     +--rw usage    identityref
|     |      |     +--rw values*   srlg
|     |      +--rw path-srlgs-names
|     |      |  +--rw path-srlgs-name* [usage]
|     |      |     +--rw usage    identityref
|     |      |     +--rw names*    string
|     |      +--rw disjointness?
```

```
|      |      |         te-path-disjointness
|      |      +--rw explicit-route-objects-always
|      |      |  +--rw route-object-exclude-always* [index]
|      |      |  |  +--rw index                   uint32
|      |      |  |  +--rw (type)?
|      |      |  |     +--:(numbered-node-hop)
|      |      |  |     |  +--rw numbered-node-hop
|      |      |  |     |     +--rw node-id      te-node-id
|      |      |  |     |     +--rw hop-type?    te-hop-type
|      |      |  |     +--:(numbered-link-hop)
|      |      |  |     |  +--rw numbered-link-hop
|      |      |  |     |     +--rw link-tp-id    te-tp-id
|      |      |  |     |     +--rw hop-type?       te-hop-type
|      |      |  |     |     +--rw direction?    te-link-direction
|      |      |  |     +--:(unnumbered-link-hop)
|      |      |  |     |  +--rw unnumbered-link-hop
|      |      |  |     |     +--rw link-tp-id    te-tp-id
|      |      |  |     |     +--rw node-id       te-node-id
|      |      |  |     |     +--rw hop-type?       te-hop-type
|      |      |  |     |     +--rw direction?    te-link-direction
|      |      |  |     +--:(as-number)
|      |      |  |     |  +--rw as-number-hop
|      |      |  |     |     +--rw as-number     inet:as-number
|      |      |  |     |     +--rw hop-type?     te-hop-type
|      |      |  |     +--:(label)
|      |      |  |        +--rw label-hop
|      |      |  |           +--rw te-label
|      |      |  |              +--rw (technology)?
|      |      |  |              |  +--:(generic)
|      |      |  |              |     +--rw generic?
|      |      |  |              |rt-types:generalized-label
|      |      |  |              +--rw direction?
|      |      |  |                      te-label-direction
|      |      |  +--rw route-object-include-exclude* [index]
|      |      |     +--rw explicit-route-usage?        identityref
|      |      |     +--rw index                   uint32
|      |      |     +--rw (type)?
|      |      |        +--:(numbered-node-hop)
|      |      |        |  +--rw numbered-node-hop
|      |      |        |     +--rw node-id      te-node-id
|      |      |        |     +--rw hop-type?    te-hop-type
|      |      |        +--:(numbered-link-hop)
|      |      |        |  +--rw numbered-link-hop
|      |      |        |     +--rw link-tp-id    te-tp-id
|      |      |        |     +--rw hop-type?       te-hop-type
|      |      |        |     +--rw direction?    te-link-direction
|      |      |        +--:(unnumbered-link-hop)
|      |      |        |  +--rw unnumbered-link-hop
```

```
|     |     |          |         +--rw link-tp-id     te-tp-id
|     |     |          |         +--rw node-id        te-node-id
|     |     |          |         +--rw hop-type?      te-hop-type
|     |     |          |         +--rw direction?    te-link-direction
|     |     |          +--:(as-number)
|     |     |          |  +--rw as-number-hop
|     |     |          |     +--rw as-number     inet:as-number
|     |     |          |     +--rw hop-type?     te-hop-type
|     |     |          +--:(label)
|     |     |          |  +--rw label-hop
|     |     |          |     +--rw te-label
|     |     |          |        +--rw (technology)?
|     |     |          |        |  +--:(generic)
|     |     |          |        |     +--rw generic?
|     |     |          |       |rt-types:generalized-label
|     |     |          |        +--rw direction?
|     |     |          |           te-label-direction
|     |     |          +--:(srlg)
|     |     |             +--rw srlg
|     |     |                +--rw srlg?   uint32
|     |  +--rw path-in-segment!
|     |  |  +--rw label-restrictions
|     |  |     +--rw label-restriction* [index]
|     |  |        +--rw restriction?    enumeration
|     |  |        +--rw index          uint32
|     |  |        +--rw label-start
|     |  |        |  +--rw te-label
|     |  |        |     +--rw (technology)?
|     |  |        |     |  +--:(generic)
|     |  |        |     |     +--rw generic?
|     |  |        |     |rt-types:generalized-label
|     |  |        |     +--rw direction?
|     |  |        |        te-label-direction
|     |  |        +--rw label-end
|     |  |        |  +--rw te-label
|     |  |        |     +--rw (technology)?
|     |  |        |     |  +--:(generic)
|     |  |        |     |     +--rw generic?
|     |  |        |     |rt-types:generalized-label
|     |  |        |     +--rw direction?
|     |  |        |        te-label-direction
|     |  |        +--rw label-step
|     |  |        |  +--rw (technology)?
|     |  |        |     +--:(generic)
|     |  |        |        +--rw generic?   int32
|     |  |        +--rw range-bitmap?   yang:hex-string
|     |  +--rw path-out-segment!
|     |  |  +--rw label-restrictions
```

```
|     |     |           +--rw label-restriction* [index]
|     |     |              +--rw restriction?    enumeration
|     |     |              +--rw index           uint32
|     |     |              +--rw label-start
|     |     |              |  +--rw te-label
|     |     |              |     +--rw (technology)?
|     |     |              |     |  +--:(generic)
|     |     |              |     |     +--rw generic?
|     |     |              |     |rt-types:generalized-label
|     |     |              |     +--rw direction?
|     |     |              |           te-label-direction
|     |     |              +--rw label-end
|     |     |              |  +--rw te-label
|     |     |              |     +--rw (technology)?
|     |     |              |     |  +--:(generic)
|     |     |              |     |     +--rw generic?
|     |     |              |     |rt-types:generalized-label
|     |     |              |     +--rw direction?
|     |     |              |           te-label-direction
|     |     |              +--rw label-step
|     |     |              |  +--rw (technology)?
|     |     |              |     +--:(generic)
|     |     |              |        +--rw generic?   int32
|     |     |              +--rw range-bitmap?   yang:hex-string
|     |     +--rw protection
|     |     |  +--rw enable?                        boolean
|     |     |  +--rw protection-type?               identityref
|     |     |  +--rw protection-reversion-disable?   boolean
|     |     |  +--rw hold-off-time?                 uint32
|     |     |  +--rw wait-to-revert?                uint16
|     |     |  +--rw aps-signal-id?                 uint8
|     |     +--rw restoration
|     |     |  +--rw enable?                         boolean
|     |     |  +--rw restoration-type?
|     |     |  |       identityref
|     |     |  +--rw restoration-scheme?
|     |     |  |       identityref
|     |     |  +--rw restoration-reversion-disable?   boolean
|     |     |  +--rw hold-off-time?                 uint32
|     |     |  +--rw wait-to-restore?               uint16
|     |     |  +--rw wait-to-revert?                uint16
|     |     +--ro computed-paths-properties
|     |     |  +--ro computed-path-properties* [k-index]
|     |     |     +--ro k-index          uint8
|     |     |     +--ro path-properties
|     |     |        +--ro path-metric* [metric-type]
|     |     |        |  +--ro metric-type         identityref
|     |     |        |  +--ro accumulative-value?   uint64
```

```
|     |     |                    +--ro path-affinities-values
|     |     |                    |  +--ro path-affinities-value* [usage]
|     |     |                    |     +--ro usage    identityref
|     |     |                    |     +--ro value?   admin-groups
|     |     |                    +--ro path-affinity-names
|     |     |                    |  +--ro path-affinity-name* [usage]
|     |     |                    |     +--ro usage            identityref
|     |     |                    |     +--ro affinity-name* [name]
|     |     |                    |        +--ro name    string
|     |     |                    +--ro path-srlgs-lists
|     |     |                    |  +--ro path-srlgs-list* [usage]
|     |     |                    |     +--ro usage    identityref
|     |     |                    |     +--ro values*   srlg
|     |     |                    +--ro path-srlgs-names
|     |     |                    |  +--ro path-srlgs-name* [usage]
|     |     |                    |     +--ro usage    identityref
|     |     |                    |     +--ro names*   string
|     |     |                    +--ro path-route-objects
|     |     |                    |  +--ro path-route-object* [index]
|     |     |                    |     +--ro index
|     |     |                    |     |      uint32
|     |     |                    |     +--ro (type)?
|     |     |                    |        +--:(numbered-node-hop)
|     |     |                    |        |  +--ro numbered-node-hop
|     |     |                    |        |     +--ro node-id     te-node-id
|     |     |                    |        |     +--ro hop-type?
|     |     |                    |        |             te-hop-type
|     |     |                    |        +--:(numbered-link-hop)
|     |     |                    |        |  +--ro numbered-link-hop
|     |     |                    |        |     +--ro link-tp-id    te-tp-id
|     |     |                    |        |     +--ro hop-type?
|     |     |                    |        |     |       te-hop-type
|     |     |                    |        |     +--ro direction?
|     |     |                    |        |             te-link-direction
|     |     |                    |        +--:(unnumbered-link-hop)
|     |     |                    |        |  +--ro unnumbered-link-hop
|     |     |                    |        |     +--ro link-tp-id    te-tp-id
|     |     |                    |        |     +--ro node-id
|     |     |                    |        |     |       te-node-id
|     |     |                    |        |     +--ro hop-type?
|     |     |                    |        |     |       te-hop-type
|     |     |                    |        |     +--ro direction?
|     |     |                    |        |             te-link-direction
|     |     |                    |        +--:(as-number)
|     |     |                    |        |  +--ro as-number-hop
|     |     |                    |        |     +--ro as-number
|     |     |                    |        |     |       inet:as-number
|     |     |                    |        |     +--ro hop-type?
```

```
|     |     |            |           |                te-hop-type
|     |     |            |         +--:(label)
|     |     |            |            +--ro label-hop
|     |     |            |               +--ro te-label
|     |     |            |                  +--ro (technology)?
|     |     |            |                  |  +--:(generic)
|     |     |            |                  |     +--ro generic?
|     |     |            |                  |rt-types:generalized-label
|     |     |            |                  +--ro direction?
|     |     |            |                           te-label-direction
|     |     |         +--ro te-bandwidth
|     |     |         |  +--ro (technology)?
|     |     |         |     +--:(generic)
|     |     |         |        +--ro generic?   te-bandwidth
|     |     |         +--ro disjointness-type?
|     |     |                  te-types:te-path-disjointness
|     |     +--ro computed-path-error-infos
|     |     |  +--ro computed-path-error-info* []
|     |     |     +--ro error-description?   string
|     |     |     +--ro error-timestamp?     yang:date-and-time
|     |     |     +--ro error-reason?        identityref
|     |     +--ro lsp-provisioning-error-infos
|     |     |  +--ro lsp-provisioning-error-info* []
|     |     |     +--ro error-description?   string
|     |     |     +--ro error-timestamp?     yang:date-and-time
|     |     |     +--ro error-node-id?       te-types:te-node-id
|     |     |     +--ro error-link-id?       te-types:te-tp-id
|     |     |     +--ro lsp-id?              uint16
|     |     +--ro lsps
|     |        +--ro lsp* [node lsp-id]
|     |           +--ro tunnel-name?
|     |           |       -> /te/lsps/lsp/tunnel-name
|     |           +--ro node
|     |           |       -> /te/lsps/lsp/node
|     |           +--ro lsp-id
|     |           |       -> /te/lsps/lsp/lsp-id
|     |           +--ro lsp-provisioning-error-infos
|     |           |  +--ro lsp-provisioning-error-info* []
|     |           |     +--ro error-description?   string
|     |           |     +--ro error-timestamp?
|     |           |     |       yang:date-and-time
|     |           |     +--ro error-node-id?
|     |           |     |       te-types:te-node-id
|     |           |     +--ro error-link-id?
|     |           |             te-types:te-tp-id
|     |           +--ro path-properties
|     |              +--ro path-metric* [metric-type]
|     |              |  +--ro metric-type           identityref
```

```
|    |                        | +--ro accumulative-value?   uint64
|    |                        +--ro path-affinities-values
|    |                        | +--ro path-affinities-value* [usage]
|    |                        |    +--ro usage    identityref
|    |                        |    +--ro value?   admin-groups
|    |                        +--ro path-affinity-names
|    |                        | +--ro path-affinity-name* [usage]
|    |                        |    +--ro usage              identityref
|    |                        |    +--ro affinity-name* [name]
|    |                        |       +--ro name    string
|    |                        +--ro path-srlgs-lists
|    |                        | +--ro path-srlgs-list* [usage]
|    |                        |    +--ro usage    identityref
|    |                        |    +--ro values*   srlg
|    |                        +--ro path-srlgs-names
|    |                        | +--ro path-srlgs-name* [usage]
|    |                        |    +--ro usage    identityref
|    |                        |    +--ro names*    string
|    |                        +--ro path-route-objects
|    |                        | +--ro path-route-object* [index]
|    |                        |    +--ro index
|    |                        |    |      uint32
|    |                        |    +--ro (type)?
|    |                        |       +--:(numbered-node-hop)
|    |                        |       | +--ro numbered-node-hop
|    |                        |       |    +--ro node-id     te-node-id
|    |                        |       |    +--ro hop-type?
|    |                        |       |            te-hop-type
|    |                        |       +--:(numbered-link-hop)
|    |                        |       | +--ro numbered-link-hop
|    |                        |       |    +--ro link-tp-id    te-tp-id
|    |                        |       |    +--ro hop-type?
|    |                        |       |    |       te-hop-type
|    |                        |       |    +--ro direction?
|    |                        |       |            te-link-direction
|    |                        |       +--:(unnumbered-link-hop)
|    |                        |       | +--ro unnumbered-link-hop
|    |                        |       |    +--ro link-tp-id    te-tp-id
|    |                        |       |    +--ro node-id
|    |                        |       |    |       te-node-id
|    |                        |       |    +--ro hop-type?
|    |                        |       |    |       te-hop-type
|    |                        |       |    +--ro direction?
|    |                        |       |            te-link-direction
|    |                        |       +--:(as-number)
|    |                        |       | +--ro as-number-hop
|    |                        |       |    +--ro as-number
|    |                        |       |    |       inet:as-number
```

```
|      |                  |         |      +--ro hop-type?
|      |                  |         |            te-hop-type
|      |                  |       +--:(label)
|      |                  |          +--ro label-hop
|      |                  |             +--ro te-label
|      |                  |                +--ro (technology)?
|      |                  |                | +--:(generic)
|      |                  |                |    +--ro generic?
|      |                  |                |rt-types:generalized-label
|      |                  |                +--ro direction?
|      |                  |                      te-label-direction
|      |            +--ro te-bandwidth
|      |            | +--ro (technology)?
|      |            |    +--:(generic)
|      |            |       +--ro generic?   te-bandwidth
|      |            +--ro disjointness-type?
|      |                     te-types:te-path-disjointness
|      +--rw secondary-reverse-paths
|      |  +--rw secondary-reverse-path* [name]
|      |     +--rw name                         string
|      |     +--rw path-computation-method?     identityref
|      |     +--rw path-computation-server
|      |     |  +--rw id?     te-generic-node-id
|      |     |  +--rw type?   enumeration
|      |     +--rw compute-only?                empty
|      |     +--rw use-path-computation?        boolean
|      |     +--rw lockdown?                    empty
|      |     +--ro path-scope?                  identityref
|      |     +--rw preference?                  uint8
|      |     +--rw association-objects
|      |     |  +--rw association-object* [association-key]
|      |     |  |  +--rw association-key    string
|      |     |  |  +--rw type?              identityref
|      |     |  |  +--rw id?                uint16
|      |     |  |  +--rw source
|      |     |  |     +--rw id?     te-generic-node-id
|      |     |  |     +--rw type?   enumeration
|      |     |  +--rw association-object-extended*
|      |     |        [association-key]
|      |     |     +--rw association-key    string
|      |     |     +--rw type?              identityref
|      |     |     +--rw id?                uint16
|      |     |     +--rw source
|      |     |     | +--rw id?     te-generic-node-id
|      |     |     | +--rw type?   enumeration
|      |     |     +--rw global-source?     uint32
|      |     |     +--rw extended-id?       yang:hex-string
|      |     +--rw optimizations
```

```
|     |     |   +--rw (algorithm)?
|     |     |      +--:(metric) {path-optimization-metric}?
|     |     |      |  +--rw optimization-metric* [metric-type]
|     |     |      |  |  +--rw metric-type
|     |     |      |  |  |        identityref
|     |     |      |  |  +--rw weight?
|     |     |      |  |  |        uint8
|     |     |      |  |  +--rw explicit-route-exclude-objects
|     |     |      |  |  |  +--rw route-object-exclude-object*
|     |     |      |  |  |          [index]
|     |     |      |  |  |     +--rw index
|     |     |      |  |  |     |      uint32
|     |     |      |  |  |     +--rw (type)?
|     |     |      |  |  |        +--:(numbered-node-hop)
|     |     |      |  |  |        |  +--rw numbered-node-hop
|     |     |      |  |  |        |     +--rw node-id
|     |     |      |  |  |        |     |      te-node-id
|     |     |      |  |  |        |     +--rw hop-type?
|     |     |      |  |  |        |            te-hop-type
|     |     |      |  |  |        +--:(numbered-link-hop)
|     |     |      |  |  |        |  +--rw numbered-link-hop
|     |     |      |  |  |        |     +--rw link-tp-id
|     |     |      |  |  |        |     |      te-tp-id
|     |     |      |  |  |        |     +--rw hop-type?
|     |     |      |  |  |        |     |      te-hop-type
|     |     |      |  |  |        |     +--rw direction?
|     |     |      |  |  |        |            te-link-direction
|     |     |      |  |  |        +--:(unnumbered-link-hop)
|     |     |      |  |  |        |  +--rw unnumbered-link-hop
|     |     |      |  |  |        |     +--rw link-tp-id
|     |     |      |  |  |        |     |      te-tp-id
|     |     |      |  |  |        |     +--rw node-id
|     |     |      |  |  |        |     |      te-node-id
|     |     |      |  |  |        |     +--rw hop-type?
|     |     |      |  |  |        |     |      te-hop-type
|     |     |      |  |  |        |     +--rw direction?
|     |     |      |  |  |        |            te-link-direction
|     |     |      |  |  |        +--:(as-number)
|     |     |      |  |  |        |  +--rw as-number-hop
|     |     |      |  |  |        |     +--rw as-number
|     |     |      |  |  |        |     |      inet:as-number
|     |     |      |  |  |        |     +--rw hop-type?
|     |     |      |  |  |        |            te-hop-type
|     |     |      |  |  |        +--:(label)
|     |     |      |  |  |        |  +--rw label-hop
|     |     |      |  |  |        |     +--rw te-label
|     |     |      |  |  |        |        +--rw (technology)?
|     |     |      |  |  |        |        |  +--:(generic)
```

```
|     |     |     |   | | |           |         |     +--rw generic?
|     |     |     |   | | |           |       |rt-types:generalized-label
|     |     |     |   | | |           |           +--rw direction?
|     |     |     |   | | |           |              te-label-direction
|     |     |     |   | | |         +--:(srlg)
|     |     |     |   | | |            +--rw srlg
|     |     |     |   | | |               +--rw srlg?   uint32
|     |     |     |   | +--rw explicit-route-include-objects
|     |     |     |   |    +--rw route-object-include-object*
|     |     |     |   |            [index]
|     |     |     |   |       +--rw index
|     |     |     |   |       |      uint32
|     |     |     |   |       +--rw (type)?
|     |     |     |   |          +--:(numbered-node-hop)
|     |     |     |   |          |  +--rw numbered-node-hop
|     |     |     |   |          |     +--rw node-id
|     |     |     |   |          |     |      te-node-id
|     |     |     |   |          |     +--rw hop-type?
|     |     |     |   |          |            te-hop-type
|     |     |     |   |          +--:(numbered-link-hop)
|     |     |     |   |          |  +--rw numbered-link-hop
|     |     |     |   |          |     +--rw link-tp-id
|     |     |     |   |          |     |      te-tp-id
|     |     |     |   |          |     +--rw hop-type?
|     |     |     |   |          |     |      te-hop-type
|     |     |     |   |          |     +--rw direction?
|     |     |     |   |          |            te-link-direction
|     |     |     |   |          +--:(unnumbered-link-hop)
|     |     |     |   |          |  +--rw unnumbered-link-hop
|     |     |     |   |          |     +--rw link-tp-id
|     |     |     |   |          |     |      te-tp-id
|     |     |     |   |          |     +--rw node-id
|     |     |     |   |          |     |      te-node-id
|     |     |     |   |          |     +--rw hop-type?
|     |     |     |   |          |     |      te-hop-type
|     |     |     |   |          |     +--rw direction?
|     |     |     |   |          |            te-link-direction
|     |     |     |   |          +--:(as-number)
|     |     |     |   |          |  +--rw as-number-hop
|     |     |     |   |          |     +--rw as-number
|     |     |     |   |          |     |      inet:as-number
|     |     |     |   |          |     +--rw hop-type?
|     |     |     |   |          |            te-hop-type
|     |     |     |   |          +--:(label)
|     |     |     |   |             +--rw label-hop
|     |     |     |   |                +--rw te-label
|     |     |     |   |                   +--rw (technology)?
|     |     |     |   |                   |  +--:(generic)
```

```
|    |    |       |    |                        |     +--rw generic?
|    |    |       |    |                        |rt-types:generalized-label
|    |    |       |    |                             +--rw direction?
|    |    |       |    |                                  te-label-direction
|    |    |       |    +--rw tiebreakers
|    |    |       |       +--rw tiebreaker* [tiebreaker-type]
|    |    |       |          +--rw tiebreaker-type    identityref
|    |    |       +--:(objective-function)
|    |    |               {path-optimization-objective-function}?
|    |    |          +--rw objective-function
|    |    |             +--rw objective-function-type?
|    |    |                     identityref
|    |    +--rw named-path-constraint?            leafref
|    |    |       {te-types:named-path-constraints}?
|    |    +--rw te-bandwidth
|    |    |  +--rw (technology)?
|    |    |     +--:(generic)
|    |    |        +--rw generic?   te-bandwidth
|    |    +--rw link-protection?                identityref
|    |    +--rw setup-priority?                 uint8
|    |    +--rw hold-priority?                  uint8
|    |    +--rw signaling-type?                 identityref
|    |    +--rw path-metric-bounds
|    |    |  +--rw path-metric-bound* [metric-type]
|    |    |     +--rw metric-type    identityref
|    |    |     +--rw upper-bound?   uint64
|    |    +--rw path-affinities-values
|    |    |  +--rw path-affinities-value* [usage]
|    |    |     +--rw usage    identityref
|    |    |     +--rw value?   admin-groups
|    |    +--rw path-affinity-names
|    |    |  +--rw path-affinity-name* [usage]
|    |    |     +--rw usage           identityref
|    |    |     +--rw affinity-name* [name]
|    |    |        +--rw name    string
|    |    +--rw path-srlgs-lists
|    |    |  +--rw path-srlgs-list* [usage]
|    |    |     +--rw usage    identityref
|    |    |     +--rw values*   srlg
|    |    +--rw path-srlgs-names
|    |    |  +--rw path-srlgs-name* [usage]
|    |    |     +--rw usage    identityref
|    |    |     +--rw names*   string
|    |    +--rw disjointness?
|    |    |       te-path-disjointness
|    |    +--rw explicit-route-objects-always
|    |    |  +--rw route-object-exclude-always* [index]
|    |    |  |  +--rw index                      uint32
```

```
|     |        |  |  +--rw (type)?
|     |        |  |     +--:(numbered-node-hop)
|     |        |  |     |  +--rw numbered-node-hop
|     |        |  |     |     +--rw node-id      te-node-id
|     |        |  |     |     +--rw hop-type?    te-hop-type
|     |        |  |     +--:(numbered-link-hop)
|     |        |  |     |  +--rw numbered-link-hop
|     |        |  |     |     +--rw link-tp-id    te-tp-id
|     |        |  |     |     +--rw hop-type?     te-hop-type
|     |        |  |     |     +--rw direction?    te-link-direction
|     |        |  |     +--:(unnumbered-link-hop)
|     |        |  |     |  +--rw unnumbered-link-hop
|     |        |  |     |     +--rw link-tp-id    te-tp-id
|     |        |  |     |     +--rw node-id       te-node-id
|     |        |  |     |     +--rw hop-type?     te-hop-type
|     |        |  |     |     +--rw direction?    te-link-direction
|     |        |  |     +--:(as-number)
|     |        |  |     |  +--rw as-number-hop
|     |        |  |     |     +--rw as-number     inet:as-number
|     |        |  |     |     +--rw hop-type?     te-hop-type
|     |        |  |     +--:(label)
|     |        |  |        +--rw label-hop
|     |        |  |           +--rw te-label
|     |        |  |              +--rw (technology)?
|     |        |  |              |  +--:(generic)
|     |        |  |              |     +--rw generic?
|     |        |  |              |rt-types:generalized-label
|     |        |  |              +--rw direction?
|     |        |  |                      te-label-direction
|     |        |  +--rw route-object-include-exclude* [index]
|     |        |     +--rw explicit-route-usage?        identityref
|     |        |     +--rw index                        uint32
|     |        |     +--rw (type)?
|     |        |        +--:(numbered-node-hop)
|     |        |        |  +--rw numbered-node-hop
|     |        |        |     +--rw node-id      te-node-id
|     |        |        |     +--rw hop-type?    te-hop-type
|     |        |        +--:(numbered-link-hop)
|     |        |        |  +--rw numbered-link-hop
|     |        |        |     +--rw link-tp-id    te-tp-id
|     |        |        |     +--rw hop-type?     te-hop-type
|     |        |        |     +--rw direction?    te-link-direction
|     |        |        +--:(unnumbered-link-hop)
|     |        |        |  +--rw unnumbered-link-hop
|     |        |        |     +--rw link-tp-id    te-tp-id
|     |        |        |     +--rw node-id       te-node-id
|     |        |        |     +--rw hop-type?     te-hop-type
|     |        |        |     +--rw direction?    te-link-direction
```

```
|     |     |                  +--:(as-number)
|     |     |                  |  +--rw as-number-hop
|     |     |                  |     +--rw as-number    inet:as-number
|     |     |                  |     +--rw hop-type?    te-hop-type
|     |     |                  +--:(label)
|     |     |                  |  +--rw label-hop
|     |     |                  |     +--rw te-label
|     |     |                  |        +--rw (technology)?
|     |     |                  |        |  +--:(generic)
|     |     |                  |        |     +--rw generic?
|     |     |                  |     |rt-types:generalized-label
|     |     |                  |        +--rw direction?
|     |     |                  |              te-label-direction
|     |     |                  +--:(srlg)
|     |     |                     +--rw srlg
|     |     |                        +--rw srlg?   uint32
|     |     +--rw path-in-segment!
|     |     |  +--rw label-restrictions
|     |     |     +--rw label-restriction* [index]
|     |     |        +--rw restriction?    enumeration
|     |     |        +--rw index           uint32
|     |     |        +--rw label-start
|     |     |        |  +--rw te-label
|     |     |        |     +--rw (technology)?
|     |     |        |     |  +--:(generic)
|     |     |        |     |     +--rw generic?
|     |     |        |     |rt-types:generalized-label
|     |     |        |     +--rw direction?
|     |     |        |           te-label-direction
|     |     |        +--rw label-end
|     |     |        |  +--rw te-label
|     |     |        |     +--rw (technology)?
|     |     |        |     |  +--:(generic)
|     |     |        |     |     +--rw generic?
|     |     |        |     |rt-types:generalized-label
|     |     |        |     +--rw direction?
|     |     |        |           te-label-direction
|     |     |        +--rw label-step
|     |     |        |  +--rw (technology)?
|     |     |        |     +--:(generic)
|     |     |        |        +--rw generic?   int32
|     |     |        +--rw range-bitmap?   yang:hex-string
|     |     +--rw path-out-segment!
|     |     |  +--rw label-restrictions
|     |     |     +--rw label-restriction* [index]
|     |     |        +--rw restriction?    enumeration
|     |     |        +--rw index           uint32
|     |     |        +--rw label-start
```

```
|     |     |           |   +--rw te-label
|     |     |           |      +--rw (technology)?
|     |     |           |      |  +--:(generic)
|     |     |           |      |     +--rw generic?
|     |     |           |      |rt-types:generalized-label
|     |     |           |      +--rw direction?
|     |     |           |            te-label-direction
|     |     |        +--rw label-end
|     |     |        |  +--rw te-label
|     |     |        |     +--rw (technology)?
|     |     |        |     |  +--:(generic)
|     |     |        |     |     +--rw generic?
|     |     |        |     |rt-types:generalized-label
|     |     |        |     +--rw direction?
|     |     |        |           te-label-direction
|     |     |        +--rw label-step
|     |     |        |  +--rw (technology)?
|     |     |        |     +--:(generic)
|     |     |        |        +--rw generic?    int32
|     |     |        +--rw range-bitmap?   yang:hex-string
|     |  +--rw protection
|     |  |  +--rw enable?                        boolean
|     |  |  +--rw protection-type?               identityref
|     |  |  +--rw protection-reversion-disable?  boolean
|     |  |  +--rw hold-off-time?                 uint32
|     |  |  +--rw wait-to-revert?                uint16
|     |  |  +--rw aps-signal-id?                 uint8
|     |  +--rw restoration
|     |  |  +--rw enable?                         boolean
|     |  |  +--rw restoration-type?
|     |  |  |        identityref
|     |  |  +--rw restoration-scheme?
|     |  |  |        identityref
|     |  |  +--rw restoration-reversion-disable?   boolean
|     |  |  +--rw hold-off-time?                   uint32
|     |  |  +--rw wait-to-restore?                 uint16
|     |  |  +--rw wait-to-revert?                  uint16
|     |  +--ro computed-paths-properties
|     |  |  +--ro computed-path-properties* [k-index]
|     |  |     +--ro k-index          uint8
|     |  |     +--ro path-properties
|     |  |        +--ro path-metric* [metric-type]
|     |  |        |  +--ro metric-type          identityref
|     |  |        |  +--ro accumulative-value?   uint64
|     |  |        +--ro path-affinities-values
|     |  |        |  +--ro path-affinities-value* [usage]
|     |  |        |     +--ro usage    identityref
|     |  |        |     +--ro value?   admin-groups
```

```
|     |     |                    +--ro path-affinity-names
|     |     |                    |  +--ro path-affinity-name* [usage]
|     |     |                    |     +--ro usage           identityref
|     |     |                    |     +--ro affinity-name* [name]
|     |     |                    |        +--ro name    string
|     |     |                    +--ro path-srlgs-lists
|     |     |                    |  +--ro path-srlgs-list* [usage]
|     |     |                    |     +--ro usage     identityref
|     |     |                    |     +--ro values*   srlg
|     |     |                    +--ro path-srlgs-names
|     |     |                    |  +--ro path-srlgs-name* [usage]
|     |     |                    |     +--ro usage     identityref
|     |     |                    |     +--ro names*   string
|     |     |                    +--ro path-route-objects
|     |     |                    |  +--ro path-route-object* [index]
|     |     |                    |     +--ro index
|     |     |                    |     |       uint32
|     |     |                    |     +--ro (type)?
|     |     |                    |        +--:(numbered-node-hop)
|     |     |                    |        |  +--ro numbered-node-hop
|     |     |                    |        |     +--ro node-id    te-node-id
|     |     |                    |        |     +--ro hop-type?
|     |     |                    |        |             te-hop-type
|     |     |                    |        +--:(numbered-link-hop)
|     |     |                    |        |  +--ro numbered-link-hop
|     |     |                    |        |     +--ro link-tp-id    te-tp-id
|     |     |                    |        |     +--ro hop-type?
|     |     |                    |        |     |       te-hop-type
|     |     |                    |        |     +--ro direction?
|     |     |                    |        |             te-link-direction
|     |     |                    |        +--:(unnumbered-link-hop)
|     |     |                    |        |  +--ro unnumbered-link-hop
|     |     |                    |        |     +--ro link-tp-id    te-tp-id
|     |     |                    |        |     +--ro node-id
|     |     |                    |        |     |       te-node-id
|     |     |                    |        |     +--ro hop-type?
|     |     |                    |        |     |       te-hop-type
|     |     |                    |        |     +--ro direction?
|     |     |                    |        |             te-link-direction
|     |     |                    |        +--:(as-number)
|     |     |                    |        |  +--ro as-number-hop
|     |     |                    |        |     +--ro as-number
|     |     |                    |        |     |       inet:as-number
|     |     |                    |        |     +--ro hop-type?
|     |     |                    |        |             te-hop-type
|     |     |                    |        +--:(label)
|     |     |                    |           +--ro label-hop
|     |     |                    |              +--ro te-label
```

```
|      |      |            |                      +--ro (technology)?
|      |      |            |                      |  +--:(generic)
|      |      |            |                      |     +--ro generic?
|      |      |            |                      |rt-types:generalized-label
|      |      |            |                      +--ro direction?
|      |      |            |                              te-label-direction
|      |      |         +--ro te-bandwidth
|      |      |         |  +--ro (technology)?
|      |      |         |     +--:(generic)
|      |      |         |         +--ro generic?   te-bandwidth
|      |      |         +--ro disjointness-type?
|      |      |                    te-types:te-path-disjointness
|      |      +--ro computed-path-error-infos
|      |      |  +--ro computed-path-error-info* []
|      |      |     +--ro error-description?   string
|      |      |     +--ro error-timestamp?     yang:date-and-time
|      |      |     +--ro error-reason?        identityref
|      |      +--ro lsp-provisioning-error-infos
|      |      |  +--ro lsp-provisioning-error-info* []
|      |      |     +--ro error-description?   string
|      |      |     +--ro error-timestamp?     yang:date-and-time
|      |      |     +--ro error-node-id?       te-types:te-node-id
|      |      |     +--ro error-link-id?       te-types:te-tp-id
|      |      |     +--ro lsp-id?              uint16
|      |      +--ro lsps
|      |         +--ro lsp* [node lsp-id]
|      |            +--ro tunnel-name?
|      |            |       -> /te/lsps/lsp/tunnel-name
|      |            +--ro node
|      |            |       -> /te/lsps/lsp/node
|      |            +--ro lsp-id
|      |            |       -> /te/lsps/lsp/lsp-id
|      |            +--ro lsp-provisioning-error-infos
|      |            |  +--ro lsp-provisioning-error-info* []
|      |            |     +--ro error-description?   string
|      |            |     +--ro error-timestamp?
|      |            |     |       yang:date-and-time
|      |            |     +--ro error-node-id?
|      |            |     |       te-types:te-node-id
|      |            |     +--ro error-link-id?
|      |            |             te-types:te-tp-id
|      |            +--ro path-properties
|      |               +--ro path-metric* [metric-type]
|      |               |  +--ro metric-type          identityref
|      |               |  +--ro accumulative-value?   uint64
|      |               +--ro path-affinities-values
|      |               |  +--ro path-affinities-value* [usage]
|      |               |     +--ro usage    identityref
```

```
|       |                       |      +--ro value?    admin-groups
|       |                 +--ro path-affinity-names
|       |                 |  +--ro path-affinity-name* [usage]
|       |                 |     +--ro usage             identityref
|       |                 |     +--ro affinity-name* [name]
|       |                 |        +--ro name    string
|       |                 +--ro path-srlgs-lists
|       |                 |  +--ro path-srlgs-list* [usage]
|       |                 |     +--ro usage     identityref
|       |                 |     +--ro values*    srlg
|       |                 +--ro path-srlgs-names
|       |                 |  +--ro path-srlgs-name* [usage]
|       |                 |     +--ro usage     identityref
|       |                 |     +--ro names*    string
|       |                 +--ro path-route-objects
|       |                 |  +--ro path-route-object* [index]
|       |                 |     +--ro index
|       |                 |     |       uint32
|       |                 |     +--ro (type)?
|       |                 |        +--:(numbered-node-hop)
|       |                 |        |  +--ro numbered-node-hop
|       |                 |        |     +--ro node-id      te-node-id
|       |                 |        |     +--ro hop-type?
|       |                 |        |             te-hop-type
|       |                 |        +--:(numbered-link-hop)
|       |                 |        |  +--ro numbered-link-hop
|       |                 |        |     +--ro link-tp-id    te-tp-id
|       |                 |        |     +--ro hop-type?
|       |                 |        |     |       te-hop-type
|       |                 |        |     +--ro direction?
|       |                 |        |             te-link-direction
|       |                 |        +--:(unnumbered-link-hop)
|       |                 |        |  +--ro unnumbered-link-hop
|       |                 |        |     +--ro link-tp-id    te-tp-id
|       |                 |        |     +--ro node-id
|       |                 |        |     |       te-node-id
|       |                 |        |     +--ro hop-type?
|       |                 |        |     |       te-hop-type
|       |                 |        |     +--ro direction?
|       |                 |        |             te-link-direction
|       |                 |        +--:(as-number)
|       |                 |        |  +--ro as-number-hop
|       |                 |        |     +--ro as-number
|       |                 |        |     |       inet:as-number
|       |                 |        |     +--ro hop-type?
|       |                 |        |             te-hop-type
|       |                 |        +--:(label)
|       |                 |           +--ro label-hop
```

```
|      |               |               +--ro te-label
|      |               |                  +--ro (technology)?
|      |               |                  |  +--:(generic)
|      |               |                  |     +--ro generic?
|      |               |                  |rt-types:generalized-label
|      |               |                  +--ro direction?
|      |               |                        te-label-direction
|      |          +--ro te-bandwidth
|      |          |  +--ro (technology)?
|      |          |     +--:(generic)
|      |          |        +--ro generic?   te-bandwidth
|      |          +--ro disjointness-type?
|      |                    te-types:te-path-disjointness
|      +---x tunnel-action
|      |  +---w input
|      |  |  +---w action-type?   identityref
|      |  +--ro output
|      |     +--ro action-result?   identityref
|      +---x protection-external-commands
|         +---w input
|            +---w protection-external-command?
|            |     identityref
|            +---w protection-group-ingress-node-id?
|            |     te-types:te-node-id
|            +---w protection-group-egress-node-id?
|            |     te-types:te-node-id
|            +---w path-ref?                      path-ref
|            +---w traffic-type?
|            |     enumeration
|            +---w extra-traffic-tunnel-ref?      tunnel-ref
+--ro lsps
   +--ro lsp* [tunnel-name lsp-id node]
      +--ro tunnel-name                  string
      +--ro lsp-id                       uint16
      +--ro node
      |     te-types:te-node-id
      +--ro source?
      |     te-types:te-node-id
      +--ro destination?
      |     te-types:te-node-id
      +--ro tunnel-id?                   uint16
      +--ro extended-tunnel-id?          yang:dotted-quad
      +--ro operational-state?           identityref
      +--ro signaling-type?              identityref
      +--ro origin-type?                 enumeration
      +--ro lsp-resource-status?         enumeration
      +--ro lockout-of-normal?           boolean
      +--ro freeze?                      boolean
```

```
             +--ro lsp-protection-role?               enumeration
             +--ro lsp-protection-state?              identityref
             +--ro protection-group-ingress-node-id?
             |       te-types:te-node-id
             +--ro protection-group-egress-node-id?
             |       te-types:te-node-id
             +--ro lsp-record-route-information
                +--ro lsp-record-route-information* [index]
                   +--ro index                      uint32
                   +--ro (type)?
                      +--:(numbered-node-hop)
                      |  +--ro numbered-node-hop
                      |     +--ro node-id    te-node-id
                      |     +--ro flags*      path-attribute-flags
                      +--:(numbered-link-hop)
                      |  +--ro numbered-link-hop
                      |     +--ro link-tp-id    te-tp-id
                      |     +--ro flags*         path-attribute-flags
                      +--:(unnumbered-link-hop)
                      |  +--ro unnumbered-link-hop
                      |     +--ro link-tp-id    te-tp-id
                      |     +--ro node-id?      te-node-id
                      |     +--ro flags*         path-attribute-flags
                      +--:(label)
                         +--ro label-hop
                            +--ro te-label
                            |  +--ro (technology)?
                            |  |  +--:(generic)
                            |  |     +--ro generic?
                            |  |rt-types:generalized-label
                            |  +--ro direction?
                            |       te-label-direction
                            +--ro flags*      path-attribute-flags

  rpcs:
    +---x tunnels-path-compute
    |  +---w input
    |  |  +---w path-compute-info
    |  +--ro output
    |     +--ro path-compute-result
    +---x tunnels-actions
       +---w input
       |  +---w tunnel-info
       |  |  +---w (filter-type)
       |  |     +--:(all-tunnels)
       |  |     |  +---w all       empty
       |  |     +--:(one-tunnel)
       |  |        +---w tunnel?   tunnel-ref
```

```
            |   +---w action-info
            |      +---w action?       identityref
            |      +---w disruptive?   empty
            +--ro output
               +--ro action-result?   identityref
```

                  Figure 7: TE generic YANG model tree diagram.

5.3. YANG Module

   The generic TE YANG module 'ietf-te' imports the following modules:

   o ietf-yang-types and ietf-inet-types defined in [RFC6991]

   o ietf-te-types defined in [RFC8776]

   This module references the following documents: [RFC6991], [RFC4875],
   [RFC7551], [RFC4206], [RFC4427], [RFC4872], [RFC3945], [RFC3209],
   [RFC6780], and [RFC7308].

```
<CODE BEGINS> file "ietf-te@2020-07-12.yang"
module ietf-te {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-te";

  /* Replace with IANA when assigned */

  prefix te;

  /* Import TE generic types */

  import ietf-te-types {
    prefix te-types;
    reference
      "RFC8776: Common YANG Data Types for Traffic Engineering.";
  }
  import ietf-inet-types {
    prefix inet;
    reference
      "RFC6991: Common YANG Data Types.";
  }
  import ietf-yang-types {
    prefix yang;
    reference
      "RFC6991: Common YANG Data Types.";
  }

  organization
```

     "IETF Traffic Engineering Architecture and Signaling (TEAS)
      Working Group.";
   contact
     "WG Web: <http://tools.ietf.org/wg/teas/>
      WG List: <mailto:teas@ietf.org>

      Editor: Tarek Saad
                 <mailto:tsaad@juniper.net>

      Editor: Rakesh Gandhi
                 <mailto:rgandhi@cisco.com>

      Editor: Vishnu Pavan Beeram
                 <mailto:vbeeram@juniper.net>

      Editor: Himanshu Shah
                 <mailto:hshah@ciena.com>

      Editor: Xufeng Liu
                 <mailto: xufeng.liu.ietf@gmail.com>

      Editor: Igor Bryskin
                 <mailto:i_bryskin@yahoo.com>";
   description
     "YANG data module for TE configuration, state, and RPCs.
      The model fully conforms to the Network Management
      Datastore Architecture (NMDA).

      Copyright (c) 2019 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.";

   // RFC Ed.: replace XXXX with actual RFC number and remove this
   // note.
   // RFC Ed.: update the date below with the date of RFC publication
   // and remove this note.

   revision 2020-07-12 {
     description
       "Latest update to TE generic YANG module.";

```
    reference
      "RFCXXXX: A YANG Data Model for Traffic Engineering Tunnels
       and Interfaces.";
  }

  identity path-computation-error-reason {
    description
      "Base identity for path computation error reasons.";
  }

  identity path-computation-error-no-topology {
    base path-computation-error-reason;
    description
      "Path computation has failed because there is no topology
       with the provided the topology-identifier.";
  }

  identity path-computation-error-no-dependent-server {
    base path-computation-error-reason;
    description
      "Path computation has failed because one or more dependent
       path computation servers are unavailable.
       The dependent path computation server could be
       a BRPC downstream PCE or a child PCE.";
    reference
      "RFC5441, RFC 8685";
  }

  identity path-computation-error-pce-unavailable {
    base path-computation-error-reason;
    description
      "Path computation has failed because PCE is not available.";
    reference
      "RFC5440";
  }

  identity path-computation-error-no-inclusion-hop {
    base path-computation-error-reason;
    description
      "Path computation has failed because there is no
       node or link provided by one or more inclusion hops.";
    reference
      "RFC8685";
  }

  identity path-computation-error-destination-unknown-in-domain {
    base path-computation-error-reason;
    description
```

```
      "Path computation has failed because the destination node is
       unknown in indicated destination domain.";
    reference
      "RFC8685";
  }

  identity path-computation-error-no-resource {
    base path-computation-error-reason;
    description
      "Path computation has failed because there is no
       available resource in one or more domains.";
    reference
      "RFC8685";
  }

  identity path-computation-error-child-pce-unresponsive {
    base path-computation-error-reason;
    description
      "Path computation has failed because child PCE is not
       responsive.";
    reference
      "RFC8685";
  }

  identity path-computation-error-destination-domain-unknown {
    base path-computation-error-reason;
    description
      "Path computation has failed because the destination domain
       was unknown.";
    reference
      "RFC8685";
  }

  identity path-computation-error-p2mp {
    base path-computation-error-reason;
    description
      "Path computation has failed because of P2MP reachability
       problem.";
    reference
      "RFC8306";
  }

  identity path-computation-error-no-gco-migration {
    base path-computation-error-reason;
    description
      "Path computation has failed because of no GCO migration
       path found.";
    reference
```

```
        "RFC5557";
    }

    identity path-computation-error-no-gco-solution {
      base path-computation-error-reason;
      description
        "Path computation has failed because of no GCO solution
         found.";
      reference
        "RFC5557";
    }

    identity path-computation-error-path-not-found {
      base path-computation-error-reason;
      description
        "Path computation no path found error reason.";
      reference
        "RFC5440";
    }

    identity path-computation-error-pks-expansion {
      base path-computation-error-reason;
      description
        "Path computation has failed because of PKS expansion
         failure.";
      reference
        "RFC5520";
    }

    identity path-computation-error-brpc-chain-unavailable {
      base path-computation-error-reason;
      description
        "Path computation has failed because PCE BRPC chain
         unavailable.";
      reference
        "RFC5441";
    }

    identity path-computation-error-source-unknown {
      base path-computation-error-reason;
      description
        "Path computation has failed because source node is unknown.";
      reference
        "RFC5440";
    }

    identity path-computation-error-destination-unknown {
      base path-computation-error-reason;
```

```
    description
      "Path computation has failed because destination node is
       unknown.";
    reference
      "RFC5440";
  }

  identity path-computation-error-no-server {
    base path-computation-error-reason;
    description
      "Path computation has failed because path computation
       server is unavailable.";
    reference
      "RFC5440";
  }

  identity tunnel-actions-type {
    description
      "TE tunnel actions type.";
  }

  identity tunnel-action-reoptimize {
    base tunnel-actions-type;
    description
      "Reoptimize tunnel action type.";
  }

  identity tunnel-admin-auto {
    base te-types:tunnel-admin-state-type;
    description
      "Tunnel administrative auto state. The administrative status in
       state datastore transitions to 'tunnel-admin-up' when the tunnel
       used by the client layer, and to 'tunnel-admin-down' when it is
       not used by the client layer.";
  }

  identity association-type-diversity {
    base te-types:association-type;
    description
      "Association Type diversity used to associate LSPs whose paths
       are to be diverse from each other.";
    reference
      "ID.ietf-pce-association-diversity.";
  }

  typedef tunnel-ref {
    type leafref {
      path "/te:te/te:tunnels/te:tunnel/te:name";
```

```
    }
    description
      "This type is used by data models that need to reference
       configured TE tunnel.";
  }

  typedef path-ref {
    type union {
      type leafref {
        path "/te:te/te:tunnels/te:tunnel/"
           + "te:primary-paths/te:primary-path/te:name";
      }
      type leafref {
        path "/te:te/te:tunnels/te:tunnel/"
           + "te:secondary-paths/te:secondary-path/te:name";
      }
    }
    description
      "This type is used by data models that need to reference
       configured primary or secondary path of a TE tunnel.";
  }

  typedef te-gen-node-id {
    type union {
      type te-types:te-node-id;
      type inet:ip-address;
    }
    description
      "Generic type that identifies a node in a TE topology.";
  }

  /**
   * TE tunnel generic groupings
   */

  grouping te-generic-node-id {
    description
      "A reusable grouping for a TE generic node identifier.";
    leaf id {
      type te-gen-node-id;
      description
        "The identifier of the node. Can be represented as IP
         address or dotted quad address.";
    }
    leaf type {
      type enumeration {
        enum ip {
          description
```

```
            "IP address representation of the node identifier.";
        }
        enum dotted-quad {
          description
            "Dotted quad address representation of the node
             identifier.";
        }
      }
      description
        "Type of node identifier representation.";
    }
  }

  grouping primary-path {
    description
      "The tunnel primary path properties.";
    uses path-common-properties;
    uses path-preference;
    uses k-requested-paths;
    uses path-compute-info;
    uses path-state;
  }

  grouping primary-reverse-path {
    description
      "The tunnel primary reverse path properties.";
    reference
      "RFC7551";
    uses path-common-properties;
    uses path-compute-info;
    uses path-state;
  }

  grouping secondary-path {
    description
      "The tunnel secondary path properties.";
    uses path-common-properties;
    uses path-preference;
    uses path-compute-info;
    uses protection-restoration-properties;
    uses path-state;
  }

  grouping secondary-reverse-path {
    description
      "The tunnel secondary reverse path properties.";
    uses path-common-properties;
    uses path-preference;
```

```
    uses path-compute-info;
    uses protection-restoration-properties;
    uses path-state;
  }

  grouping path-common-properties {
    description
      "Common path attributes.";
    leaf name {
      type string;
      description
        "TE path name.";
    }
    leaf path-computation-method {
      type identityref {
        base te-types:path-computation-method;
      }
      default "te-types:path-locally-computed";
      description
        "The method used for computing the path, either
         locally computed, queried from a server or not
         computed at all (explicitly configured).";
    }
    container path-computation-server {
      when "derived-from-or-self(../path-computation-method, "
         + "'te-types:path-externally-queried')" {
        description
           "The path-computation server when the path is
            externally queried.";
      }
      uses te-generic-node-id;
      description
        "Address of the external path computation
         server.";
    }
    leaf compute-only {
      type empty;
      description
        "When set, the path is computed and updated whenever
         the topology is updated. No resources are committed
         or reserved in the network.";
    }
    leaf use-path-computation {
      when "derived-from-or-self(../path-computation-method, "
         + "'te-types:path-locally-computed')";
      type boolean;
      default "true";
      description
```

```
            "When 'true' indicates the path is dynamically computed and/or
             validated against the Traffic-Engineering Database (TED),
             and when 'false' indicates no validation against the TED is
             required.";
      }
      leaf lockdown {
        type empty;
        description
          "Indicates no reoptimization to be attempted for this path.";
      }
      leaf path-scope {
        type identityref {
          base te-types:path-scope-type;
        }
        default "te-types:path-scope-end-to-end";
        config false;
        description
          "Path scope if segment or an end-to-end path.";
      }
    }

    /* This grouping will be re-used in path-computation rpc */

    grouping path-compute-info {
      description
        "Attributes used for path computation request.";
      uses tunnel-associations-properties;
      uses te-types:generic-path-optimization;
      leaf named-path-constraint {
        if-feature "te-types:named-path-constraints";
        type leafref {
          path "/te/globals/named-path-constraints/"
             + "named-path-constraint/name";
        }
        description
          "Reference to a globally defined named path constraint set.";
      }
      uses path-constraints-common;
    }

    /* This grouping will be re-used in path-computation rpc */

    grouping path-preference {
      description
        "The path preference.";
      leaf preference {
        type uint8 {
          range "1..255";
```

```
      }
      default "1";
      description
        "Specifies a preference for this path. The lower the number
         higher the preference.";
    }
  }

  /* This grouping will be re-used in path-computation rpc */

  grouping k-requested-paths {
    description
      "The k-shortest paths requests.";
    leaf k-requested-paths {
      type uint8;
      default "1";
      description
        "The number of k-shortest-paths  requested from the path
         computation server and returned sorted by its optimization
         objective.";
    }
  }

  grouping path-properties {
    description
      "TE computed path properties grouping.";
    uses te-types:generic-path-properties {
      augment "path-properties" {
        description
          "additional path properties returned by path computation.";
        uses te-types:te-bandwidth;
        leaf disjointness-type {
          type te-types:te-path-disjointness;
          config false;
          description
            "The type of resource disjointness.
             When reported for a primary path, it represents the
             minimum level of disjointness of all the secondary
             paths.
             When reported for a secondary path, it represents the
             disjointness of the secondary path.";
        }
      }
    }
  }

  grouping path-state {
    description
```

```
      "TE per path state parameters.";
    uses path-computation-response;
    uses lsp-provisioning-error-info {
      augment "lsp-provisioning-error-infos/"
            + "lsp-provisioning-error-info" {
        description
          "Augmentation of LSP provisioning information under a
           specific path.";
        leaf lsp-id {
          type uint16;
          description
            "The LSP-ID for which path computation was performed.";
        }
      }
    }
    container lsps {
      config false;
      description
        "The TE LSPs container.";
      list lsp {
        key "node lsp-id";
        description
          "List of LSPs associated with the tunnel.";
        leaf tunnel-name {
          type leafref {
            path "/te/lsps/lsp/te:tunnel-name";
          }
          description "TE tunnel name.";
        }
        leaf node {
          type leafref {
            path "/te/lsps/lsp/te:node";
          }
          description "The node where the LSP state resides on.";
        }
        leaf lsp-id {
          type leafref {
            path "/te/lsps/lsp/lsp-id";
          }
          description "The TE LSP identifier.";
        }
        uses lsp-provisioning-error-info;
        uses path-properties {
          description
            "The TE path actual properties.";
        }
      }
    }
```

```
  }

  /* This grouping will be re-used in path-computation rpc */

  grouping path-computation-response {
    description
      "Attributes reported by path computation response.";
    container computed-paths-properties {
      config false;
      description
        "Computed path properties container.";
      list computed-path-properties {
        key "k-index";
        description
          "List of computed paths.";
        leaf k-index {
          type uint8;
          description
            "The k-th path returned from the computation server.
             A lower k value path is more optimal than higher k
             value path(s)";
        }
        uses path-properties {
          description
            "The TE path computed properties.";
        }
      }
    }
    container computed-path-error-infos {
      config false;
      description
        "Path computation information container.";
      list computed-path-error-info {
        description
          "List of path computation info entries.";
        leaf error-description {
          type string;
          description
            "Textual representation of the error occurred during
             path computation.";
        }
        leaf error-timestamp {
          type yang:date-and-time;
          description
            "Timestamp of last path computation attempt.";
        }
        leaf error-reason {
          type identityref {
```

```
              base path-computation-error-reason;
            }
            description
              "Reason for the path computation error.";
        }
      }
    }
  }

  grouping lsp-provisioning-error-info {
    description
      "Grouping for LSP provisioning error information.";
    container lsp-provisioning-error-infos {
      config false;
      description
        "LSP provisioning error information.";
      list lsp-provisioning-error-info {
        description
          "List of LSP provisioning error info entries.";
        leaf error-description {
          type string;
          description
            "Textual representation of the error occurred during
             path computation.";
        }
        leaf error-timestamp {
          type yang:date-and-time;
          description
            "Timestamp of when the reported error occurred.";
        }
        leaf error-node-id {
          type te-types:te-node-id;
          default "0.0.0.0";
          description
            "Node identifier of node where error occurred.";
        }
        leaf error-link-id {
          type te-types:te-tp-id;
          default "0";
          description
            "Link ID where the error occurred.";
        }
      }
    }
  }

  grouping protection-restoration-properties-state {
    description
```

```
        "Protection parameters grouping.";
      leaf lockout-of-normal {
        type boolean;
        default "false";
        description
          "When set to 'True', it represents a lockout of normal
           traffic external command. When set to 'False', it
           represents a clear lockout of normal traffic external
           command. The lockout of normal traffic command applies
           to this Tunnel.";
        reference
          "RFC4427";
      }
      leaf freeze {
        type boolean;
        default "false";
        description
          "When set to 'True', it represents a freeze external
           command. When set to 'False', it represents a clear
           freeze external command. The freeze command command
           applies to all the Tunnels which are sharing the
           protection resources with this Tunnel.";
        reference
          "RFC4427";
      }
      leaf lsp-protection-role {
        type enumeration {
          enum working {
            description
              "A working LSP must be a primary LSP whilst a protecting
               LSP can be either a primary or a secondary LSP. Also,
               known as protected LSPs when working LSPs are associated
               with protecting LSPs.";
          }
          enum protecting {
            description
              "A secondary LSP is an LSP that has been provisioned
               in the control plane only; e.g. resource allocation
               has not been committed at the data plane.";
          }
        }
        default "working";
        description
          "LSP role type.";
        reference
          "RFC4872, section 4.2.1";
      }
      leaf lsp-protection-state {
```

```
      type identityref {
        base te-types:lsp-protection-state;
      }
      default "te-types:normal";
      description
        "The state of the APS state machine controlling which
         tunnels is using the resources of the protecting LSP.";
    }
    leaf protection-group-ingress-node-id {
      type te-types:te-node-id;
      default "0.0.0.0";
      description
        "Indicates the te-node-id of the protection group
         ingress node when the APS state represents an external
         command (LoP, SF, MS) applied to it or a WTR timer
         running on it. If the external command is not applied to
         the ingress node or the WTR timer is not running on it,
         this attribute is not specified. A value 0.0.0.0 is used
         when the te-node-id of the protection group ingress node is
         unknown (e.g., because the ingress node is outside the scope
         of control of the server)";
    }
    leaf protection-group-egress-node-id {
      type te-types:te-node-id;
      default "0.0.0.0";
      description
        "Indicates the te-node-id of the protection group egress node
         when the APS state represents an external command (LoP, SF,
         MS) applied to it or a WTR timer running on it. If the
         external command is not applied to the ingress node or
         the WTR timer is not running on it, this attribute is not
         specified. A value 0.0.0.0 is used when the te-node-id of
         the protection group ingress node is unknown (e.g., because
         the ingress node is outside the scope of control of the
         server)";
    }
  }

  grouping protection-restoration-properties {
    description
      "Protection and restoration parameters.";
    container protection {
      description
        "Protection parameters.";
      leaf enable {
        type boolean;
        default "false";
        description
```

```
          "A flag to specify if LSP protection is enabled.";
        reference
          "RFC4427";
      }
      leaf protection-type {
        type identityref {
          base te-types:lsp-protection-type;
        }
        default "te-types:lsp-protection-unprotected";
        description
          "LSP protection type.";
      }
      leaf protection-reversion-disable {
        type boolean;
        default "false";
        description
          "Disable protection reversion to working path.";
      }
      leaf hold-off-time {
        type uint32;
        units "milli-seconds";
        default "0";
        description
          "The time between the declaration of an SF or SD condition
           and the initialization of the protection switching
           algorithm.";
        reference
          "RFC4427";
      }
      leaf wait-to-revert {
        type uint16;
        units "seconds";
        description
          "Time to wait before attempting LSP reversion.";
        reference
          "RFC4427";
      }
      leaf aps-signal-id {
        type uint8 {
          range "1..255";
        }
        default "1";
        description
          "The APS signal number used to reference the traffic of this
           tunnel. The default value for normal traffic is 1.
           The default value for extra-traffic is 255. If not specified,
           non-default values can be assigned by the server,
           if and only if, the server controls both endpoints.";
```

```
            reference
              "RFC4427";
          }
        }
      container restoration {
        description
          "Restoration parameters.";
        leaf enable {
          type boolean;
          default "false";
          description
            "A flag to specify if LSP restoration is enabled.";
          reference
            "RFC4427";
        }
        leaf restoration-type {
          type identityref {
            base te-types:lsp-restoration-type;
          }
          default "te-types:lsp-restoration-restore-any";
          description
            "LSP restoration type.";
        }
        leaf restoration-scheme {
          type identityref {
            base te-types:restoration-scheme-type;
          }
          default "te-types:restoration-scheme-preconfigured";
          description
            "LSP restoration scheme.";
        }
        leaf restoration-reversion-disable {
          type boolean;
          default "false";
          description
            "Disable restoration reversion to working path.";
        }
        leaf hold-off-time {
          type uint32;
          units "milli-seconds";
          description
            "The time between the declaration of an SF or SD condition
             and the initialization of the protection switching
             algorithm.";
          reference
            "RFC4427";
        }
        leaf wait-to-restore {
```

```
        type uint16;
        units "seconds";
        description
          "Time to wait before attempting LSP restoration.";
        reference
          "RFC4427";
      }
      leaf wait-to-revert {
        type uint16;
        units "seconds";
        description
          "Time to wait before attempting LSP reversion.";
        reference
          "RFC4427";
      }
    }
  }

  grouping tunnel-associations-properties {
    description
      "TE tunnel association grouping.";
    container association-objects {
      description
        "TE tunnel associations.";
      list association-object {
        key "association-key";
        unique "type id source/id source/type";
        description
          "List of association base objects.";
        reference
          "RFC4872";
        leaf association-key {
          type string;
          description
            "Association key used to identify a specific
             association in the list";
        }
        leaf type {
          type identityref {
            base te-types:association-type;
          }
          description
            "Association type.";
          reference
            "RFC4872";
        }
        leaf id {
          type uint16;
```

```
            description
              "Association identifier.";
            reference
              "RFC4872";
          }
          container source {
            uses te-generic-node-id;
            description
              "Association source.";
            reference
              "RFC4872";
          }
        }
        list association-object-extended {
          key "association-key";
          unique
            "type id source/id source/type global-source extended-id";
          description
            "List of extended association objects.";
          reference
            "RFC6780";
          leaf association-key {
            type string;
            description
              "Association key used to identify a specific
               association in the list";
          }
          leaf type {
            type identityref {
              base te-types:association-type;
            }
            description
              "Association type.";
            reference
              "RFC4872, RFC6780";
          }
          leaf id {
            type uint16;
            description
              "Association identifier.";
            reference
              "RFC4872, RFC6780";
          }
          container source {
            uses te-generic-node-id;
            description
              "Association source.";
            reference
```

```
                "RFC4872, RFC6780";
          }
          leaf global-source {
            type uint32;
            description
              "Association global source.";
            reference
              "RFC6780";
          }
          leaf extended-id {
            type yang:hex-string;
            description
              "Association extended identifier.";
            reference
              "RFC6780";
          }
        }
      }
    }
  }

  /* TE tunnel configuration/state grouping */
  /* This grouping will be re-used in path-computation rpc */

  grouping tunnel-hierarchy-properties {
    description
      "A grouping for TE tunnel hierarchy information.";
    container hierarchy {
      description
        "Container for TE hierarchy related information.";
      container dependency-tunnels {
        description
          "List of tunnels that this tunnel can be potentially
           dependent on.";
        list dependency-tunnel {
          key "name";
          description
            "A tunnel entry that this tunnel can potentially depend
             on.";
          leaf name {
            type leafref {
              path "../../../../../../tunnels/tunnel/name";
              require-instance false;
            }
            description
              "Dependency tunnel name. The tunnel may not have been
               instantiated yet.";
          }
          leaf encoding {
```

```
            type identityref {
              base te-types:lsp-encoding-types;
            }
            default "te-types:lsp-encoding-packet";
            description
              "The LSP encoding type for the dependency tunnel.";
            reference
              "RFC3945";
          }
          leaf switching-type {
            type identityref {
              base te-types:switching-capabilities;
            }
            default "te-types:switching-psc1";
            description
              "The LSP switching type for the dependency tunnel.";
            reference
              "RFC3945";
          }
        }
      }
      container hierarchical-link {
        description
          "Identifies a hierarchical link (in client layer)
           that this tunnel is associated with.";
        reference
          "RFC4206";
        leaf local-te-node-id {
          type te-types:te-node-id;
          default "0.0.0.0";
          description
            "The local TE node identifier.";
        }
        leaf local-te-link-tp-id {
          type te-types:te-tp-id;
          default "0";
          description
            "The local TE link termination point identifier.";
        }
        leaf remote-te-node-id {
          type te-types:te-node-id;
          default "0.0.0.0";
          description
            "Remote TE node identifier.";
        }
        uses te-types:te-topology-identifier;
      }
    }
```

```
  }

  grouping tunnel-properties {
    description
      "Top level grouping for tunnel properties.";
    leaf operational-state {
      type identityref {
        base te-types:tunnel-state-type;
      }
      config false;
      description
        "TE tunnel operational state.";
    }
    leaf name {
      type string;
      description
        "TE tunnel name.";
    }
    leaf identifier {
      type uint32;
      description
        "TE tunnel Identifier.";
      reference
        "RFC3209";
    }
    leaf description {
      type string;
      default "None";
      description
        "Textual description for this TE tunnel.";
    }
    leaf encoding {
      type identityref {
        base te-types:lsp-encoding-types;
      }
      default "te-types:lsp-encoding-packet";
      description
        "LSP encoding type.";
      reference
        "RFC3945";
    }
    leaf switching-type {
      type identityref {
        base te-types:switching-capabilities;
      }
      default "te-types:switching-psc1";
      description
        "LSP switching type.";
```

```
        reference
          "RFC3945";
      }
      leaf admin-state {
        type identityref {
          base te-types:tunnel-admin-state-type;
        }
        default "te-types:tunnel-admin-state-up";
        description
          "TE tunnel administrative state.";
      }
      leaf reoptimize-timer {
        type uint16;
        units "seconds";
        description
          "Frequency of reoptimization of a traffic engineered LSP.";
      }
      leaf source {
        type te-types:te-node-id;
        description
          "TE tunnel source node ID.";
      }
      leaf destination {
        type te-types:te-node-id;
        description
          "TE tunnel destination node identifier.";
      }
      leaf src-tunnel-tp-id {
        type binary;
        description
          "TE tunnel source termination point identifier.";
      }
      leaf dst-tunnel-tp-id {
        type binary;
        description
          "TE tunnel destination termination point identifier.";
      }
      leaf bidirectional {
        type boolean;
        default "false";
        description
          "Indicates a bidirectional co-routed LSP.";
      }
      uses tunnel-associations-properties;
      uses protection-restoration-properties;
      uses te-types:tunnel-constraints;
      uses tunnel-hierarchy-properties;
      container primary-paths {
```

```
        description
          "The set of primary paths.";
        list primary-path {
          key "name";
          description
            "List of primary paths for this tunnel.";
          uses primary-path;
          container primary-reverse-path {
            description
              "The reverse primary path properties.";
            uses primary-reverse-path;
            container candidate-secondary-reverse-paths {
              description
                "The set of referenced candidate reverse secondary paths
                 from the full set of secondary reverse paths which may be
                 used for this primary path.";
              list candidate-secondary-reverse-path {
                key "secondary-path";
                description
                  "List of candidate secondary reverse path(s)";
                leaf secondary-path {
                  type leafref {
                    path "../../../../../../secondary-reverse-paths/"
                       + "secondary-reverse-path/name";
                  }
                  description
                    "A reference to the secondary reverse path that
                     should be utilised when the containing primary
                     reverse path option is in use.";
                }
              }
            }
          }
          container candidate-secondary-paths {
            description
              "The set of candidate secondary paths which may be used
               for this primary path. When secondary paths are specified
               in the list the path of the secondary LSP in use must be
               restricted to those path options referenced. The
               priority of the secondary paths is specified within the
               list. Higher priority values are less preferred - that is
               to say that a path with priority 0 is the most preferred
               path. In the case that the list is empty, any secondary
               path option may be utilised when the current primary path
               is in use.";
            list candidate-secondary-path {
              key "secondary-path";
              description
```

```
                 "List of candidate secondary paths for this tunnel.";
              leaf secondary-path {
                type leafref {
                  path "../../../../../secondary-paths/"
                     + "secondary-path/name";
                }
                description
                  "A reference to the secondary path that should be
                   utilised when the containing primary path option is
                   in use.";
              }
              leaf active {
                type boolean;
                config false;
                description
                  "Indicates the current active path option that has
                   been selected of the candidate secondary paths.";
              }
            }
          }
        }
      }
    }
    container secondary-paths {
      description
        "The set of secondary paths.";
      list secondary-path {
        key "name";
        description
          "List of secondary paths for this tunnel.";
        uses secondary-path;
      }
    }
    container secondary-reverse-paths {
      description
        "The set of secondary reverse paths.";
      list secondary-reverse-path {
        key "name";
        description
          "List of secondary paths for this tunnel.";
        uses secondary-reverse-path;
      }
    }
  }

  grouping tunnel-actions {
    description
      "Tunnel actions.";
    action tunnel-action {
```

```
          description
            "Tunnel action.";
          input {
            leaf action-type {
              type identityref {
                base tunnel-actions-type;
              }
              description
                "Tunnel action type.";
            }
          }
          output {
            leaf action-result {
              type identityref {
                base te-types:te-action-result;
              }
              description
                "The result of the tunnel action operation.";
            }
          }
        }
      }

      grouping tunnel-protection-actions {
        description
          "Protection external command actions.";
        action protection-external-commands {
          input {
            leaf protection-external-command {
              type identityref {
                base te-types:protection-external-commands;
              }
              description
                "Protection external command.";
            }
            leaf protection-group-ingress-node-id {
              type te-types:te-node-id;
              description
                "When specified, indicates whether the action is
                 applied on ingress node.
                 By default, if neither ingress nor egress node-id
                 is set, the action applies to ingress node only.";
            }
            leaf protection-group-egress-node-id {
              type te-types:te-node-id;
              description
                "When specified, indicates whether the action is
                 applied on egress node.
```

```
              By default, if neither ingress nor egress node-id
              is set, the action applies to ingress node only.";
        }
        leaf path-ref {
          type path-ref;
          description
            "Indicates to which path the external command applies to.";
        }
        leaf traffic-type {
          type enumeration {
            enum normal-traffic {
              description
                "The manual-switch or forced-switch command applies to
                 the normal traffic (this Tunnel).";
            }
            enum null-traffic {
              description
                "The manual-switch or forced-switch command applies to
                 the null traffic.";
            }
            enum extra-traffic {
              description
                "The manual-switch or forced-switch command applies to
                 the extra traffic (the extra-traffic Tunnel sharing
                 protection bandwidth with this Tunnel).";
            }
          }
          description
            "Indicates whether the manual-switch or forced-switch
             commands applies to the normal traffic, the null traffic
             or the extra-traffic.";
          reference
            "RFC4427";
        }
        leaf extra-traffic-tunnel-ref {
          type tunnel-ref;
          description
            "In case there are multiple extra-traffic tunnels sharing
             protection bandwidth with this Tunnel (m:n protection),
             represents which extra-traffic Tunnel the manual-switch or
             forced-switch to extra-traffic command applies to.";
        }
      }
    }
  }

  /*** End of TE tunnel groupings ***/
  /**
```

```
   * LSP related generic groupings
   */

grouping lsp-record-route-information-state {
  description
    "LSP Recorded route information grouping.";
  container lsp-record-route-information {
    description
      "RSVP recorded route object information.";
    list lsp-record-route-information {
      when "../../origin-type = 'ingress'" {
        description
          "Applicable on ingress LSPs only.";
      }
      key "index";
      description
        "Record route list entry.";
      uses te-types:record-route-state;
    }
  }
}

grouping lsps-grouping {
  description
    "LSPs state operational data grouping.";
  container lsps {
    config false;
    description
      "TE LSPs state container.";
    list lsp {
      key "tunnel-name lsp-id node";
      unique "source destination tunnel-id lsp-id "
        + "extended-tunnel-id";
      description
        "List of LSPs associated with the tunnel.";
      leaf tunnel-name {
        type string;
        description "The TE tunnel name.";
      }
      leaf lsp-id {
        type uint16;
        description
          "Identifier used in the SENDER_TEMPLATE and the FILTER_SPEC
           that can be changed to allow a sender to share resources
           with itself.";
        reference
          "RFC3209";
      }
```

```
          leaf node {
            type te-types:te-node-id;
            description
              "The node where the TE LSP state resides on.";
          }
          uses lsp-properties-state;
          uses lsp-record-route-information-state;
        }
      }
    }

    /*** End of TE LSP groupings ***/
    /**
     * TE global generic groupings
     */
    /* Global named admin-groups configuration data */

    grouping named-admin-groups-properties {
      description
        "Global named administrative groups configuration
         grouping.";
      leaf name {
        type string;
        description
          "A string name that uniquely identifies a TE
           interface named admin-group.";
      }
      leaf bit-position {
        type uint32;
        description
          "Bit position representing the administrative group.";
        reference
          "RFC3209 and RFC7308";
      }
    }

    grouping named-admin-groups {
      description
        "Global named administrative groups configuration
         grouping.";
      container named-admin-groups {
        description
          "TE named admin groups container.";
        list named-admin-group {
          if-feature "te-types:extended-admin-groups";
          if-feature "te-types:named-extended-admin-groups";
          key "name";
          description
```

```
          "List of named TE admin-groups.";
        uses named-admin-groups-properties;
      }
    }
  }

  /* Global named admin-srlgs configuration data */

  grouping named-srlgs {
    description
      "Global named SRLGs configuration grouping.";
    container named-srlgs {
      description
        "TE named SRLGs container.";
      list named-srlg {
        if-feature "te-types:named-srlg-groups";
        key "name";
        description
          "A list of named SRLG groups.";
        leaf name {
          type string;
          description
            "A string name that uniquely identifies a TE
             interface named SRLG.";
        }
        leaf group {
          type te-types:srlg;
          description
            "An SRLG value.";
        }
        leaf cost {
          type uint32;
          description
            "SRLG associated cost. Used during path to append
             the path cost when traversing a link with this SRLG.";
        }
      }
    }
  }

  /* Global named paths constraints configuration data */

  grouping path-constraints-common {
    description
      "Global named path constraints configuration
       grouping.";
    uses te-types:common-path-constraints-attributes;
    uses te-types:generic-path-disjointness;
```

```
    uses te-types:path-constraints-route-objects;
    container path-in-segment {
      presence "The end-to-end tunnel starts in a previous domain;
                this tunnel is a segment in the current domain.";
      description
        "If an end-to-end tunnel crosses multiple domains using
         the same technology, some additional constraints have to be
         taken in consideration in each domain.
         This tunnel is a segment that needs to be coordinated
         with previous segment stitched on head-end side.";
      uses te-types:label-set-info;
    }
    container path-out-segment {
      presence
        "The end-to-end tunnel is not terminated in this domain;
         this tunnel is a segment in the current domain.";
      description
        "If an end-to-end tunnel crosses multiple domains using
         the same technology, some additional constraints have to be
         taken in consideration in each domain.
         This tunnel is a segment that needs to be coordinated
         with previous segment stitched on head-end side.";
      uses te-types:label-set-info;
    }
  }

  grouping named-path-constraints {
    description
      "Global named path constraints configuration
       grouping.";
    container named-path-constraints {
      description
        "TE named path constraints container.";
      list named-path-constraint {
        if-feature "te-types:named-path-constraints";
        key "name";
        leaf name {
          type string;
          description
            "A string name that uniquely identifies a
             path constraint set.";
        }
        uses path-constraints-common;
        description
          "A list of named path constraints.";
      }
    }
  }
```

```
  /* TE globals container data */

  grouping globals-grouping {
    description
      "Globals TE system-wide configuration data grouping.";
    container globals {
      description
        "Globals TE system-wide configuration data container.";
      uses named-admin-groups;
      uses named-srlgs;
      uses named-path-constraints;
    }
  }

  /* TE tunnels container data */

  grouping tunnels-grouping {
    description
      "Tunnels TE configuration data grouping.";
    container tunnels {
      description
        "Tunnels TE configuration data container.";
      list tunnel {
        key "name";
        description
          "The list of TE tunnels.";
        uses tunnel-properties;
        uses tunnel-actions;
        uses tunnel-protection-actions;
      }
    }
  }

  /* TE LSPs ephemeral state container data */

  grouping lsp-properties-state {
    description
      "LSPs state operational data grouping.";
    leaf source {
      type te-types:te-node-id;
      description
        "Tunnel sender address extracted from
         SENDER_TEMPLATE  object.";
      reference
        "RFC3209";
    }
    leaf destination {
      type te-types:te-node-id;
```

```
          description
            "The tunnel endpoint address extracted from SESSION object.";
          reference
            "RFC3209";
        }
        leaf tunnel-id {
          type uint16;
          description
            "The tunnel identifier used in the SESSION that remains constant
             over the life of the tunnel.";
          reference
            "RFC3209";
        }
        leaf extended-tunnel-id {
          type yang:dotted-quad;
          description
            "The LSP Extended Tunnel ID.";
          reference
            "RFC3209";
        }
        leaf operational-state {
          type identityref {
            base te-types:lsp-state-type;
          }
          description
            "The LSP operational state.";
        }
        leaf signaling-type {
          type identityref {
            base te-types:path-signaling-type;
          }
          description
            "The signaling protocol used to set up this LSP.";
        }
        leaf origin-type {
          type enumeration {
            enum ingress {
              description
                "Origin ingress.";
            }
            enum egress {
              description
                "Origin egress.";
            }
            enum transit {
              description
                "Origin transit.";
            }
```

```
      }
      default "ingress";
      description
        "The origin of the LSP relative to the location of the local
         switch in the path.";
    }
    leaf lsp-resource-status {
      type enumeration {
        enum primary {
          description
            "A primary LSP is a fully established LSP for which the
             resource allocation has been committed at the data
             plane.";
        }
        enum secondary {
          description
            "A secondary LSP is an LSP that has been provisioned
             in the control plane only; e.g. resource allocation
             has not been committed at the data plane.";
        }
      }
      default "primary";
      description
        "LSP resource allocation state.";
      reference
        "RFC4872, section 4.2.1";
    }
    uses protection-restoration-properties-state;
  }

  /*** End of TE global groupings ***/
  /**
   * TE container
   */

  container te {
    presence "Enable TE feature.";
    description
      "TE global container.";
    /* TE Global Data */
    uses globals-grouping;

    /* TE Tunnel Data */
    uses tunnels-grouping;

    /* TE LSPs Data */
    uses lsps-grouping;
  }
```

```
  /* TE Tunnel RPCs/execution Data */

  rpc tunnels-path-compute {
    description
      "TE tunnels RPC nodes.";
    input {
      container path-compute-info {
        /* An external path compute module may augment this target. */
        description
          "RPC input information.";
      }
    }
    output {
      container path-compute-result {
        /* An external path compute module may augment this target. */
        description
          "RPC output information.";
      }
    }
  }

  rpc tunnels-actions {
    description
      "TE tunnels actions RPC";
    input {
      container tunnel-info {
        description
          "TE tunnel information.";
        choice filter-type {
          mandatory true;
          description
            "Filter choice.";
          case all-tunnels {
            leaf all {
              type empty;
              mandatory true;
              description
                "Apply action on all TE tunnels.";
            }
          }
          case one-tunnel {
            leaf tunnel {
              type tunnel-ref;
              description
                "Apply action on the specific TE tunnel.";
            }
          }
        }
```

```
      }
      container action-info {
        description
          "TE tunnel action information.";
        leaf action {
          type identityref {
            base tunnel-actions-type;
          }
          description
            "The action type.";
        }
        leaf disruptive {
          when "derived-from-or-self(../action, "
             + "'te:tunnel-action-reoptimize')";
          type empty;
          description
            "Specifies whether or not the reoptimization action
             is allowed to be disruptive.";
        }
      }
    }
    output {
      leaf action-result {
        type identityref {
          base te-types:te-action-result;
        }
        description
          "The result of the tunnel action operation.";
      }
    }
  }
}
<CODE ENDS>
```

                    Figure 8: generic TE YANG module

6. TE Device YANG Model

   The device TE YANG module ('ietf-te-device') models data that is
   specific to managing a TE device. This module augments the generic
   TE YANG module.

6.1. Module Structure

6.1.1. **TE Interfaces**

   This branch of the model manages TE interfaces that are present on a
   device. Examples of TE interface properties are:

   o Maximum reservable bandwidth, bandwidth constraints (BC)

   o Flooding parameters

      * Flooding intervals and threshold values

   o interface attributes

      * (Extended) administrative groups

      * SRLG values

      * TE metric value

   o Fast reroute backup tunnel properties (such as static, auto-
      tunnel)

   The derived state associated with interfaces is grouped under the
   interface "state" sub-container as shown in Figure 9. This covers
   state data such as:

   o Bandwidth information: maximum bandwidth, available bandwidth at
      different priorities and for each class-type (CT)

   o List of admitted LSPs

      * Name, bandwidth value and pool, time, priority

   o Statistics: state counters, flooding counters, admission counters
      (accepted/rejected), preemption counters

   o Adjacency information

      * Neighbor address

      * Metric value

```
module: ietf-te-device
  augment /te:te:
      +--rw interfaces
            .
         +-- rw te-dev:te-attributes
               <<intended configuration>>
             .
           +-- ro state
               <<derived state associated with the TE interface>>

                  Figure 9: TE interface state
```

6.2. Tree Diagram

Figure 10 shows the tree diagram of the device TE YANG model defined
in modules 'ietf-te.yang'.

```
module: ietf-te-device
  augment /te:te:
    +--rw interfaces
    |  +--rw threshold-type?          enumeration
    |  +--rw delta-percentage?        rt-types:percentage
    |  +--rw threshold-specification?  enumeration
    |  +--rw up-thresholds*           rt-types:percentage
    |  +--rw down-thresholds*         rt-types:percentage
    |  +--rw up-down-thresholds*      rt-types:percentage
    |  +--rw interface* [interface]
    |     +--rw interface                         if:interface-ref
    |     +--rw te-metric?
    |     |       te-types:te-metric
    |     +--rw (admin-group-type)?
    |     |  +--:(value-admin-groups)
    |     |  |  +--rw (value-admin-group-type)?
    |     |  |     +--:(admin-groups)
    |     |  |     |  +--rw admin-group?
    |     |  |     |        te-types:admin-group
    |     |  |     +--:(extended-admin-groups)
    |     |  |             {te-types:extended-admin-groups}?
    |     |  |        +--rw extended-admin-group?
    |     |  |              te-types:extended-admin-group
    |     |  +--:(named-admin-groups)
    |     |     +--rw named-admin-groups* [named-admin-group]
    |     |             {te-types:extended-admin-groups,
    |     |              te-types:named-extended-admin-groups}?
    |     |        +--rw named-admin-group    leafref
    |     +--rw (srlg-type)?
    |     |  +--:(value-srlgs)
    |     |  |  +--rw values* [value]
```

```
           |      |  |      +--rw value     uint32
           |      |  +--:(named-srlgs)
           |      |     +--rw named-srlgs* [named-srlg]
           |      |             {te-types:named-srlg-groups}?
           |      |        +--rw named-srlg    leafref
           |      +--rw threshold-type?                    enumeration
           |      +--rw delta-percentage?
           |      |       rt-types:percentage
           |      +--rw threshold-specification?        enumeration
           |      +--rw up-thresholds*
           |      |       rt-types:percentage
           |      +--rw down-thresholds*
           |      |       rt-types:percentage
           |      +--rw up-down-thresholds*
           |      |       rt-types:percentage
           |      +--rw switching-capabilities* [switching-capability]
           |      |  +--rw switching-capability    identityref
           |      |  +--rw encoding?               identityref
           |      +--ro state
           |         +--ro te-advertisements-state
           |            +--ro flood-interval?        uint32
           |            +--ro last-flooded-time?     uint32
           |            +--ro next-flooded-time?     uint32
           |            +--ro last-flooded-trigger?    enumeration
           |            +--ro advertised-level-areas* [level-area]
           |               +--ro level-area    uint32
       +--rw performance-thresholds
     augment /te:te/te:globals:
       +--rw lsp-install-interval?       uint32
       +--rw lsp-cleanup-interval?       uint32
       +--rw lsp-invalidation-interval?  uint32
     augment /te:te/te:tunnels/te:tunnel:
       +--rw path-invalidation-action?   identityref
       +--rw lsp-install-interval?       uint32
       +--rw lsp-cleanup-interval?       uint32
       +--rw lsp-invalidation-interval?  uint32
     augment /te:te/te:lsps/te:lsp:
       +--ro lsp-timers
       |  +--ro life-time?        uint32
       |  +--ro time-to-install?  uint32
       |  +--ro time-to-destroy?  uint32
       +--ro downstream-info
       |  +--ro nhop?                 te-types:te-tp-id
       |  +--ro outgoing-interface?   if:interface-ref
       |  +--ro neighbor
       |  |  +--ro id?      te-generic-node-id
       |  |  +--ro type?    enumeration
       |  +--ro label?                rt-types:generalized-label
```

```
      +--ro upstream-info
         +--ro phop?        te-types:te-tp-id
         +--ro neighbor
         |  +--ro id?      te-generic-node-id
         |  +--ro type?    enumeration
         +--ro label?        rt-types:generalized-label
    augment /te:te/te:tunnels/te:tunnel/te:secondary-paths
            /te:secondary-path/te:lsps/te:lsp:
      +--ro lsp-timers
      |  +--ro life-time?        uint32
      |  +--ro time-to-install?   uint32
      |  +--ro time-to-destroy?   uint32
      +--ro downstream-info
      |  +--ro nhop?               te-types:te-tp-id
      |  +--ro outgoing-interface?   if:interface-ref
      |  +--ro neighbor
      |  |  +--ro id?      te-generic-node-id
      |  |  +--ro type?    enumeration
      |  +--ro label?               rt-types:generalized-label
      +--ro upstream-info
         +--ro phop?        te-types:te-tp-id
         +--ro neighbor
         |  +--ro id?      te-generic-node-id
         |  +--ro type?    enumeration
         +--ro label?        rt-types:generalized-label
    augment /te:te/te:tunnels/te:tunnel/te:primary-paths
            /te:primary-path/te:lsps/te:lsp:
      +--ro lsp-timers
      |  +--ro life-time?        uint32
      |  +--ro time-to-install?   uint32
      |  +--ro time-to-destroy?   uint32
      +--ro downstream-info
      |  +--ro nhop?               te-types:te-tp-id
      |  +--ro outgoing-interface?   if:interface-ref
      |  +--ro neighbor
      |  |  +--ro id?      te-generic-node-id
      |  |  +--ro type?    enumeration
      |  +--ro label?               rt-types:generalized-label
      +--ro upstream-info
         +--ro phop?        te-types:te-tp-id
         +--ro neighbor
         |  +--ro id?      te-generic-node-id
         |  +--ro type?    enumeration
         +--ro label?        rt-types:generalized-label

    rpcs:
      +---x link-state-update
         +---w input
```

```
            +---w (filter-type)
               +--:(match-all)
               |  +---w all          empty
               +--:(match-one-interface)
                  +---w interface?   if:interface-ref
```

            Figure 10: TE generic YANG model tree diagram.

6.3. YANG Module

   The device TE YANG module 'ietf-te-device' imports the following
   module(s):

   o ietf-yang-types and ietf-inet-types defined in [RFC6991]

   o ietf-interfaces defined in [RFC8343]

   o ietf-routing-types defined in [RFC8294]

   o ietf-te-types defined in [RFC8776]

   o ietf-te defined in this document

 <CODE BEGINS> file "ietf-te-device@2020-07-12.yang"

 module ietf-te-device {
   yang-version 1.1;
   namespace "urn:ietf:params:xml:ns:yang:ietf-te-device";

   /* Replace with IANA when assigned */

   prefix te-dev;

   /* Import TE module */

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

   /* Import TE types */

   import ietf-te-types {
     prefix te-types;
     reference
```

```
          "RFC8776: Common YANG Data Types for Traffic Engineering.";
    }
    import ietf-interfaces {
      prefix if;
      reference
        "RFC8343: A YANG Data Model for Interface Management";
    }
    import ietf-routing-types {
      prefix rt-types;
      reference
        "RFC8294: Common YANG Data Types for the Routing Area";
    }

    organization
      "IETF Traffic Engineering Architecture and Signaling (TEAS)
       Working Group";
    contact
      "WG Web:   <http://tools.ietf.org/wg/teas/>
       WG List:  <mailto:teas@ietf.org>

       Editor:    Tarek Saad
                  <mailto:tsaad@juniper.net>

       Editor:    Rakesh Gandhi
                  <mailto:rgandhi@cisco.com>

       Editor:    Vishnu Pavan Beeram
                  <mailto:vbeeram@juniper.net>

       Editor:    Himanshu Shah
                  <mailto:hshah@ciena.com>

       Editor:    Xufeng Liu
                  <mailto: xufeng.liu.ietf@gmail.com>

       Editor:    Igor Bryskin
                  <mailto:i_bryskin@yahoo.com>";
    description
      "YANG data module for TE device configurations,
       state, and RPCs. The model fully conforms to the
       Network Management Datastore Architecture (NMDA).

       Copyright (c) 2019 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.";

   // RFC Ed.: replace XXXX with actual RFC number and remove this
   // note.
   // RFC Ed.: update the date below with the date of RFC publication
   // and remove this note.

   revision 2020-07-12 {
     description
       "Latest update to TE device YANG module.";
     reference
       "RFCXXXX: A YANG Data Model for Traffic Engineering Tunnels
        and Interfaces";
   }

   /**
    * TE LSP device state grouping
    */

   grouping lsps-device-info {
     description
       "TE LSP device state grouping.";
     container lsp-timers {
       when "../te:origin-type = 'ingress'" {
         description
           "Applicable to ingress LSPs only.";
       }
       description
         "Ingress LSP timers.";
       leaf life-time {
         type uint32;
         units "seconds";
         description
           "TE LSP life time.";
       }
       leaf time-to-install {
         type uint32;
         units "seconds";
         description
           "TE LSP installation delay time.";
       }
       leaf time-to-destroy {
         type uint32;
         units "seconds";
```

```
            description
              "TE LSP expiration delay time.";
          }
        }
        container downstream-info {
          when "../te:origin-type != 'egress'" {
            description
              "Downstream information of the LSP.";
          }
          description
            "downstream information.";
          leaf nhop {
            type te-types:te-tp-id;
            description
              "downstream nexthop address.";
          }
          leaf outgoing-interface {
            type if:interface-ref;
            description
              "downstream interface.";
          }
          container neighbor {
            uses te:te-generic-node-id;
            description
              "downstream neighbor address.";
          }
          leaf label {
            type rt-types:generalized-label;
            description
              "downstream label.";
          }
        }
        container upstream-info {
          when "../te:origin-type != 'ingress'" {
            description
              "Upstream information of the LSP.";
          }
          description
            "upstream information.";
          leaf phop {
            type te-types:te-tp-id;
            description
              "upstream nexthop or previous-hop address.";
          }
          container neighbor {
            uses te:te-generic-node-id;
            description
              "upstream neighbor address.";
```

```
          }
          leaf label {
            type rt-types:generalized-label;
            description
              "upstream label.";
          }
        }
      }
    }

    /**
     * Device general groupings.
     */

    grouping lsp-device-timers {
      description
        "Device TE LSP timers configs.";
      leaf lsp-install-interval {
        type uint32;
        units "seconds";
        description
          "TE LSP installation delay time.";
      }
      leaf lsp-cleanup-interval {
        type uint32;
        units "seconds";
        description
          "TE LSP cleanup delay time.";
      }
      leaf lsp-invalidation-interval {
        type uint32;
        units "seconds";
        description
          "TE LSP path invalidation before taking action delay time.";
      }
    }

    /**
     * TE global device groupings
     */
    /* TE interface container data */

    grouping interfaces-grouping {
      description
        "TE interface configuration data grouping.";
      container interfaces {
        description
          "Configuration data model for TE interfaces.";
        uses te-all-attributes;
```

```
        list interface {
          key "interface";
          description
            "TE interfaces.";
          leaf interface {
            type if:interface-ref;
            description
              "TE interface name.";
          }
          /* TE interface parameters */
          uses te-attributes;
        }
      }
    }

    /**
     * TE interface device groupings
     */

    grouping te-admin-groups-config {
      description
        "TE interface affinities grouping.";
      choice admin-group-type {
        description
          "TE interface administrative groups
           representation type.";
        case value-admin-groups {
          choice value-admin-group-type {
            description
              "choice of admin-groups.";
            case admin-groups {
              description
                "Administrative group/Resource
                 class/Color.";
              leaf admin-group {
                type te-types:admin-group;
                description
                  "TE interface administrative group.";
              }
            }
            case extended-admin-groups {
              if-feature "te-types:extended-admin-groups";
              description
                "Extended administrative group/Resource
                 class/Color.";
              leaf extended-admin-group {
                type te-types:extended-admin-group;
                description
```

```
                    "TE interface extended administrative group.";
                }
              }
            }
          }
        case named-admin-groups {
          list named-admin-groups {
            if-feature "te-types:extended-admin-groups";
            if-feature "te-types:named-extended-admin-groups";
            key "named-admin-group";
            description
              "A list of named admin-group entries.";
            leaf named-admin-group {
              type leafref {
                path "../../../../te:globals/"
                    + "te:named-admin-groups/te:named-admin-group/"
                    + "te:name";
              }
              description
                "A named admin-group entry.";
            }
          }
        }
      }
    }

    /* TE interface SRLGs */

    grouping te-srlgs-config {
      description
        "TE interface SRLG grouping.";
      choice srlg-type {
        description
          "Choice of SRLG configuration.";
        case value-srlgs {
          list values {
            key "value";
            description
              "List of SRLG values that
               this link is part of.";
            leaf value {
              type uint32 {
                range "0..4294967295";
              }
              description
                "Value of the SRLG";
            }
          }
```

```
              }
          case named-srlgs {
            list named-srlgs {
              if-feature "te-types:named-srlg-groups";
              key "named-srlg";
              description
                "A list of named SRLG entries.";
              leaf named-srlg {
                type leafref {
                  path "../../../../te:globals/"
                      + "te:named-srlgs/te:named-srlg/te:name";
                }
                description
                  "A named SRLG entry.";
              }
            }
          }
        }
      }

    grouping te-igp-flooding-bandwidth-config {
      description
        "Configurable items for igp flooding bandwidth
         threshold configuration.";
      leaf threshold-type {
        type enumeration {
          enum delta {
            description
              "'delta' indicates that the local
               system should flood IGP updates when a
               change in reserved bandwidth >= the specified
               delta occurs on the interface.";
          }
          enum threshold-crossed {
            description
              "THRESHOLD-CROSSED indicates that
               the local system should trigger an update (and
               hence flood) the reserved bandwidth when the
               reserved bandwidth changes such that it crosses,
               or becomes equal to one of the threshold values.";
          }
        }
        description
          "The type of threshold that should be used to specify the
           values at which bandwidth is flooded. 'delta' indicates that
           the local system should flood IGP updates when a change in
           reserved bandwidth >= the specified delta occurs on the
           interface. Where 'threshold-crossed' is specified, the local
```

```
              system should trigger an update (and hence flood) the
              reserved bandwidth when the reserved bandwidth changes such
              that it crosses, or becomes equal to one of the threshold
              values.";
        }
        leaf delta-percentage {
          when "../threshold-type = 'delta'" {
            description
              "The percentage delta can only be specified when the
               threshold type is specified to be a percentage delta of
               the reserved bandwidth.";
          }
          type rt-types:percentage;
          description
            "The percentage of the maximum-reservable-bandwidth
             considered as the delta that results in an IGP update
             being flooded.";
        }
        leaf threshold-specification {
          when "../threshold-type = 'threshold-crossed'" {
            description
              "The selection of whether mirrored or separate threshold
               values are to be used requires user specified thresholds to
               be set.";
          }
          type enumeration {
            enum mirrored-up-down {
              description
                "mirrored-up-down indicates that a single set of
                 threshold values should be used for both increasing
                 and decreasing bandwidth when determining whether
                 to trigger updated bandwidth values to be flooded
                 in the IGP TE extensions.";
            }
            enum separate-up-down {
              description
                "separate-up-down indicates that a separate
                 threshold values should be used for the increasing
                 and decreasing bandwidth when determining whether
                 to trigger updated bandwidth values to be flooded
                 in the IGP TE extensions.";
            }
          }
          description
            "This value specifies whether a single set of threshold
             values should be used for both increasing and decreasing
             bandwidth when determining whether to trigger updated
             bandwidth values to be flooded in the IGP TE extensions.
```

```
            'mirrored-up-down' indicates that a single value (or set of
            values) should be used for both increasing and decreasing
            values, where 'separate-up-down' specifies that the increasing
            and decreasing values will be separately specified.";
      }
      leaf-list up-thresholds {
        when "../threshold-type = 'threshold-crossed'"
           + "and ../threshold-specification = 'separate-up-down'" {
           description
             "A list of up-thresholds can only be specified when the
              bandwidth update is triggered based on crossing a
              threshold and separate up and down thresholds are
              required.";
        }
        type rt-types:percentage;
        description
          "The thresholds (expressed as a percentage of the maximum
           reservable bandwidth) at which bandwidth updates are to be
           triggered when the bandwidth is increasing.";
      }
      leaf-list down-thresholds {
        when "../threshold-type = 'threshold-crossed'"
           + "and ../threshold-specification = 'separate-up-down'" {
           description
             "A list of down-thresholds can only be specified when the
              bandwidth update is triggered based on crossing a
              threshold and separate up and down thresholds are
              required.";
        }
        type rt-types:percentage;
        description
          "The thresholds (expressed as a percentage of the maximum
           reservable bandwidth) at which bandwidth updates are to be
           triggered when the bandwidth is decreasing.";
      }
      leaf-list up-down-thresholds {
        when "../threshold-type = 'threshold-crossed'"
           + "and ../threshold-specification = 'mirrored-up-down'" {
           description
             "A list of thresholds corresponding to both increasing
              and decreasing bandwidths can be specified only when an
              update is triggered based on crossing a threshold, and
              the same up and down thresholds are required.";
        }
        type rt-types:percentage;
        description
          "The thresholds (expressed as a percentage of the maximum
           reservable bandwidth of the interface) at which bandwidth
```

```
          updates are flooded - used both when the bandwidth is
          increasing and decreasing.";
    }
  }

  /* TE interface metric */

  grouping te-metric-config {
    description
      "TE interface metric grouping.";
    leaf te-metric {
      type te-types:te-metric;
      description
        "TE interface metric.";
    }
  }

  /* TE interface switching capabilities */

  grouping te-switching-cap-config {
    description
      "TE interface switching capabilities.";
    list switching-capabilities {
      key "switching-capability";
      description
        "List of interface capabilities for this interface.";
      leaf switching-capability {
        type identityref {
          base te-types:switching-capabilities;
        }
        description
          "Switching Capability for this interface.";
      }
      leaf encoding {
        type identityref {
          base te-types:lsp-encoding-types;
        }
        description
          "Encoding supported by this interface.";
      }
    }
  }

  grouping te-advertisements-state {
    description
      "TE interface advertisements state grouping.";
    container te-advertisements-state {
      description
```

```
          "TE interface advertisements state container.";
        leaf flood-interval {
          type uint32;
          description
            "The periodic flooding interval.";
        }
        leaf last-flooded-time {
          type uint32;
          units "seconds";
          description
            "Time elapsed since last flooding in seconds.";
        }
        leaf next-flooded-time {
          type uint32;
          units "seconds";
          description
            "Time remained for next flooding in seconds.";
        }
        leaf last-flooded-trigger {
          type enumeration {
            enum link-up {
              description
                "Link-up flooding trigger.";
            }
            enum link-down {
              description
                "Link-down flooding trigger.";
            }
            enum threshold-up {
              description
                "Bandwidth reservation up threshold.";
            }
            enum threshold-down {
              description
                "Bandwidth reservation down threshold.";
            }
            enum bandwidth-change {
              description
                "Bandwidth capacity change.";
            }
            enum user-initiated {
              description
                "Initiated by user.";
            }
            enum srlg-change {
              description
                "SRLG property change.";
            }
```

```
            enum periodic-timer {
              description
                "Periodic timer expired.";
            }
          }
          default "periodic-timer";
          description
            "Trigger for the last flood.";
        }
        list advertised-level-areas {
          key "level-area";
          description
            "List of level-areas that the TE interface is advertised
             in.";
          leaf level-area {
            type uint32;
            description
              "The IGP area or level where the TE interface link state
               is advertised in.";
          }
        }
      }
    }

    /* TE interface attributes grouping */

    grouping te-attributes {
      description
        "TE attributes configuration grouping.";
      uses te-metric-config;
      uses te-admin-groups-config;
      uses te-srlgs-config;
      uses te-igp-flooding-bandwidth-config;
      uses te-switching-cap-config;
      container state {
        config false;
        description
          "State parameters for interface TE metric.";
        uses te-advertisements-state;
      }
    }

    grouping te-all-attributes {
      description
        "TE attributes configuration grouping for all
         interfaces.";
      uses te-igp-flooding-bandwidth-config;
    }
```

```
   /*** End of TE interfaces device groupings ***/
   /**
    * TE device augmentations
    */

   augment "/te:te" {
     description
       "TE global container.";
     /* TE Interface Configuration Data */
     uses interfaces-grouping;
     container performance-thresholds {
       description
         "Performance parameters configurable thresholds.";
     }
   }

   /* TE globals device augmentation */

   augment "/te:te/te:globals" {
     description
       "Global TE device specific configuration parameters.";
     uses lsp-device-timers;
   }

   /* TE tunnels device configuration augmentation */

   augment "/te:te/te:tunnels/te:tunnel" {
     description
       "Tunnel device dependent augmentation.";
     leaf path-invalidation-action {
       type identityref {
         base te-types:path-invalidation-action-type;
       }
       description
         "Tunnel path invalidation action.";
     }
     uses lsp-device-timers;
   }

   /* TE LSPs device state augmentation */

   augment "/te:te/te:lsps/te:lsp" {
     description
       "TE LSP device dependent augmentation.";
     uses lsps-device-info;
   }

   /* TE interfaces RPCs/execution Data */
```

```
  rpc link-state-update {
    description
      "Triggers a link state update for the specific interface.";
    input {
      choice filter-type {
        mandatory true;
        description
          "Filter choice.";
        case match-all {
          leaf all {
            type empty;
            mandatory true;
            description
              "Match all TE interfaces.";
          }
        }
        case match-one-interface {
          leaf interface {
            type if:interface-ref;
            description
              "Match a specific TE interface.";
          }
        }
      }
    }
  }
 }
 <CODE ENDS>
```

                  Figure 11: TE device specific YANG module

7. Notifications

   Notifications are a key component of any topology data model.

   [RFC8639] and [RFC8641] define a subscription mechanism and a push
   mechanism for YANG datastores. These mechanisms currently allow the
   user to:

   o Subscribe to notifications on a per-client basis.

   o Specify subtree filters or XML Path Language (XPath) filters so
      that only contents of interest will be sent.

   o Specify either periodic or on-demand notifications.

8. TE Generic and Helper YANG Modules

9. IANA Considerations

   This document registers the following URIs in the IETF XML registry
   [RFC3688]. Following the format in [RFC3688], the following
   registrations are requested to be made.

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

      URI: urn:ietf:params:xml:ns:yang:ietf-te-device
      Registrant Contact: The IESG.
      XML: N/A, the requested URI is an XML namespace.

   This document registers two YANG modules in the YANG Module Names
   registry [RFC6020].

      Name: ietf-te
      Namespace: urn:ietf:params:xml:ns:yang:ietf-te
      Prefix: te
      Reference: RFCXXXX

      Name: ietf-te-device
      Namespace: urn:ietf:params:xml:ns:yang:ietf-te-device
      Prefix: te-device
      Reference: RFCXXXX

10. 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 Network Configuration Access Control Model (NACM) [RFC8341]
   provides the means to restrict access for particular NETCONF or
   RESTCONF users to a preconfigured subset of all available NETCONF or
   RESTCONF protocol operations and content.

   There are a number of data nodes defined in this YANG module that are
   writable/creatable/deletable (i.e., config true, which is the
   default). These data nodes may be considered sensitive or vulnerable
   in some network environments. Write operations (e.g., edit-config)

to these data nodes without proper protection can have a negative
effect on network operations. These are the subtrees and data nodes
and their sensitivity/vulnerability:

"/te/globals": This module specifies the global TE configurations on
a device. Unauthorized access to this container could cause the
device to ignore packets it should receive and process.

"/te/tunnels": This list specifies the configured TE tunnels on a
device. Unauthorized access to this list could cause the device to
ignore packets it should receive and process.

"/te/interfaces": This list specifies the configured TE interfaces on
a device. Unauthorized access to this list could cause the device to
ignore packets it should receive and process.

Some of the readable data nodes in this YANG module may be considered
sensitive or vulnerable in some network environments. It is thus
important to control read access (e.g., via get, get-config, or
notification) to these data nodes. These are the subtrees and data
nodes and their sensitivity/vulnerability:

"/te/lsps": this list contains information state about established
LSPs in the network. An attacker can use this information to derive
information about the network topology, and subsequently orchestrate
further attacks.

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

"unnels-actions": using this RPC, an attacker can modify existing
paths that may be carrying live traffic, and hence result to
interruption to services carried over the network.

"/te/tunnels-path-compute": using this RPC, an attacker can retrieve
secured information about the network provider which can be used to
orchestrate further attacks.

The security considerations spelled out in the YANG 1.1 specification
[RFC7950] apply for this document as well.

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12. Contributors

    Himanshu Shah
    Ciena

    Email: hshah@ciena.com

    Xia Chen
    Huawei Technologies

    Email: jescia.chenxia@huawei.com

    Raqib Jones
    Brocade

    Email: raqib@Brocade.com

    Bin Wen
    Comcast

    Email: Bin_Wen@cable.comcast.com

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Authors' Addresses

   Tarek Saad
   Juniper Networks

   Email: tsaad@juniper.net

Rakesh Gandhi
Cisco Systems Inc

Email: rgandhi@cisco.com

Xufeng Liu
Volta Networks

Email: xufeng.liu.ietf@gmail.com

Vishnu Pavan Beeram
Juniper Networks

Email: vbeeram@juniper.net

Igor Bryskin
Individual

Email: i_bryskin@yahoo.com