YANG data model for Flexi-Grid Optical Networks
draft-ietf-ccamp-flexigrid-yang-03.txt

Status of this Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79. This document may not be modified, and derivative works of it may not be created, except to publish it as an RFC and to translate it into languages other than English.

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF), its areas, and its working groups. Note that other groups may also distribute working documents as Internet-Drafts.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

The list of current Internet-Drafts can be accessed at http://www.ietf.org/ietf/1id-abstracts.txt

The list of Internet-Draft Shadow Directories can be accessed at http://www.ietf.org/shadow.html

This Internet-Draft will expire on September 25, 2019.

Copyright Notice

Copyright (c) 2019 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to BCP 78 and the IETF Trust’s Legal Provisions Relating to IETF Documents (http://trustee.ietf.org/license-info) in effect on the date of publication of this document. Please review these documents.
carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.

Abstract

This document defines a YANG model for managing flexi-grid optical Networks. The model described in this document defines a flexi-grid traffic engineering database. A complementary module is referenced to detail the flexi-grid media channels.

This module is grounded on other defined YANG abstract models.

Table of Contents

1. Introduction .............................................. 2
2. Conventions used in this document ....................... 3
3. Flexi-grid network topology model overview ............... 3
4. Main building blocks of the Flexi-grid TED ............... 4
   4.1 Formal Syntax ....................................... 7
5. Example of use ............................................. 8
6. Flexi-grid TED YANG Model ............................... 9
   6.1 YANG Model - Tree .................................... 9
   6.2 YANG Model - Code .................................... 30
   6.3 License ............................................... 69
7. Security Considerations ................................... 69
8. IANA Considerations ....................................... 70
9. References ................................................ 71
   9.1 Normative References ................................ 71
   9.2 Informative References ............................... 71
10. Contributors ............................................... 72
11. Acknowledgments ........................................ 72
Authors’ Addresses ........................................... 72

1. Introduction

Internet-based traffic is dramatically increasing every year. Moreover, such traffic is also becoming more dynamic. Thus, transport networks need to evolve from current DWDM systems towards elastic optical networks, based on flexi-grid transmission and switching technologies [RFC7698]. This technology aims at increasing both transport network scalability and flexibility, allowing the optimization of bandwidth usage.
This document presents a YANG [RFC7950] model for flexi-grid objects in the dynamic optical network, including the nodes, transponders and links between them, as well as how such links interconnect nodes and transponders.

The YANG model for flexi-grid networks allows the representation of the flexi-grid optical layer of a network, combined with the underlying physical layer.

This document identifies the flexi-grid components, parameters and their values, characterizes the features and the performances of the flexi-grid elements. An application example is provided towards the end of the document to better understand their utility.

2. Conventions used in this document

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

In this document, these words will appear with that interpretation only when in ALL CAPS. Lower case uses of these words are not to be interpreted as carrying RFC-2119 significance.

In this document, the characters ">>" preceding an indented line(s) indicates a compliance requirement statement using the key words listed above. This convention aids reviewers in quickly identifying or finding the explicit compliance requirements of this RFC.

3. Flexi-grid network topology model overview

YANG is a data modeling language used to model configuration data manipulated by the NETCONF protocol. Several YANG models have already been specified for network configurations. For instance, the work in [RFC8345] has proposed a generic YANG model for network/service topologies and inventories. The work in [I-D.draft-ietf-teas-yang-te-topo] presents a data model to represent, retrieve and manipulate Traffic Engineering (TE) Topologies. These models serve as base models that other technology specific models can augment. A YANG model has also been proposed in [I-D.draft-dharini-ccamp-dwdm-if-yang] to manage single channel optical interface parameters of DWDM applications, and in
Another model has been specified for the routing and wavelength assignment TE topology in wavelength switched optical networks (WSONs). None of them are specific for flexi-grid technology.

Then, as stated before, we propose a model to describe a flexi-grid topology that is split in two YANG sub-modules:

- **Flexi-grid-topology**: In order to be compatible with existing proposals, we augment the definitions contained in [RFC8345] and [I-D.draft-ietf-teas-yang-te-topo], by defining the different elements we can find in a flexi-grid network: a node, a transponder and a link. For that, each of those elements is defined as a container that includes a group of attributes. References to the elements are provided to be later used in the definition of a media channel. It also includes the data types for the type of modulation, the flexi-grid technology, the FEC, etc.

- **Media-channel**: This module defines the whole path from a source transponder to the destination through a number of intermediate nodes and links. For this, it takes the information defined before in the flexi-grid topology. This module is described in [I-D.draft-ietf-ccamp-flexigrid-media-channel-yang]

The following section provides a detailed view of the first module.

### 4. Main building blocks of the Flexi-grid topology

This section details the defined YANG module. It is listed below in section 6.

The description of the three main components, flexi-grid-node, flexi-grid-transponder and flexi-grid-link is provided below. flexi-grid-sliceable-transponders are also defined.

```
<flexi-grid-node> ::= <config> <state>

<flexi-grid-node>: This element designates a node in the network.

<config> ::= <flexi-grid-node-attributes-config>

<config>: Contains the configuration of a node.
<flexi-grid-node-attributes-config> ::= <list-interface> <connectivity_matrix>

<flexi-grid-node-attributes-config>: Contains all the attributes related to the node configuration, such as its interfaces or its management addresses.
```
<list-interface> ::= <name> <port-number>
<input-port> <output-port> <description>
@interface-type>
[<numbered-interface> / <unnumbered-interface>]

=list-interface>: The list containing all the information of the interfaces.
=name>: Determines the interface name.
=port-number>: Port number of the interface.
=input-port>: Boolean value that defines whether the interface is input or not.
=output-port>: Boolean value that defines whether the interface is output or not.
=description>: Description of the usage of the interface.
@interface-type>: Determines if the interface is numbered or unnumbered.

<numbered-interface> ::= <n-i-ip-address>
<numbered-interface>: An interface with its own IP address.
<n-i-ip-address>: Only available if <interface-type> is "numbered-interface". Determines the IP address of the interface.

<unnumbered-interface> ::= <u-i-ip-address> <label>
<unnumbered-interface>: A interface that needs a label to be unique.
<u-i-ip-address>: Only available if <interface-type> is "numbered-interface". Determines the node IP address, which with the label defines the interface.
<label>: Label that determines the interface, joint with the node IP address.

=connectivity-matrix> ::= <connections>

=connectivity-matrix>: Determines whether a connection port in/port out exists.
=connections> ::= <input-port-id> <output-port-id>
<flexi-grid-transponder> ::= <transponder-type> <config> <state>

<flexi-grid-transponder>: This item designates a transponder of a node.

<config> ::= <flexi-grid-transponder-attributes-config>

<config>: Contains the configuration of a transponder.

<flexi-grid-transponder-attributes-config> ::= <available-operational-mode> <operational-mode>

<flexi-grid-transponder-attributes>: Contains all the attributes related to the transponder.

<available-operational-mode>: It provides a list of the operational modes available at this transponder.

<operational-mode>: Determines the type of operational mode in use.

<state> ::= <flexi-grid-transponder-attributes-config> <flexi-grid-transponder-attributes-state>

<state>: Contains the state of a transponder.

<flexi-grid-transponder-attributes-config>: See above.

<flexi-grid-transponder-attributes-state>: Contains the state of a transponder.

<link> ::= <config> <state>

<link>: This element describes all the information of a link.

<config> ::= <flexi-grid-link-attributes-config>

<config>: Contains the configuration of a link.
<flexi-grid-link-attributes-config> ::= <technology-type>
<available-label-flexi-grid> <N-max> <base-frequency>
<nominal-central-frequency-granularity>
<slot-width-granularity>

<flexi-grid-link-attributes>: Contains all the attributes related to the link, such as its unique id, its N value, its latency, etc.

<link-id>: Unique id of the link.

<available-label-flexi-grid>: Array of bits that determines, with each bit, the availability of each interface for flexi-grid technology.

<N-max>: The max value of N in this link, being N the number of slots.

<base-frequency>: The default central frequency used in the link.

<nominal-central-frequency-granularity>: It is the spacing between allowed nominal central frequencies and it is set to 6.25 GHz (note: sometimes referred to as 0.00625 THz).

<slot-width-granularity>: 12.5 GHz, as defined in G.694.1.

<state> ::= <flexi-grid-link-attributes-config>
<flexi-grid-link-attributes-state>

<state>: Contains the state of a link.

<flexi-grid-link-attributes-config>: See above.

<flexi-grid-link-attributes-state>: Contains all the information related to the state of a link.

4.1. Formal Syntax

The previous syntax specification uses the augmented Backus-Naur Form (BNF) as described in [RFC5234].

5. Example of use

In order to explain how this model is used, we provide the following example. An optical network usually has multiple transponders, switches (nodes) and links between them. Figure 1 shows a simple topology, where two physical paths interconnect two optical transponders.

In order to configure a media channel to interconnect transponders A and E, first of all we have to populate the flexi-grid TED YANG model with all elements in the network:

1. We define the transponders A and E, including their FEC type, if enabled, and modulation type. We also provide node identifiers and addresses for the transponders, as well as interfaces included in the transponders. Sliceable transponders can also be defined if needed.

2. We do the same for the nodes B, C and D, providing their identifiers, addresses and interfaces, as well as the internal connectivity matrix between interfaces.

3. Then, we also define the links 1 to 5 that interconnect nodes and transponders, indicating which flexi-grid labels are available. Other information, such as the slot frequency and granularity are also provided.
Next, we can configure the media channel from the information we have stored in the flexi-grid TED, by querying which elements are available, and planning the resources that have to be provided on each situation. Note that every element in the flexi-grid TED has a reference, and this is the way in which they are called in the media channel. We refer to [I-D.draft-ietf-ccamp-flexigrid-media-channel-yang] to complete this example.

6. Flexi-grid TED YANG Model

6.1. Yang Model - Tree Structure

module: ietf-flexi-grid-topology
   augment /nw:networks/nw:network/nw:network-types/tet:te-topology:
      +--rw flexi-grid-topology!
   augment /nw:networks/nw:network/nt:link/tet:te/tet:te-link-attributes:
      +--rw supported-payload-types* [index]
      |  +--rw index   uint16
      |  +--rw payload-type? string
      +--rw client-facing?             boolean
   augment /nw:networks/nw:network/nw:node/tet:te/tet:te-node-attributes:
      +--rw flexi-grid-node
      +--rw node-type?   identityref
   augment /nw:networks/nw:network/nw:node/tet:te/tet:tunnel-termination-point:
      +--rw supported-operational-modes*    layer0-types:operational-mode
      +--rw configured-operational-modes?   layer0-types:operational-mode
      +--rw supported-fec-types*            identityref
      +--rw supported-termination-types*    identityref
      +--rw supports-bit-stuffing?          boolean
      +--rw is-tunable?                     boolean
      +--rw max-subcarrier-channel-num?     uint8
      +--rw supports-flexi-grid?             boolean
      tet:interface-switching-capability/tet:max-lsp-bandwidth/
      tet:technology:
         +--:(flexi-grid)
         +--rw bandwidth-type?   identityref
      tet:connectivity-matrices/tet:path-constraints/tet:te-bandwidth/
      tet:technology:
         +--:(flexi-grid)
         +--rw supported-bandwidth-list*   identityref
augment
  tet:connectivity-matrices/tet:connectivity-matrix/
  tet:path-constraints/tet:te-bandwidth/tet:technology:
  ++--:(flexi-grid)
  +--rw supported-bandwidth-list* identityref
augment
  /nw:networks/nw:network/nw:node/tet:te/
  tet:information-source-entry/tet:connectivity-matrices/
  tet:path-constraints/tet:te-bandwidth/tet:technology:
  ++--:(flexi-grid)
  +--ro supported-bandwidth-list* identityref
augment
  /nw:networks/nw:network/nw:node/tet:te/
  tet:technology:
  ++--:(flexi-grid)
  +--ro supported-bandwidth-list* identityref
augment
  /nw:networks/nw:network/nw:node/tet:te/
  tet:tunnel-termination-point/tet:client-layer-adaptation/
  tet:switching-capability/tet:te-bandwidth/tet:technology:
  ++--:(flexi-grid)
  +--rw supported-bandwidth-list* identityref
augment
  /nw:networks/nw:network/nw:node/tet:te/
  tet:tunnel-termination-point/tet:local-link-connectivities/
  tet:path-constraints/tet:te-bandwidth/tet:technology:
  ++--:(flexi-grid)
  +--rw supported-bandwidth-list* identityref
augment
  /nw:networks/nw:network/nw:node/tet:te/
  tet:tunnel-termination-point/tet:local-link-connectivities/
  tet:local-link-connectivity/tet:path-constraints/
  tet:te-bandwidth/tet:technology:
  ++--:(flexi-grid)
  +--rw supported-bandwidth-list* identityref
augment
  tet:interface-switching-capability/tet:max-lsp-bandwidth/
  tet:te-bandwidth/tet:technology:
  ++--:(flexi-grid)
  +--rw bandwidth-type? identityref
augment
  tet:max-link-bandwidth/tet:te-bandwidth/tet:technology:
  ++--:(flexi-grid)
  +--rw supported-bandwidth-list* identityref
    tet:max-resv-link-bandwidth/tet:te-bandwidth/tet:technology:
    +--:(flexi-grid)
        +--rw supported-bandwidth-list* identityref
    tet:unreserved-bandwidth/tet:te-bandwidth/tet:technology:
    +--:(flexi-grid)
        +--rw supported-bandwidth-list* identityref
augment /nw:networks/nw:network/nt:link/tet:te/
    tet:information-source-entry/tet:interface-switching-capability/
    tet:max-lsp-bandwidth/tet:te-bandwidth/tet:technology:
    +--:(flexi-grid)
        +--ro bandwidth-type? identityref
augment /nw:networks/nw:network/nt:link/tet:te/
    tet:information-source-entry/tet:max-link-bandwidth/
    tet:te-bandwidth/tet:technology:
    +--:(flexi-grid)
        +--ro supported-bandwidth-list* identityref
augment /nw:networks/nw:network/nt:link/tet:te/
    tet:information-source-entry/tet:max-resv-link-bandwidth/
    tet:te-bandwidth/tet:technology:
    +--:(flexi-grid)
        +--ro supported-bandwidth-list* identityref
augment /nw:networks/nw:network/nt:link/tet:te/
    tet:information-source-entry/tet:unreserved-bandwidth/
    tet:te-bandwidth/tet:technology:
    +--:(flexi-grid)
        +--ro supported-bandwidth-list* identityref
    tet:te-link-attributes/tet:interface-switching-capability/
    tet:max-lsp-bandwidth/tet:te-bandwidth/tet:technology:
    +--:(flexi-grid)
        +--rw bandwidth-type? identityref
    tet:te-link-attributes/tet:max-link-bandwidth/tet:te-bandwidth/
    tet:technology:
    +--:(flexi-grid)
        +--rw supported-bandwidth-list* identityref
    tet:te-link-attributes/tet:max-resv-link-bandwidth/
    tet:te-bandwidth/tet:technology:
    +--:(flexi-grid)
        +--rw supported-bandwidth-list* identityref
augment
tet:te-link-attributes/tet:unreserved-bandwidth/
tet:te-bandwidth/tet:technology:
  +--:(flexi-grid)
  |    +--rw supported-bandwidth-list* identityref
augment
tet:connectivity-matrices/tet:label-restrictions/
tet:label-restriction:
  +--rw grid-type? identityref
  +--rw priority? uint8
  +--rw flexi-grid
    +--rw nominal-central-frequency-granularity? identityref
    +--rw slot-width-granularity? identityref
    +--rw min-slot-width-factor? uint16
    +--rw max-slot-width-factor? uint16
augment
tet:connectivity-matrices/tet:label-restrictions/
tet:label-restriction/tet:label-start/tet:te-label/
tet:technology:
  +--:(flexi-grid)
  |    +--rw flex-n? int16
augment
tet:connectivity-matrices/tet:label-restrictions/
tet:label-restriction/tet:label-end/tet:te-label/tet:technology:
  +--:(flexi-grid)
  |    +--rw flex-n? int16
augment
tet:connectivity-matrices/tet:label-restrictions/
tet:label-restriction/tet:label-step/tet:technology:
  +--:(flexi-grid)
  |    +--rw flex? identityref
augment
tet:connectivity-matrices/tet:underlay/tet:primary-path/
tet:technology:
  +--:(flexi-grid)
  |    +--rw (single-or-super-channel)?
  |      +--:(single)
  |        |    +--rw flex-n? int16
  |      |    +--rw flex-m? uint16
  |      +--:(super)
  |        +--rw subcarrier-flex-n* [flex-n]
  |          +--rw flex-n int16
  |          +--rw flex-m? uint16
augment
tet:technology:
  ++--:(flexi-grid)
  ++--rw (single-or-super-channel)?
    ++--:(single)
      | ++--rw flex-n? int16
      | ++--rw flex-m? uint16
    ++--:(super)
      ++--rw subcarrier-flex-n* [flex-n]
         ++--rw flex-n int16
         ++--rw flex-m? uint16

augment
tet:metric/tet:optimization-metric/
tet:explicit-route-exclude-objects/
tet:route-object-exclude-object/tet:type/tet:label/
tet:label-hop/tet:te-label/tet:technology:
  ++--:(flexi-grid)
  ++--rw (single-or-super-channel)?
    ++--:(single)
      | ++--rw flex-n? int16
      | ++--rw flex-m? uint16
    ++--:(super)
      ++--rw subcarrier-flex-n* [flex-n]
         ++--rw flex-n int16
         ++--rw flex-m? uint16

augment
tet:metric/tet:optimization-metric/
tet:explicit-route-include-objects/
tet:route-object-include-object/tet:type/tet:label/
tet:label-hop/tet:te-label/tet:technology:
  ++--:(flexi-grid)
  ++--rw (single-or-super-channel)?
    ++--:(single)
      | ++--rw flex-n? int16
      | ++--rw flex-m? uint16
    ++--:(super)
      ++--rw subcarrier-flex-n* [flex-n]
         ++--rw flex-n int16
         ++--rw flex-m? uint16

augment
tet:connectivity-matrices/tet:path-properties/
tet:path-route-objects/tet:path-route-object/tet:type/
tet:label/tet:label-hop/tet:te-label/tet:technology:
  +--ro (single-or-super-channel)?
  +--:(single)
   |  +--ro flex-n?  int16
   |  +--ro flex-m?  uint16
  +--:(super)
   +--ro subcarrier-flex-n* [flex-n]
     +--ro flex-n  int16
     +--ro flex-m? uint16
augment
tet:label-restrictions/tet:label-restriction:
  +--rw grid-type?  identityref
  +--rw priority?  uint8
  +--rw flexi-grid
   +--rw nominal-central-frequency-granularity?  identityref
   +--rw slot-width-granularity?  identityref
   +--rw min-slot-width-factor?  uint16
   +--rw max-slot-width-factor?  uint16
augment
tet:label-restrictions/tet:label-restriction/tet:label-start:
  +--:(flexi-grid)
    +--rw flex-n?  int16
augment
tet:label-restrictions/tet:label-restriction/tet:label-end:
  +--:(flexi-grid)
    +--rw flex-n?  int16
augment
tet:label-restrictions/tet:label-restriction/tet:label-step/
tet:technology:
  +--:(flexi-grid)
    +--rw flex?  identityref
Internet-Draft     A YANG data model for Flexi-Grid     March 2019

augment
tet:label-restrictions/tet:label-restriction:
  +--rw grid-type?      identityref
  +--rw priority?       uint8
  +--rw flexi-grid
    +--rw nominal-central-frequency-granularity?   identityref
    +--rw slot-width-granularity?                  identityref
    +--rw min-slot-width-factor?                   uint16
    +--rw max-slot-width-factor?                   uint16

augment
tet:label-restrictions/tet:label-restriction/tet:label-start/
tet:te-label/tet:technology:
  +=:(flexi-grid)
  +--rw flex-n?     int16

augment
tet:label-restrictions/tet:label-restriction/tet:label-end/
tet:te-label/tet:technology:
  +=:(flexi-grid)
  +--rw flex-n?     int16

augment
tet:label-restrictions/tet:label-restriction/tet:label-step/
tet:te-label/tet:technology:
  +=:(flexi-grid)
  +--rw flex?       identityref

augment
tet:primary-path/tet:path-element/tet:type/tet:label/
tet:label-hop/tet:te-label/tet:technology:
  +=:(flexi-grid)
  +--rw (single-or-super-channel)?
    +=:(single)
      |  +--rw flex-n?     int16
      |  +--rw flex-m?     uint16
    +=:(super)
      +--rw subcarrier-flex-n* [flex-n]
        +--rw flex-n     int16
        +--rw flex-m?    uint16

augment
tet:label-hop/tet:te-label/tet:technology:
  +--:(flexi-grid)
    +--rw (single-or-super-channel)?
      +--:(single)
      |  +--rw flex-n? int16
      |  +--rw flex-m? uint16
      +--:(super)
      |  +--rw subcarrier-flex-n* [flex-n]
      |     +--rw flex-n int16
      |     +--rw flex-m? uint16

augment
tet:connectivity-matrices/tet:connectivity-matrix/
tet:optimizations/tet:algorithm/tet:metric/
tet:optimization-metric/tet:explicit-route-exclude-objects/
tet:route-object-exclude-object/tet:type/tet:te-label/
tet:label-hop/tet:te-label/tet:technology:
  +--:(flexi-grid)
    +--rw (single-or-super-channel)?
      +--:(single)
      |  +--rw flex-n? int16
      |  +--rw flex-m? uint16
      +--:(super)
      |  +--rw subcarrier-flex-n* [flex-n]
      |     +--rw flex-n int16
      |     +--rw flex-m? uint16

augment
tet:connectivity-matrices/tet:connectivity-matrix/
tet:optimizations/tet:algorithm/tet:metric/
tet:optimization-metric/tet:explicit-route-include-objects/
tet:route-object-include-object/tet:type/tet:te-label/
tet:label-hop/tet:te-label/tet:technology:
  +--:(flexi-grid)
    +--rw (single-or-super-channel)?
      +--:(single)
      |  +--rw flex-n? int16
      |  +--rw flex-m? uint16
      +--:(super)
      |  +--rw subcarrier-flex-n* [flex-n]
      |     +--rw flex-n int16
      |     +--rw flex-m? uint16

augment
tet:connectivity-matrices/tet:connectivity-matrix/
tet:path-properties/tet:path-route-objects/
tet:path-route-object/tet:type/tet:label/tet:label-hop/
tet:te-label/tet:technology:
  +--:(flexi-grid)
  |    +--ro (single-or-super-channel)?
  |    |    +--:(single)
  |    |      |    +--ro flex-n? int16
  |    |      |    +--ro flex-m? uint16
  |    +--:(super)
  |        +--ro subcarrier-flex-n* [flex-n]
  |        |    +--ro flex-n int16
  |        |    +--ro flex-m? uint16
augment
/nw:networks/nw:network/nw:node/tet:te/
tet:information-source-entry/tet:connectivity-matrices/
tet:label-restrictions/tet:label-restriction:
  +--ro grid-type? identityref
  +--ro priority? uint8
  +--ro flexi-grid
  |    +--ro nominal-central-frequency-granularity? identityref
  |    +--ro slot-width-granularity? identityref
  |    +--ro min-slot-width-factor? uint16
  |    +--ro max-slot-width-factor? uint16
augment
/nw:networks/nw:network/nw:node/tet:te/
tet:information-source-entry/tet:connectivity-matrices/
tet:label-restrictions/tet:label-restriction/tet:label-start/
tet:te-label/tet:technology:
  +--:(flexi-grid)
  |    +--ro flex-n? int16
augment
/nw:networks/nw:network/nw:node/tet:te/
tet:information-source-entry/tet:connectivity-matrices/
tet:label-restrictions/tet:label-restriction/tet:label-end/
tet:te-label/tet:technology:
  +--:(flexi-grid)
  |    +--ro flex-n? int16
augment
/nw:networks/nw:network/nw:node/tet:te/
tet:information-source-entry/tet:connectivity-matrices/
tet:label-restrictions/tet:label-restriction/tet:label-step/
tet:technology:
  +--:(flexi-grid)
  +--ro flex? identityref

augment
/nw:networks/nw:network/nw:node/tet:te/
  tet:information-source-entry/tet:connectivity-matrices/
  tet:underlay/tet:primary-path/tet:path-element/tet:type/
  tet:label/tet:label-hop/tet:te-label/tet:technology:
  +--:(flexi-grid)
  |  +--ro (single-or-super-channel)?
  |  |  +--:(single)
  |  |  |  +--ro flex-n?              int16
  |  |  |  +--ro flex-m?              uint16
  |  |  +--:(super)
  |  |  |  +--ro subcarrier-flex-n* [flex-n]
  |  |  |  |  +--ro flex-n    int16
  |  |  +--ro flex-m?   uint16
augment
/nw:networks/nw:network/nw:node/tet:te/
  tet:information-source-entry/tet:connectivity-matrices/
  tet:label/tet:label-hop/tet:te-label/tet:technology:
  +--:(flexi-grid)
  |  +--ro (single-or-super-channel)?
  |  |  +--:(single)
  |  |  |  +--ro flex-n?              int16
  |  |  |  +--ro flex-m?              uint16
  |  |  +--:(super)
  |  |  |  +--ro subcarrier-flex-n* [flex-n]
  |  |  |  |  +--ro flex-n    int16
  |  |  +--ro flex-m?   uint16
augment
/nw:networks/nw:network/nw:node/tet:te/
  tet:information-source-entry/tet:connectivity-matrices/
  tet:optimizations/tet:algorithm/tet:metric/
  tet:optimization-metric/tet:explicit-route-exclude-objects/
  tet:route-object-exclude-object/tet:type/tet:label/
  tet:label-hop/tet:te-label/tet:technology:
  +--:(flexi-grid)
  |  +--ro (single-or-super-channel)?
  |  |  +--:(single)
  |  |  |  +--ro flex-n?              int16
  |  |  |  +--ro flex-m?              uint16
  |  |  +--:(super)
  |  |  |  +--ro subcarrier-flex-n* [flex-n]
  |  |  |  |  +--ro flex-n    int16
  |  |  +--ro flex-m?   uint16
augment
/nw:networks/nw:network/nw:node/tet:te/
  tet:information-source-entry/tet:connectivity-matrices/
  tet:optimization-tet:algorithm/tet:metric/
  tet:optimization-metric/tet:explicit-route-include-objects/
  tet:route-object-include-object/tet:type/tet:label/
  tet:label-hop/tet:te-label/tet:technology:
++--:(flexi-grid)
  +++-ro (single-or-super-channel)?
    ++--:(single)
      |  +++-ro flex-n?           int16
      |  +++-ro flex-m?           uint16
    ++--:(super)
      +++-ro subcarrier-flex-n* [flex-n]
      +++-ro flex-n    int16
      +++-ro flex-m?   uint16
augment
/nw:networks/nw:network/nw:node/tet:te/
  tet:information-source-entry/tet:connectivity-matrices/
  tet:path-properties/tet:path-route-objects/
  tet:path-route-object/tet:type/tet:label/tet:label-hop/
  tet:te-label/tet:technology:
++--:(flexi-grid)
  +++-ro (single-or-super-channel)?
    ++--:(single)
      |  +++-ro flex-n?           int16
      |  +++-ro flex-m?           uint16
    ++--:(super)
      +++-ro subcarrier-flex-n* [flex-n]
      +++-ro flex-n    int16
      +++-ro flex-m?   uint16
augment
/nw:networks/nw:network/nw:node/tet:te/
  tet:information-source-entry/tet:connectivity-matrices/
  tet:connectivity-matrix/tet:from/tet:label-restrictions/
  tet:label-restriction:
++--ro grid-type?   identityref
++--ro priority?    uint8
++--ro flexi-grid
  +++-ro nominal-central-frequency-granularity?   identityref
  +++-ro slot-width-granularity?                   identityref
  +++-ro min-slot-width-factor?                   uint16
  +++-ro max-slot-width-factor?                   uint16
augment
/nw:networks/nw:network/nw:node/tet:te/
  tet:information-source-entry/tet:connectivity-matrices/
  tet:connectivity-matrix/tet:from/tet:label-restrictions/
  tet:label-restriction/tet:label-start/tet:te-label/
  tet:technology:
++--:(flexi-grid)
  +++-ro flex-n?   int16

augment
/nw:networks/nw:network/nw:node/tet:te/
  tet:information-source-entry/tet:connectivity-matrices/
  tet:connectivity-matrix/tet:from/tet:label-restrictions/
  tet:label-restriction/tet:label-end/tet:te-label/tet:technology:
    +-•:(flexi-grid)
    +--ro flex-n?   int16

augment
/nw:networks/nw:network/nw:node/tet:te/
  tet:information-source-entry/tet:connectivity-matrices/
  tet:connectivity-matrix/tet:from/tet:label-restrictions/
  tet:label-restriction/tet:label-step/tet:technology:
    +-•:(flexi-grid)
    +--ro flex?   identityref

augment
/nw:networks/nw:network/nw:node/tet:te/
  tet:information-source-entry/tet:connectivity-matrices/
  tet:connectivity-matrix/tet:to/tet:label-restrictions/
  tet:label-restriction/tet:label-start/tet:te-label/
  tet:technology:
    +-•:(flexi-grid)
    +--ro flex-n?   int16

augment
/nw:networks/nw:network/nw:node/tet:te/
  tet:information-source-entry/tet:connectivity-matrices/
  tet:connectivity-matrix/tet:to/tet:label-restrictions/
  tet:label-restriction/tet:label-end/tet:te-label/tet:technology:
    +-•:(flexi-grid)
    +--ro flex-n?   int16

augment
/nw:networks/nw:network/nw:node/tet:te/
  tet:information-source-entry/tet:connectivity-matrices/
  tet:connectivity-matrix/tet:to/tet:label-restrictions/
  tet:label-restriction/tet:label-step/tet:technology:
    +-•:(flexi-grid)
    +--ro flex?   identityref
augment
  /nw:networks/nw:network/nw:node/tet:te/
  tet:information-source-entry/tet:connectivity-matrices/
  tet:connectivity-matrix/tet:underlay/tet:primary-path/
  tet:path-element/tet:type/tet:label/tet:label-hop/
  tet:te-label/tet:technology:
  +--:(flexi-grid)
  +--ro (single-or-super-channel)?
  +--:(single)
    |  +--ro flex-n?     int16
    |  +--ro flex-m?     uint16
  +--:(super)
    +--ro subcarrier-flex-n* [flex-n]
    +--ro flex-n     int16
    +--ro flex-m?    uint16
augment
  /nw:networks/nw:network/nw:node/tet:te/
  tet:information-source-entry/tet:connectivity-matrices/
  tet:path-element/tet:type/tet:label/tet:label-hop/
  tet:te-label/tet:technology:
  +--:(flexi-grid)
  +--ro (single-or-super-channel)?
  +--:(single)
    |  +--ro flex-n?     int16
    |  +--ro flex-m?     uint16
  +--:(super)
    +--ro subcarrier-flex-n* [flex-n]
    +--ro flex-n     int16
    +--ro flex-m?    uint16
augment
  /nw:networks/nw:network/nw:node/tet:te/
  tet:information-source-entry/tet:connectivity-matrices/
  tet:metric/tet:optimization-metric/
  tet:explicit-route-exclude-objects/
  tet:route-object-exclude-object/tet:type/tet:label/
  tet:label-hop/tet:te-label/tet:technology:
  +--:(flexi-grid)
  +--ro (single-or-super-channel)?
  +--:(single)
    |  +--ro flex-n?     int16
    |  +--ro flex-m?     uint16
  +--:(super)
    +--ro subcarrier-flex-n* [flex-n]
    +--ro flex-n     int16
    +--ro flex-m?    uint16
augment
/nw:networks/nw:network/nw:node/tet:te/
  tet:information-source-entry/tet:connectivity-matrices/
  tet:metric/tet:optimization-metric/
  tet:explicit-route-include-objects/
  tet:route-object-include-object/tet:type/tet:label/
  tet:label-hop/tet:te-label/tet:technology:
    ++--:(flexi-grid)
    |   ++--ro (single-or-super-channel)?
    |   |      +--:(single)
    |   |      |      ++--ro flex-n?              int16
    |   |      |      ++--ro flex-m?              uint16
    |   |      ++--:(super)
    |   |      |      ++--ro subcarrier-flex-n* [flex-n]
    |   |      |      |      ++--ro flex-n    int16
    |   |      |      |      ++--ro flex-m?   uint16
    |   |      ++--:(single)
    |   |      |      ++--ro flex-n?              int16
    |   |      |      ++--ro flex-m?              uint16
    |   |      ++--:(super)
    |   |      |      ++--ro subcarrier-flex-n* [flex-n]
    |   |      |      |      ++--ro flex-n    int16
    |   |      |      |      ++--ro flex-m?   uint16
augment
/nw:networks/nw:network/nw:node/tet:te/
  tet:information-source-entry/tet:connectivity-matrices/
  tet:connectivity-matrix/tet:path-properties/
  tet:label-hop/tet:te-label/tet:technology:
    ++--:(flexi-grid)
    |   ++--ro (single-or-super-channel)?
    |   |      +--:(single)
    |   |      |      ++--ro flex-n?              int16
    |   |      |      ++--ro flex-m?              uint16
    |   |      ++--:(super)
    |   |      |      ++--ro subcarrier-flex-n* [flex-n]
    |   |      |      |      ++--ro flex-n    int16
    |   |      |      |      ++--ro flex-m?   uint16
    |   |      ++--:(flexi-grid)
    |   |      |      ++--ro (single-or-super-channel)?
    |   |      |      |      +--:(single)
    |   |      |      |      |      ++--ro flex-n?              int16
    |   |      |      |      |      ++--ro flex-m?              uint16
    |   |      |      |      |      ++--:(super)
    |   |      |      |      |      ++--ro subcarrier-flex-n* [flex-n]
    |   |      |      |      |      |      ++--ro flex-n    int16
    |   |      |      |      |      |      ++--ro flex-m?   uint16
    |   |      |      |      |      |      |      ++--ro flex-n?              int16
    |   |      |      |      |      |      |      |      ++--ro flex-m?              uint16

augment
/nw:networks/nw:network/nw:node/tet:te/
  tet:tunnel-termination-point/tet:local-link-connectivities/
  tet:label-restrictions/tet:label-restriction:
    ++--rw grid-type?   identityref
    ++--rw priority?    uint8
    ++--rw flexi-grid
      ++--rw nominal-central-frequency-granularity? identityref
      ++--rw slot-width-granularity? identityref
      ++--rw min-slot-width-factor?           uint16
      ++--rw max-slot-width-factor?           uint16
augment
/nw:networks/nw:network/nw:node/tet:te/
  tet:tunnel-termination-point/tet:local-link-connectivities/
  tet:label-restrictions/tet:label-restriction/tet:label-start/
  tet:label/tet:technology:
    ++--:(flexi-grid)
    |    ++--rw flexi-grid
    |         ++--rw flex-n?              int16
augment
/nw:networks/nw:network/nw:node/tet:te/
tet:tunnel-termination-point/tet:local-link-connectivities/
tet:label-restrictions/tet:label-restriction/tet:label-end/
tet:te-label/tet:technology:
    +--:(flexi-grid)
    +--rw flex-n?   int16
augment
/nw:networks/nw:network/nw:node/tet:te/
tet:tunnel-termination-point/tet:local-link-connectivities/
tet:label-restrictions/tet:label-restriction/tet:label-step/
tet:technology:
    +--:(flexi-grid)
    +--rw flex?   identityref
augment
/nw:networks/nw:network/nw:node/tet:te/
tet:tunnel-termination-point/tet:local-link-connectivities/
tet:underlay/tet:primary-path/tet:path-element/tet:type/
tet:label/tet:label-hop/tet:te-label/tet:technology:
    +--:(flexi-grid)
    +--rw (single-or-super-channel)?
        +--:(single)
            |   +--rw flex-n?   int16
            |   +--rw flex-m?   uint16
        +--:(super)
            +--rw subcarrier-flex-n* [flex-n]
                +--rw flex-n   int16
                +--rw flex-m?   uint16
augment
/nw:networks/nw:network/nw:node/tet:te/
tet:tunnel-termination-point/tet:local-link-connectivities/
tet:label/tet:label-hop/tet:te-label/tet:technology:
    +--:(flexi-grid)
    +--rw (single-or-super-channel)?
        +--:(single)
            |   +--rw flex-n?   int16
            |   +--rw flex-m?   uint16
        +--:(super)
            +--rw subcarrier-flex-n* [flex-n]
                +--rw flex-n   int16
                +--rw flex-m?   uint16
augment
/nw:networks/nw:network/nw:node/tet:te/
  tet:tunnel-termination-point/tet:local-link-connectivities/
  tet:optimizations/tet:algorithm/tet:metric/
  tet:optimization-metric/tet:explicit-route-exclude-objects/
  tet:route-object-exclude-object/tet:type/tet:label/
  tet:label-hop/tet:te-label/tet:technology:
  +--:(flexi-grid)
  ++--rw (single-or-super-channel)?
    +--:(single)
    | ++--rw flex-n? int16
    | ++--rw flex-m? uint16
    +--:(super)
    ++--rw subcarrier-flex-n* [flex-n]
    ++--rw flex-n int16
    ++--rw flex-m? uint16

augment
/nw:networks/nw:network/nw:node/tet:te/
  tet:tunnel-termination-point/tet:local-link-connectivities/
  tet:optimizations/tet:algorithm/tet:metric/
  tet:optimization-metric/tet:explicit-route-include-objects/
  tet:route-object-include-object/tet:type/tet:label/
  tet:label-hop/tet:te-label/tet:technology:
  +--:(flexi-grid)
  ++--rw (single-or-super-channel)?
    +--:(single)
    | ++--rw flex-n? int16
    | ++--rw flex-m? uint16
    +--:(super)
    ++--rw subcarrier-flex-n* [flex-n]
    ++--rw flex-n int16
    ++--rw flex-m? uint16

augment
/nw:networks/nw:network/nw:node/tet:te/
  tet:tunnel-termination-point/tet:local-link-connectivities/
  tet:path-properties/tet:path-route-objects/
  tet:path-route-object/tet:type/tet:label/tet:label-hop/
  tet:te-label/tet:technology:
  +--:(flexi-grid)
  ++--ro (single-or-super-channel)?
    +--:(single)
    | ++--ro flex-n? int16
    | ++--ro flex-m? uint16
    +--:(super)
    ++--ro subcarrier-flex-n* [flex-n]
    ++--ro flex-n int16
    ++--ro flex-m? uint16
augment
nw:networks/nw:network/nw:node/tet:te/
tet:tunnel-termination-point/tet:local-link-connectivities/
tet:local-link-connectivity/tet:label-restrictions/
tet:label-restriction:
  +--rw grid-type? identityref
  +--rw priority? uint8
  +--rw flexi-grid
    +--rw nominal-central-frequency-granularity? identityref
    +--rw slot-width-granularity? identityref
    +--rw min-slot-width-factor? uint16
    +--rw max-slot-width-factor? uint16
augment
nw:networks/nw:network/nw:node/tet:te/
tet:tunnel-termination-point/tet:local-link-connectivities/
tet:local-link-connectivity/tet:label-restrictions/
tet:label-restriction/tet:te-label/
tet:technology:
  +--:(flexi-grid)
    +--rw flex-n? int16
augment
nw:networks/nw:network/nw:node/tet:te/
tet:tunnel-termination-point/tet:local-link-connectivities/
tet:local-link-connectivity/tet:label-restrictions/
tet:label-restriction/tet:te-label/
tet:technology:
  +--:(flexi-grid)
    +--rw flex-n? int16
augment
nw:networks/nw:network/nw:node/tet:te/
tet:tunnel-termination-point/tet:local-link-connectivities/
tet:local-link-connectivity/tet:label-restrictions/
tet:label-restriction/tet:label-step/tet:technology:
  +--:(flexi-grid)
    +--rw flex? identityref
augment
nw:networks/nw:network/nw:node/tet:te/
tet:tunnel-termination-point/tet:local-link-connectivities/
tet:local-link-connectivity/tet:underlay/tet:primary-path/
tet:path-element/tet:type/tet:label/tet:label-hop/
tet:te-label/tet:technology:
  +--:(flexi-grid)
    +--rw (single-or-super-channel)?
      +--:(single)
        |  +--rw flex-n? int16
        |  +--rw flex-m? uint16
      +--:(super)
        +--rw subcarrier-flex-n* [flex-n]
          +--rw flex-n int16
          +--rw flex-m? uint16
augment
acl:tunnel-termination-point/acl:local-link-connectivities/
acl:local-link-connectivity/acl:underlay/acl:backup-path/
acl:path-element/acl:type/acl:label/acl:label-hop/
acl:te-label/acl:technology:
  +--acl:flexi-grid
     +--acl:rw acl:single-or-super-channel?
        +--acl:(single)
            |  +--acl:rw acl:flex-n? int16
            |  +--acl:rw acl:flex-m? uint16
            +--acl:(super)
                +--acl:rw acl:subcarrier-flex-n* [acl:flex-n]
                    +--acl:rw acl:flex-n int16
                    +--acl:rw acl:flex-m? uint16

augment
acl:tunnel-termination-point/acl:local-link-connectivities/
acl:local-link-connectivity/acl:optimizations/acl:algorithm/
acl:metric/acl:optimization-metric/
acl:explicit-route-exclude-objects/
acl:route-object-exclude-object/acl:type/acl:label/
acl:label-hop/acl:te-label/acl:technology:
  +--acl:flexi-grid
     +--acl:rw acl:single-or-super-channel?
        +--acl:(single)
            |  +--acl:rw acl:flex-n? int16
            |  +--acl:rw acl:flex-m? uint16
            +--acl:(super)
                +--acl:rw acl:subcarrier-flex-n* [acl:flex-n]
                    +--acl:rw acl:flex-n int16
                    +--acl:rw acl:flex-m? uint16

augment
acl:tunnel-termination-point/acl:local-link-connectivities/
acl:local-link-connectivity/acl:optimizations/acl:algorithm/
acl:metric/acl:optimization-metric/
acl:explicit-route-include-objects/
acl:route-object-include-object/acl:type/acl:label/
acl:label-hop/acl:te-label/acl:technology:
  +--acl:flexi-grid
     +--acl:rw acl:single-or-super-channel?
        +--acl:(single)
            |  +--acl:rw acl:flex-n? int16
            |  +--acl:rw acl:flex-m? uint16
            +--acl:(super)
                +--acl:rw acl:subcarrier-flex-n* [acl:flex-n]
                    +--acl:rw acl:flex-n int16
                    +--acl:rw acl:flex-m? uint16
augment
/nw:networks/nw:network/nw:node/tet:te/
  tet:tunnel-termination-point/tet:local-link-connectivities/
  tet:local-link-connectivity/tet:path-properties/
  tet:path-route-objects/tet:path-route-object/tet:type/
  tet:label/tet:label-hop/tet:te-label/tet:technology:
  +--:(flexi-grid)
    +--ro (single-or-super-channel)?
      +--:(single)
        | +--ro flex-n?              int16
        | +--ro flex-m?              uint16
      +--:(super)
        +--ro subcarrier-flex-n* [flex-n]
          +--ro flex-n    int16
          +--ro flex-m?   uint16

augment
  tet:underlay/tet:primary-path/tet:path-element/tet:type/
  tet:label/tet:label-hop/tet:te-label/tet:technology:
  +--:(flexi-grid)
    +--rw (single-or-super-channel)?
      +--:(single)
        | +--rw flex-n?              int16
        | +--rw flex-m?              uint16
      +--:(super)
        +--rw subcarrier-flex-n* [flex-n]
          +--rw flex-n    int16
          +--rw flex-m?   uint16

augment
  tet:label/tet:label-hop/tet:te-label/tet:technology:
  +--:(flexi-grid)
    +--rw (single-or-super-channel)?
      +--:(single)
        | +--rw flex-n?              int16
        | +--rw flex-m?              uint16
      +--:(super)
        +--rw subcarrier-flex-n* [flex-n]
          +--rw flex-n    int16
          +--rw flex-m?   uint16

augment
  tet:label-restrictions/tet:label-restriction:
  +--rw grid-type?   identityref
  +--rw priority?    uint8
  +--rw flexi-grid
    +--rw nominal-central-frequency-granularity? identityref
    +--rw slot-width-granularity? identityref
    +--rw min-slot-width-factor? uint16
    +--rw max-slot-width-factor? uint16
augment
tet:label-restrictions/tet:label-restriction/tet:label-start/
tet:te-label/tet:technology:
  +--:(flexi-grid)
    +--rw flex-n?  int16
augment
tet:label-restrictions/tet:label-restriction/tet:label-end/
tet:te-label/tet:technology:
  +--:(flexi-grid)
    +--rw flex-n?  int16
augment
tet:label-restrictions/tet:label-restriction/tet:label-step/
tet:technology:
  +--:(flexi-grid)
    +--rw flex?   identityref
augment
/nw:networks/nw:network/nt:link/tet:te/
tet:information-source-entry/tet:label-restrictions/
tet:label-restriction:
  +--ro grid-type?  identityref
  +--ro priority?  uint8
  +--ro flexi-grid
    +--ro nominal-central-frequency-granularity?  identityref
    +--ro slot-width-granularity?  identityref
    +--ro min-slot-width-factor?  uint16
    +--ro max-slot-width-factor?  uint16
augment
/nw:networks/nw:network/nt:link/tet:te/
tet:information-source-entry/tet:label-restrictions/
tet:label-restriction/tet:label-start/tet:te-label/
tet:technology:
  +--:(flexi-grid)
    +--ro flex-n?  int16
augment
/nw:networks/nw:network/nt:link/tet:te/
tet:information-source-entry/tet:label-restrictions/
tet:label-restriction/tet:label-end/tet:te-label/
tet:technology:
  +--:(flexi-grid)
    +--ro flex-n?  int16
augment
/nw:networks/nw:network/nt:link/tet:te/
tet:information-source-entry/tet:label-restrictions/
tet:label-restriction/tet:label-step/tet:te-label/
tet:technology:
  +--:(flexi-grid)
    +--ro flex?   identityref
augment
tet:te-link-attributes/tet:underlay/tet:primary-path/
tet:path-element/tet:type/tet:label/tet:label-hop/
tet:te-label/tet:technology:
  +--:(flexi-grid)
  +--rw (single-or-super-channel)?
      +--:(single)
      |   +--rw flex-n?       int16
      |   +--rw flex-m?       uint16
      +--:(super)
      +--rw subcarrier-flex-n* [flex-n]
      |   +--rw flex-n        int16
      |   +--rw flex-m?       uint16
augment
tet:te-link-attributes/tet:underlay/tet:backup-path/
tet:path-element/tet:type/tet:label/tet:label-hop/
tet:te-label/tet:technology:
  +--:(flexi-grid)
  +--rw (single-or-super-channel)?
      +--:(single)
      |   +--rw flex-n?       int16
      |   +--rw flex-m?       uint16
      +--:(super)
      +--rw subcarrier-flex-n* [flex-n]
      |   +--rw flex-n        int16
      |   +--rw flex-m?       uint16
augment
tet:te-link-attributes/tet:label-restrictions/
tet:label-restriction:
  +--rw grid-type?    identityref
  +--rw priority?     uint8
  +--rw flexi-grid
      +--rw nominal-central-frequency-granularity? identityref
      +--rw slot-width-granularity?    identityref
      +--rw min-slot-width-factor?     uint16
      +--rw max-slot-width-factor?     uint16
augment
tet:te-link-attributes/tet:label-restrictions/
tet:label-restriction/tet:label-start/tet:te-label/
tet:technology:
  +--:(flexi-grid)
      +--rw flex-n?       int16
augment
tet:te-link-attributes/tet:label-restrictions/
tet:label-restriction/tet:label-end/tet:te-label/
tet:technology:

6.2. YANG Model - Code

```
<CODE BEGINS> file "ietf-flexi-grid-topology@2019-03-24.yang"
module ietf-flexi-grid-topology {

  yang-version 1.1;


  prefix "flexi-grid";

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

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

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

  /* Note: The RFC Editor will replace YYYY with the number assigned to the RFC once draft-ietf-teas-yang-te-topo becomes an RFC.*/

  import ietf-layer0-types {
    prefix "layer0-types";
    reference
      "RFC XXXX: A YANG Data Model for WSON (Wavelength Switched Optical Networks)";
  }

  /* Note: The RFC Editor will replace XXXX with the number assigned to the RFC once draft-ietf-ccamp-wson-yang becomes an RFC.*/
```
grouping flexi-grid-node-attributes {
  description "flexi-grid node attributes.";

  container flexi-grid-node {
    description "flexi-grid node attributes.";
    leaf node-type {
      type identityref {
        base layer0-types:layer0-node-type;
      }
      description "flexi-grid node type.";
    }
  }
}
grouping flexi-grid-link-attributes {
    description
    "Future flexi-grid link attributes extensions";
}

grouping flexi-grid-tp-attributes {
    description "flexi-grid-tp-attributes";
    list supported-payload-types {
        key "index";
        description
        "Supported payload types of a TP. The payload type is defined
        as the generalized PIDs in GMPLS.";
        leaf index {
            type uint16;
            description "payload type index";
        }
        leaf payload-type {
            type string;
            description "the payload type supported by this client tp";
            reference
            "http://www.iana.org/assignments/gmpls-sig-parameters/
gmpls-sig-parameters.xhtml";
        }
    }
    leaf client-facing {
        type boolean;
        default 'false';
        description
        "Indicating if it is a client-facing TP.";
    }
}

grouping flexi-grid-ttp-attributes {
    description
    "flexi-grid tunnel termination point (e.g.tranponder) attributes";
    leaf-list supported-operational-modes {
        type layer0-types:operational-mode;
        description
        "List of all supported vendor-specific mode identifiers";
    }
    leaf configured-operational-modes {
        type layer0-types:operational-mode;
        description
        "Vendor-specific mode identifier configured on the TTP.";
    }
}
leaf-list supported-fec-types {
  type identityref {
    base layer0-types:fec-type;
  }
  description
    "List of all supported FEC types by this TTP.";
}

leaf-list supported-termination-types {
  type identityref {
    base layer0-types:term-type;
  }
  description
    "List of all supported termination types by this TTP.";
}

leaf supports-bit-stuffing {
  type boolean;
  description
    "Indicate whether bit stuffing is supported by this TTP.";
}

leaf is-tunable {
  type boolean;
  description
    "Indicates if the TTP, or transponder, is tunable. Tunable
    transponders are assumed to be fully tunable to any of the
    96 channels within DWDM C-band.";
}

leaf max-subcarrier-channel-num {
  type uint8 {
    range "1..max";
  }
  default 1;
  description
    "Indicate the maximum number of subcarrier channels for
    super-channel transponders. When the value equals 1 it
    represents regular single-channel transponder.";
}

leaf supports-flexi-grid {
  type boolean;
  description
    "Indicates if the TTP, or transponder, supports flex grid.";
}

/*
 * Data nodes
 */
augment "/nw:networks/nw:network/nw:network-types" 
  + "'/tet:te-topology" { 
    description "flexi-grid-topology augmented";
    container flexi-grid-topology { 
      presence "indicates a topology of Flex Grid";
      description "Container to identify flexi-grid topology type";
    }
  }
}

augment "/nw:networks/nw:network/nt:link/tet:te" 
  + "'/tet:te-link-attributes" { 
    when "/nw:networks/nw:network/nw:network-types" 
      +"'/tet:te-topology/flexi-grid:flexi-grid-topology" { 
      description "This augment is only valid for flexi-grid.";
    }
    description "flexi-grid Link augmentation.";
    uses flexi-grid-link-attributes;
  }
}

augment "/nw:networks/nw:network/nw:node/nt:termination-point/" 
  + "'/tet:te" { 
    when "/nw:networks/nw:network/nw:network-types" 
      +"'/tet:te-topology/flexi-grid:flexi-grid-topology" { 
      description "This augment is only valid for flexi-grid.";
    }
    description "flexi-grid TP attributes.";
    uses flexi-grid-tp-attributes;
  }
}

augment "/nw:networks/nw:network/nw:node/tet:te" 
  + "'/tet:te-node-attributes" { 
    when "/nw:networks/nw:network/nw:network-types" 
      +"'/tet:te-topology/flexi-grid:flexi-grid-topology" { 
      description "This augment is only valid for flexi-grid.";
    }
    description "flexi-grid Node augmentation.";
    uses flexi-grid-node-attributes;
  }
}

augment "/nw:networks/nw:network/nw:node/tet:te" 
  + "'/tet:tunnel-termination-point" { 
    when "/nw:networks/nw:network/nw:network-types" 
      +"'/tet:te-topology/flexi-grid:flexi-grid-topology" { 
      description "This augment is only valid for flexi-grid.";
    }
    description "flexi-grid tunnel termination point augmentation.";
    uses flexi-grid-ttp-attributes;
  }
}
/* Augment maximum LSP bandwidth of link termination point (LTP) */
augment "/nw:networks/nw:network/nw:node/nt:termination-point/"
  + "tet:te/
  + "tet:interface-switching-capability/tet:max-lsp-bandwidth/
  + "tet:te-bandwidth/tet:technology"
when "././././././././././nw:network-types/tet:te-topology/
  + "flexi-grid:flexi-grid-topology"
  description "Augment flexi-grid TE bandwidth";
}
description "flexi-grid bandwidth."

/* Augment bandwidth path constraints of connectivity-matrices */
augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/
  + "tet:path-constraints/tet:te-bandwidth/tet:technology"
when "././././././././nw:network-types/tet:te-topology/
  + "flexi-grid:flexi-grid-topology"
  description "Augment flexi-grid TE bandwidth";
}
description "flexi-grid bandwidth."

/* Augment bandwidth path constraints of connectivity-matrix */
augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/
  + "tet:connectivity-matrix/
  + "tet:path-constraints/tet:te-bandwidth/tet:technology"
when "./././././././././nw:network-types/tet:te-topology/
  + "flexi-grid:flexi-grid-topology"
  description "Augment flexi-grid TE bandwidth";
}
description "flexi-grid bandwidth."

/* Augment bandwidth path constraints of connectivity-matrix */
/* Augment bandwidth path constraints of connectivity-matrices */
  + "tet:information-source-entry/tet:connectivity-matrices/"
  + "tet:path-constraints/tet:te-bandwidth/tet:technology" {
    when "../../../nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
      description "Augment flexi-grid TE bandwidth";
    }
    description "flexi-grid bandwidth.";
    case flexi-grid {
      uses layer0-types:flexi-grid-link-bandwidth;
    }
  }
/* Augment bandwidth path constraints of connectivity-matrix information-source */
  + "tet:information-source-entry/tet:connectivity-matrices/"
  + "tet:path-constraints/tet:te-bandwidth/tet:technology" {
    when "../../../nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
      description "Augment flexi-grid TE bandwidth";
    }
    description "flexi-grid bandwidth.";
    case flexi-grid {
      uses layer0-types:flexi-grid-link-bandwidth;
    }
  }
/* Augment client bandwidth of tunnel termination point (TTP) */
  + "tet:tunnel-termination-point/"
  + "tet:client-layer-adaptation/tet:switching-capability/"
  + "tet:te-bandwidth/tet:technology" {
    when "../../../nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
      description "Augment flexi-grid TE bandwidth";
    }
    description "flexi-grid bandwidth.";
    case flexi-grid {
      uses layer0-types:flexi-grid-link-bandwidth;
    }
  }
Lopez de Vergara, et al. Expires September 25, 2019
/* Augment bandwidth path constraints of local-link-connectivities */
  + "tet:tunnel-termination-point/"
  + "tet:local-link-connectivities/tet:path-constraints/"
  + "tet:te-bandwidth/tet:technology"
when "."/"./"./"./"./n:network-types/tet:te-topology/
  + "flexi-grid:flexi-grid-topology"
  description "Augment flexi-grid TE bandwidth";
}
description "flexi-grid bandwidth.";
case flexi-grid {
  uses layer0-types:flexi-grid-link-bandwidth;
}
}

/* Augment maximum LSP bandwidth of TE link */
  + "tet:te-link-attributes/"
  + "tet:interface-switching-capability/tet:max-lsp-bandwidth/"
  + "tet:te-bandwidth/tet:technology"
when "."/"./"./"./"./n:network-types/tet:te-topology/
  + "flexi-grid:flexi-grid-topology"
  description "flexi-grid TE bandwidth.";
}
description "flexi-grid bandwidth.";
case flexi-grid {
  uses layer0-types:flexi-grid-path-bandwidth;
}
/* Augment maximum bandwidth of TE link */
 + "tet:te-link-attributes/
 + "tet:max-link-bandwidth/
 + "tet:te-bandwidth/tet:technology" {
 when "../././././nw:network-types/tet:te-topology/
 + "flexi-grid:flexi-grid-topology" {
 description "flexi-grid TE bandwidth.";
 }
description "flexi-grid bandwidth.";
case flexi-grid {
 uses layer0-types:flexi-grid-link-bandwidth;
 }
}

/* Augment maximum reservable bandwidth of TE link */
 + "tet:te-link-attributes/
 + "tet:max-resv-link-bandwidth/
 + "tet:te-bandwidth/tet:technology" {
 when "../././././nw:network-types/tet:te-topology/
 + "flexi-grid:flexi-grid-topology" {
 description "flexi-grid TE bandwidth.";
 }
description "flexi-grid bandwidth.";
case flexi-grid {
 uses layer0-types:flexi-grid-link-bandwidth;
 }
}

/* Augment unreserved bandwidth of TE Link */
 + "tet:te-link-attributes/
 + "tet:unreserved-bandwidth/
 + "tet:te-bandwidth/tet:technology" {
 when "../././././nw:network-types/tet:te-topology/
 + "flexi-grid:flexi-grid-topology" {
 description "flexi-grid TE bandwidth.";
 }
description "flexi-grid bandwidth.";
case flexi-grid {
 uses layer0-types:flexi-grid-link-bandwidth;
 }
}
/* Augment maximum LSP bandwidth of TE link information-source */
    + "tet:information-source-entry/
    + "tet:interface-switching-capability/
    + "tet:max-lsp-bandwidth/
    + "tet:te-bandwidth/tet:technology" {
    when ".../.../.../.../nw:network-types/tet:te-topology/
        + "flexi-grid:flexi-grid-topology" {
            description "flexi-grid TE bandwidth.";
        }
    description "flexi-grid bandwidth.";
    case flexi-grid {
        uses layer0-types:flexi-grid-path-bandwidth;
    }
}

/* Augment maximum bandwidth of TE link information-source */
    + "tet:information-source-entry/
    + "tet:max-link-bandwidth/
    + "tet:te-bandwidth/tet:technology" {
    when ".../.../.../.../nw:network-types/tet:te-topology/
        + "flexi-grid:flexi-grid-topology" {
            description "flexi-grid TE bandwidth.";
        }
    description "flexi-grid bandwidth.";
    case flexi-grid {
        uses layer0-types:flexi-grid-link-bandwidth;
    }
}

/* Augment maximum reservable bandwidth of TE link information-source */
    + "tet:information-source-entry/
    + "tet:max-resv-link-bandwidth/
    + "tet:te-bandwidth/tet:technology" {
    when ".../.../.../.../nw:network-types/tet:te-topology/
        + "flexi-grid:flexi-grid-topology" {
            description "flexi-grid TE bandwidth.";
        }
    description "flexi-grid bandwidth.";
    case flexi-grid {
        uses layer0-types:flexi-grid-link-bandwidth;
    }
}
+ "tet:information-source-entry/
+ "tet:unreserved-bandwidth/
+ "tet:te-bandwidth/tet:technology" 
when "/nw:network-types/tet:te-topology/
+ "flexi-grid:flexi-grid-topology" {
  description "flexi-grid TE bandwidth."
}
description "flexi-grid bandwidth.");
case flexi-grid {
  uses layer0-types:flexi-grid-link-bandwidth;
}

/* Augment maximum LSP bandwidth of TE link template */
+ "tet:link-template/tet:te-link-attributes/
+ "tet:interface-switching-capability/
+ "tet:max-lsp-bandwidth/
+ "tet:te-bandwidth/tet:technology" 
/*
when "/nw:network-types/tet:te-topology/
+ "flexi-grid:flexi-grid-topology" {
  description "flexi-grid TE bandwidth."
}
*/
description "flexi-grid bandwidth.");
case flexi-grid {
  uses layer0-types:flexi-grid-path-bandwidth;
}

/* Augment maximum bandwidth of TE link template */
+ "tet:link-template/tet:te-link-attributes/
+ "tet:max-link-bandwidth/
+ "tet:te-bandwidth/tet:technology" 
/*
when "/nw:network-types/tet:te-topology/
+ "flexi-grid:flexi-grid-topology" {
  description "flexi-grid TE bandwidth."
}
*/
description "flexi-grid bandwidth.");
case flexi-grid {
  uses layer0-types:flexi-grid-link-bandwidth;
}
/* Augment maximum reservable bandwidth of TE link template */
  + "tet:link-template/tet:te-link-attributes/
  + "tet:max-resv-link-bandwidth/
  + "tet:te-bandwidth/tet:technology" {
  when ".//..//..//..//nw:network-types/tet:te-topology/
    + "flexi-grid:flexi-grid-topology" {
      description "flexi-grid TE bandwidth.";
    }
  }
} description "flexi-grid bandwidth.";
case flexi-grid {
  uses layer0-types:flexi-grid-link-bandwidth;
}
}

/* Augment unreserved bandwidth of TE link template */
  + "tet:link-template/tet:te-link-attributes/
  + "tet:unreserved-bandwidth/
  + "tet:te-bandwidth/tet:technology" {
  when ".//..//..//..//..//nw:network-types/tet:te-topology/
    + "flexi-grid:flexi-grid-topology" {
      description "flexi-grid TE bandwidth.";
    }
  }
} description "flexi-grid bandwidth.";
case flexi-grid {
  uses layer0-types:flexi-grid-link-bandwidth;
}
}

/* Augment TE label. */

/* Augment label restrictions of connectivity-matrices */
  + "tet:te-node-attributes/tet:connectivity-matrices/
  + "tet:label-restrictions/tet:label-restriction" {
  when ".//..//..//..//..//nw:network-types/tet:te-topology/
    + "flexi-grid:flexi-grid-topology" {
      description "Augment flexi-grid TE label";
    }
  }
description "flexi-grid label.";
uses layer0-types:flexi-grid-label-restriction;
}
/* Augment label restrictions start of connectivity-matrices */
augment "//nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/
  + "tet:label-restrictions/tet:label-restriction/
  + "tet:label-start/
  + "tet:te-label/tet:technology" {
when "/nw:network-types/tet:te-topology/"
  + "flexi-grid:flexi-grid-topology" {
    description "Augment flexi-grid TE label";
  }
}
description "flexi-grid label.";
case flexi-grid {
  uses layer0-types:flexi-grid-link-label;
}
/* Augment label restrictions end of connectivity-matrices */
augment "//nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/
  + "tet:label-restrictions/
  + "tet:label-end/
  + "tet:te-label/tet:technology" {
when "//nw:network-types/tet:te-topology/"
  + "flexi-grid:flexi-grid-topology" {
    description "Augment flexi-grid TE label";
  }
}
description "flexi-grid label.";
case flexi-grid {
  uses layer0-types:flexi-grid-link-label;
}
/* Augment label restrictions step of connectivity-matrices */
augment "//nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/
  + "tet:label-restrictions/
  + "tet:label-restriction/tet:label-end/
  + "tet:te-label/tet:technology" {
when "//nw:network-types/tet:te-topology/"
  + "flexi-grid:flexi-grid-topology" {
    description "Augment flexi-grid TE label";
  }
}
description "flexi-grid label step.";
case flexi-grid {
  uses layer0-types:flexi-grid-label-step;
}
/** Augment label hop of underlay primary path of connectivity-matrices */

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/"
  + "tet:underlay/tet:primary-path/tet:path-element/"
  + "tet:type/tet:label/tet:label-hop/"
  + "tet:label/tet:technology" {
when "/nw:networks/nw:network/nw:node/tet:te/"
  + "nw:network-types/tet:te-topology/"
  + "flexi-grid:flexi-grid-topology" {
    description "Augment flexi-grid TE label";
    }
}
description "flexi-grid label.";
case flexi-grid {
  uses layer0-types:flexi-grid-path-label;
}

/* Augment label hop of underlay backup path of connectivity-matrices */

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/"
  + "tet:underlay/tet:backup-path/tet:path-element/"
  + "tet:type/tet:label/tet:label-hop/"
  + "tet:label/tet:technology" {
when "/nw:networks/nw:network/nw:node/tet:te/"
  + "nw:network-types/tet:te-topology/"
  + "flexi-grid:flexi-grid-topology" {
    description "Augment flexi-grid TE label";
    }
}
description "flexi-grid label.";
case flexi-grid {
  uses layer0-types:flexi-grid-path-label;
}

/* Augment label hop of route-exclude of connectivity-matrices */

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/"
  + "tet:optimizations/tet:algorithm/tet:metric/"
  + "tet:optimization-metric/"
  + "tet:explicit-route-exclude-objects/"
  + "tet:route-object-exclude-object/"
  + "tet:type/tet:label/tet:label-hop/"
  + "tet:label/tet:technology" {
when "/nw:networks/nw:network/nw:node/tet:te/"
  + "nw:network-types/tet:te-topology/"
  + "flexi-grid:flexi-grid-topology" {
    description "Augment flexi-grid TE label";
    }
}
description "flexi-grid label.";
case flexi-grid {
  uses layer0-types:flexi-grid-path-label;
}
/* Augment label hop of route-include of connectivity-matrices (added) */

  + "tet:te-node-attributes/tet:connectivity-matrices/
  + "tet:optimizations/tet:algorithm/tet:metric/
  + "tet:optimization-metric/
  + "tet:explicit-route-include-objects/
  + "tet:route-object-include-object/
  + "tet:type/tet:label/tet:label-hop/
  + "tet:te-label/tet:technology" {
  when "./././././././././././././././.
  + "nw:network-types/tet:te-topology/
  + "flexi-grid:flexi-grid-topology" {
    description "Augment flexi-grid TE label";
  }
  description "flexi-grid label.";
  case flexi-grid {
    uses layer0-types:flexi-grid-path-label;
  }
}

/* Augment label hop of path-route of connectivity-matrices */

  + "tet:te-node-attributes/tet:connectivity-matrices/
  + "tet:path-properties/tet:path-route-objects/
  + "tet:path-route-object/tet:type/tet:label/tet:label-hop/
  + "tet:te-label/tet:technology" {
  when "./././././././././././././././.
  + "nw:network-types/tet:te-topology/
  + "flexi-grid:flexi-grid-topology" {
    description "Augment flexi-grid TE label";
  }
  description "flexi-grid label.";
  case flexi-grid {
    uses layer0-types:flexi-grid-path-label;
  }
}

/* Augment ingress label restrictions of connectivity-matrix */

  + "tet:te-node-attributes/tet:connectivity-matrices/
  + "tet:connectivity-matrix/tet:from/
  + "tet:label-restrictions/tet:label-restriction" {
  when "./././././././././././././././.
  + "nw:network-types/tet:te-topology/
  + "flexi-grid:flexi-grid-topology" {
    description "Augment flexi-grid TE label";
  }
  description "flexi-grid label.";
  uses layer0-types:flexi-grid-label-restriction;
}
/* Augment ingress label restrictions start of connectivity-matrix */
   + "tet:te-node-attributes/tet:connectivity-matrices/
   + "tet:connectivity-matrix/tet:from/
   + "tet:label-restrictions/tet:label-restriction/
   + "tet:label-start/
   + "tet:te-label/tet:technology" {when "../.../.../.../.../.../.../" + "nw:network-types/tet:te-topology/
   + "flexi-grid:flexi-grid-topology" {
description "Augment flexi-grid TE label";
}
description "flexi-grid label.";
case flexi-grid {
   uses layer0-types:flexi-grid-link-label;
}
} /* Augment ingress label restrictions end of connectivity-matrix */
   + "tet:te-node-attributes/tet:connectivity-matrices/
   + "tet:connectivity-matrix/tet:from/
   + "tet:label-restrictions/tet:label-restriction/
   + "tet:label-end/
   + "tet:te-label/tet:technology" {when "../.../.../.../.../.../.../" + "nw:network-types/tet:te-topology/
   + "flexi-grid:flexi-grid-topology" {
description "Augment flexi-grid TE label";
}
description "flexi-grid label.";
case flexi-grid {
   uses layer0-types:flexi-grid-link-label;
}
} /* Augment ingress label restrictions step of connectivity-matrix */
   + "tet:te-node-attributes/tet:connectivity-matrices/
   + "tet:connectivity-matrix/tet:from/
   + "tet:label-restrictions/tet:label-restriction/
   + "tet:label-step/
   + "tet:technology" {when "../.../.../.../.../.../.../" + "nw:network-types/tet:te-topology/
   + "flexi-grid:flexi-grid-topology" {
description "Augment flexi-grid TE label";
}
description "flexi-grid label.";
case flexi-grid {
   uses layer0-types:flexi-grid-label-step;
}
/* Augment egress label restrictions of connectivity-matrix */
augment " /nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/"
  + "tet:connectivity-matrix/tet:to/"
  + "tet:label-restrictions/tet:label-restriction" 
  when "../.../.../.../.../.../" 
  + "nw:network-types/tet:te-topology/"
  + "flexi-grid:flexi-grid-topology" 
    description "Augment flexi-grid TE label";
}
description "flexi-grid label.";
uses layer0-types:flexi-grid-label-restriction;
}

/* Augment egress label restrictions start of connectivity-matrix */
augment " /nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/"
  + "tet:connectivity-matrix/tet:to/"
  + "tet:label-restrictions/tet:label-restriction/"
  + "tet:label-start/"
  + "tet:te-label/tet:technology" 
  when "../.../.../.../.../.../" 
  + "nw:network-types/tet:te-topology/"
  + "flexi-grid:flexi-grid-topology" 
    description "Augment flexi-grid TE label";
}
description "flexi-grid label.";

case flexi-grid {
  uses layer0-types:flexi-grid-link-label;
}

/* Augment egress label restrictions end of connectivity-matrix */
augment " /nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/"
  + "tet:connectivity-matrix/tet:to/"
  + "tet:label-restrictions/tet:label-restriction/"
  + "tet:label-end/"
  + "tet:te-label/tet:technology" 
  when "../.../.../.../.../.../" 
  + "nw:network-types/tet:te-topology/"
  + "flexi-grid:flexi-grid-topology" 
    description "Augment flexi-grid TE label";
}
description "flexi-grid label.";

case flexi-grid {
  uses layer0-types:flexi-grid-link-label;
}
/* Augment egress label restrictions step of connectivity-matrix */
 + "tet:te-node-attributes/tet:connectivity-matrices/
 + "tet:connectivity-matrix/tet:to/
 + "tet:label-restrictions/tet:label-restriction/
 + "tet:label-step/
 + "tet:technology" {
 when "/nw:networks/nw:network/nw:node/tet:te/
 + "tet:te-node-attributes/tet:connectivity-matrices/
 + "tet:connectivity-matrix/tet:to/
 + "tet:label-restrictions/tet:label-restriction/
 + "tet:label-step/
 + "tet:technology" {
 description "flexi-grid label.";
 case flexi-grid {
 uses layer0-types:flexi-grid-label-step;
 }
 }
 /* Augment label hop of underlay primary path of connectivity-matrix */
 + "tet:te-node-attributes/tet:connectivity-matrices/
 + "tet:connectivity-matrix/
 + "tet:underlay/tet:primary-path/tet:path-element/
 + "tet:type/tet:label/tet:label-hop/
 + "tet:te-label/tet:technology" {
 when "/nw:networks/nw:network/nw:node/tet:te/
 + "tet:te-node-attributes/tet:connectivity-matrices/
 + "tet:connectivity-matrix/
 + "tet:underlay/tet:primary-path/tet:path-element/
 + "tet:type/tet:label/tet:label-hop/
 + "tet:te-label/tet:technology" {
 description "flexi-grid label.";
 case flexi-grid {
 uses layer0-types:flexi-grid-path-label;
 }
 }
 /* Augment label hop of underlay backup path of connectivity-matrix */
 + "tet:te-node-attributes/tet:connectivity-matrices/
 + "tet:connectivity-matrix/
 + "tet:underlay/tet:backup-path/tet:path-element/
 + "tet:type/tet:label/tet:label-hop/
 + "tet:te-label/tet:technology" {
 when "/nw:networks/nw:network/nw:node/tet:te/
 + "tet:te-node-attributes/tet:connectivity-matrices/
 + "tet:connectivity-matrix/
 + "tet:underlay/tet:backup-path/tet:path-element/
 + "tet:type/tet:label/tet:label-hop/
 + "tet:te-label/tet:technology" {
 description "flexi-grid label.";
 case flexi-grid {
 uses layer0-types:flexi-grid-path-label;
 }
 }
/* Augment label hop of route-exclude of connectivity-matrix */
augment "/*/nw:networks/nw:network/nw:node/tet:te/
  + "tet:te-node-attributes/tet:connectivity-matrices/"
  + "tet:connectivity-matrix/tet:optimizations/"
  + "tet:algorithm/tet:metric/tet:optimization-metric/"
  + "tet:explicit-route-exclude-objects/"
  + "tet:route-object-exclude-object/tet:type/"
  + "tet:label/tet:label-hop/tet:te-label/tet:technology" { 
  when "././././././././././././././././././././././././././././." 
  + "nw:network-types/tet:te-topology/"
  + "flexi-grid:flexi-grid-topology" { 
    description "Augment flexi-grid TE label";
  }
} 
description "flexi-grid label.";
case flexi-grid {
  uses layer0-types:flexi-grid-path-label;
}
}

/* Augment label hop of route-include of connectivity-matrix */
augment "/*/nw:networks/nw:network/nw:node/tet:te/
  + "tet:te-node-attributes/tet:connectivity-matrices/"
  + "tet:connectivity-matrix/tet:optimizations/"
  + "tet:algorithm/tet:metric/tet:optimization-metric/"
  + "tet:explicit-route-include-objects/"
  + "tet:route-object-include-object/tet:type/"
  + "tet:label/tet:label-hop/tet:te-label/tet:technology" { 
  when "././././././././././././././././././././././././././././." 
  + "nw:network-types/tet:te-topology/"
  + "flexi-grid:flexi-grid-topology" { 
    description "Augment flexi-grid TE label";
  }
} 
description "flexi-grid label.";
case flexi-grid {
  uses layer0-types:flexi-grid-path-label;
}
}

/* Augment label hop of path-route of connectivity-matrix */
augment "/*/nw:networks/nw:network/nw:node/tet:te/
  + "tet:te-node-attributes/tet:connectivity-matrices/"
  + "tet:connectivity-matrix/"
  + "tet:path-properties/tet:path-route-objects/"
  + "tet:path-route-object/tet:type/"
  + "tet:label/tet:label-hop/tet:te-label/tet:technology" { 
  when "././././././././././././././././././././././././././././." 
  + "nw:network-types/tet:te-topology/"
  + "flexi-grid:flexi-grid-topology" { 
    description "Augment flexi-grid TE label";
  }
} 
description "flexi-grid label.";
case flexi-grid {
  uses layer0-types:flexi-grid-path-label;
}
}
/* Augment label restrictions of connectivity-matrices information-source */
  + "tet:information-source-entry/
  + "tet:connectivity-matrices/tet:label-restrictions/
  + "tet:label-restriction"
when "."/nw:network-types/tet:te-topology/
  + "flexi-grid:flexi-grid-topology" {
  description "Augment flexi-grid TE label";
}
description "flexi-grid label.";
uses layer0-types:flexi-grid-label-restriction;
}

/* Augment label restrictions start of connectivity-matrices information-source */
  + "tet:information-source-entry/
  + "tet:connectivity-matrices/tet:label-restrictions/
  + "tet:label-start/tet:te-label/tet:technology"
when "."/nw:network-types/tet:te-topology/
  + "flexi-grid:flexi-grid-topology" {
  description "Augment flexi-grid TE label";
}
description "flexi-grid label.";
case flexi-grid {
  uses layer0-types:flexi-grid-link-label;
}
}
/* Augment label restrictions end of connectivity-matrices information-source */
  + "tet:information-source-entry/
  + "tet:connectivity-matrices/tet:label-restrictions/
  + "tet:label-end/tet:te-label/tet:technology"
when "."/nw:network-types/tet:te-topology/
  + "flexi-grid:flexi-grid-topology" {
  description "Augment flexi-grid TE label";
}
description "flexi-grid label.";
case flexi-grid {
  uses layer0-types:flexi-grid-link-label;
}
}
/* Augment label restrictions step of connectivity-matrices information-source */
  + "tet:information-source-entry/"
  + "tet:connectivity-matrices/tet:label-restrictions/"
  + "tet:label-restriction/"
  + "tet:label-step/tet:technology" {
    when "/.../.../.../.../.../" 
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
      description "Augment flexi-grid TE label";
    }
    description "flexi-grid label.";
    case flexi-grid {
      uses layer0-types:flexi-grid-label-step;
    }
  }
/* Augment label hop of underlay primary path of connectivity-matrices information-source */
  + "tet:information-source-entry/tet:connectivity-matrices/"
  + "tet:underlay/tet:primary-path/tet:path-element/tet:type/"
  + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
    when "/.../.../.../.../.../" 
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
      description "Augment flexi-grid TE label";
    }
    description "flexi-grid label.";
    case flexi-grid {
      uses layer0-types:flexi-grid-path-label;
    }
  }
/* Augment label hop of underlay backup path of connectivity-matrices information-source */
  + "tet:information-source-entry/tet:connectivity-matrices/"
  + "tet:underlay/tet:backup-path/tet:path-element/tet:type/"
  + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
    when "/.../.../.../.../.../" 
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
      description "Augment flexi-grid TE label";
    }
    description "flexi-grid label.";
    case flexi-grid {
      uses layer0-types:flexi-grid-path-label;
    }
  }
/* Augment label hop of route-exclude of connectivity-matrices information-source */
augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:information-source-entry/tet:connectivity-matrices/"
  + "tet:optimizations/tet:algorithm/tet:metric/"
  + "tet:optimization-metric/"
  + "tet:explicit-route-exclude-objects/"
  + "tet:route-object-exclude-object/tet:type/"
  + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
  when "./././././././././././././." 
  + "nw:network-types/tet:te-topology/"
  + "flexi-grid:flexi-grid-topology" {
    description "Augment flexi-grid TE label";
  }
  description "flexi-grid label.";
  case flexi-grid {
    uses layer0-types:flexi-grid-path-label;
  }
}

/* Augment label hop of route-include of connectivity-matrices information-source */
augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:information-source-entry/tet:connectivity-matrices/"
  + "tet:optimizations/tet:algorithm/tet:metric/"
  + "tet:optimization-metric/"
  + "tet:explicit-route-include-objects/"
  + "tet:route-object-include-object/tet:type/"
  + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
  when "./././././././././././././." 
  + "nw:network-types/tet:te-topology/"
  + "flexi-grid:flexi-grid-topology" {
    description "Augment flexi-grid TE label";
  }
  description "flexi-grid label.";
  case flexi-grid {
    uses layer0-types:flexi-grid-path-label;
  }
}
/* Augment label hop of path-route of connectivity-matrices information-source */
augment "nw:networks/nw:network/nw:node/tet:te/
  + "tet:information-source-entry/tet:connectivity-matrices/
  + "tet:path-properties/tet:path-route-objects/
  + "tet:path-route-object/tet:type/
  + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
  when "./././././././." 
  + "nw:network-types/tet:te-topology/
  + "flexi-grid:flexi-grid-topology" {
    description "Augment flexi-grid TE label";
  }
  description "flexi-grid label.";
  case flexi-grid {
    uses layer0-types:flexi-grid-path-label;
  }
}

/* Augment ingress label restrictions of connectivity-matrix information-source */
augment "nw:networks/nw:network/nw:node/tet:te/
  + "tet:information-source-entry/tet:connectivity-matrices/
  + "tet:from/tet:label-restrictions/tet:label-restriction" {
  when "././././././././." 
  + "nw:network-types/tet:te-topology/
  + "flexi-grid:flexi-grid-topology" {
    description "Augment flexi-grid TE label";
  }
  description "flexi-grid label.";
  uses layer0-types:flexi-grid-label-restriction;
}

/* Augment ingress label restrictions start of connectivity-matrix information-source */
augment "nw:networks/nw:network/nw:node/tet:te/
  + "tet:information-source-entry/tet:connectivity-matrices/
  + "tet:connectivity-matrix/
  + "tet:from/tet:label-restrictions/
  + "tet:label-restriction/
  + "tet:label-start/tet:te-label/tet:technology" {
  when "./././././././././." 
  + "nw:network-types/tet:te-topology/
  + "flexi-grid:flexi-grid-topology" {
    description "Augment flexi-grid TE label";
  }
  description "flexi-grid label.";
  case flexi-grid {
    uses layer0-types:flexi-grid-link-label;
  }
}
/* Augment ingress label restrictions end of connectivity-matrix information-source */
    + "tet:information-source-entry/tet:connectivity-matrices/
    + "tet:connectivity-matrix/
    + "tet:from/tet:label-restrictions/
    + "tet:label-restriction/
    + "tet:label-end/tet:te-label/tet:technology" {
when "././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././../" + "nw:network-types/tet:te-topology/
    + "flexi-grid:flexi-grid-topology" {
        description "Augment flexi-grid TE label";
    }
    description "flexi-grid label.";
    case flexi-grid {
        uses layer0-types:flexi-grid-link-label;
    }
}
/* Augment ingress label restrictions step of connectivity-matrix information-source */
    + "tet:information-source-entry/tet:connectivity-matrices/
    + "tet:connectivity-matrix/
    + "tet:from/tet:label-restrictions/
    + "tet:label-restriction/
    + "tet:label-step/tet:technology" {
when "./././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././.." + "nw:network-types/tet:te-topology/
    + "flexi-grid:flexi-grid-topology" {
        description "Augment flexi-grid TE label";
    }
    description "flexi-grid label.";
    case flexi-grid {
        uses layer0-types:flexi-grid-label-step;
    }
}
/* Augment egress label restrictions of connectivity-matrix information-source */
  + "tet:information-source-entry/tet:connectivity-matrices/
  + "tet:connectivity-matrix/
  + "tet:to/tet:label-restrictions/tet:label-restriction" {
when "../../../../../../../../nw:network-types/tet:te-topology/
  + "flexi-grid:flexi-grid-topology" {
  description "Augment flexi-grid TE label";
}
  uses layer0-types:flexi-grid-label-restriction;
}

/* Augment egress label restrictions start of connectivity-matrix information-source */
  + "tet:information-source-entry/tet:connectivity-matrices/
  + "tet:connectivity-matrix/
  + "tet:to/tet:label-restrictions/tet:label-restriction/
  + "tet:label-start/tet:te-label/tet:technology" {
when "../../../../../../../../nw:network-types/tet:te-topology/
  + "flexi-grid:flexi-grid-topology" {
  description "Augment flexi-grid TE label";
}
  uses layer0-types:flexi-grid-link-label;
}
  case flexi-grid {
    uses layer0-types:flexi-grid-link-label;
  }
}

/* Augment egress label restrictions end of connectivity-matrix information-source */
  + "tet:information-source-entry/tet:connectivity-matrices/
  + "tet:connectivity-matrix/
  + "tet:to/tet:label-restrictions/tet:label-restriction/
  + "tet:label-end/tet:te-label/tet:technology" {
when "../../../../../../../../nw:network-types/tet:te-topology/
  + "flexi-grid:flexi-grid-topology" {
  description "Augment flexi-grid TE label";
}
  uses layer0-types:flexi-grid-link-label;
}
  case flexi-grid {
    uses layer0-types:flexi-grid-link-label;
  }
}
/* Augment egress label restrictions step of connectivity-matrix information-source */
    + "tet:information-source-entry/tet:connectivity-matrices/"
    + "tet:connectivity-matrix/"
    + "tet:to/tet:label-restrictions/tet:label-restriction/"
    + "tet:label-step/tet:technology" {
    when ".../.../.../.../.../.../.../.../.../.../.../.../"
        + "nw:network-types/tet:te-topology/"
        + "flexi-grid:flexi-grid-topology" {
            description "Augment flexi-grid TE label";
        }
    description "flexi-grid label.";
    case flexi-grid {
        uses layer0-types:flexi-grid-label-step;
    }
}
/* Augment label hop of underlay primary path of connectivity-matrix information-source */
    + "tet:information-source-entry/tet:connectivity-matrices/"
    + "tet:connectivity-matrix/"
    + "tet:underlay/tet:primary-path/tet:path-element/tet:type/"
    + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
    when ".../.../.../.../.../.../.../.../.../.../.../.../"
        + "nw:network-types/tet:te-topology/"
        + "flexi-grid:flexi-grid-topology" {
            description "Augment flexi-grid TE label";
        }
    description "flexi-grid label.";
    case flexi-grid {
        uses layer0-types:flexi-grid-path-label;
    }
}
/* Augment label hop of underlay backup path of connectivity-matrix information-source */
    + "tet:information-source-entry/tet:connectivity-matrices/"
    + "tet:connectivity-matrix/"
    + "tet:underlay/tet:backup-path/tet:path-element/tet:type/"
    + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
    when ".../.../.../.../.../.../.../.../.../.../.../.../"
        + "nw:network-types/tet:te-topology/"
        + "flexi-grid:flexi-grid-topology" {
            description "Augment flexi-grid TE label";
        }
    description "flexi-grid label.";
    case flexi-grid {
        uses layer0-types:flexi-grid-path-label;
    }
}
/* Augment label hop of route-exclude of connectivity-matrix information-source */
    + "tet:information-source-entry/tet:connectivity-matrices/
    + "tet:connectivity-matrix/
    + "tet:optimizations/tet:algorithm/tet:metric/
    + "tet:optimization-metric/
    + "tet:explicit-route-exclude-objects/
    + "tet:route-object-exclude-object/tet:type/
    + "tet:label/tet:label-hop/tet:te-label/tet:technology"
when "../../../../../../../../../../../"
    + "nw:network-types/tet:te-topology/
    + "flexi-grid:flexi-grid-topology"
    + "flexi-grid label."
    case flexi-grid {
    uses layer0-types:flexi-grid-path-label;
    }
}

/* Augment label hop of route-include of connectivity-matrix information-source */
    + "tet:information-source-entry/tet:connectivity-matrices/
    + "tet:connectivity-matrix/
    + "tet:optimizations/tet:algorithm/tet:metric/
    + "tet:optimization-metric/
    + "tet:explicit-route-include-objects/
    + "tet:route-object-include-object/tet:type/
    + "tet:label/tet:label-hop/tet:te-label/tet:technology"
when "../../../../../../../../../../../"
    + "nw:network-types/tet:te-topology/
    + "flexi-grid:flexi-grid-topology"
    + "flexi-grid label."
    case flexi-grid {
    uses layer0-types:flexi-grid-path-label;
    }
/* Augment label hop of path-route of connectivity-matrix information-source */
  + "tet:information-source-entry/tet:connectivity-matrices/
  + "tet:connectivity-matrix/"
  + "tet:path-properties/tet:path-route-objects/"
  + "tet:path-route-object/tet:type/"
    + "tet:information-source-entry/tet:connectivity-matrices/"
    + "tet:connectivity-matrix/"
    + "tet:path-properties/tet:path-route-objects/"
    + "tet:path-route-object/tet:type/"
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" { description "Augment flexi-grid TE label";
          description "flexi-grid label.";
          case flexi-grid {
            uses layer0-types:flexi-grid-path-label;
          }
    }
}

/* Augment label restrictions start of local-link-connectivities */
  + "tet:tunnel-termination-point/"
  + "tet:local-link-connectivities/"
  + "tet:label-restrictions/tet:label-restriction/"
  + "nw:network-types/tet:te-topology/"
  + "flexi-grid:flexi-grid-topology" { description "Augment flexi-grid TE label";
          description "flexi-grid label.";
          uses layer0-types:flexi-grid-label-restriction;
    }

/* Augment label restrictions start of local-link-connectivities */
  + "tet:tunnel-termination-point/"
  + "tet:local-link-connectivities/"
  + "tet:label-restrictions/tet:label-restriction/"
    + "tet:tunnel-termination-point/"
    + "tet:local-link-connectivities/"
    + "tet:label-restrictions/tet:label-restriction/"
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" { description "Augment flexi-grid TE label";
          description "flexi-grid label.";
          case flexi-grid {
            uses layer0-types:flexi-grid-link-label;
          }
    }

Lopez de Vergara, et al. Expires September 25, 2019
/* Augment label restrictions end of local-link-connectivities */
+ "tet:tunnel-termination-point/
+ "tet:local-link-connectivities/
+ "tet:label-restrictions/tet:label-restriction/
+ "tet:label-end/
+ "tet:te-label/tet:technology"
when "../\n+ "nw:network-types/tet:te-topology/
+ "flexi-grid:flexi-grid-topology" {
  description "Augment flexi-grid TE label";
}
description "flexi-grid label.";
case flexi-grid {
  uses layer0-types:flexi-grid-label;
}

/* Augment label restrictions step of local-link-connectivities */
+ "tet:tunnel-termination-point/
+ "tet:local-link-connectivities/
+ "tet:label-restrictions/tet:label-restriction/
+ "tet:label-step/
+ "tet:technology"
when "/\n+ "nw:network-types/tet:te-topology/
+ "flexi-grid:flexi-grid-topology" {
  description "Augment flexi-grid TE label";
}
description "flexi-grid label.";
case flexi-grid {
  uses layer0-types:flexi-grid-label-step;
}

/* Augment label hop of underlay primary path of local-link-connectivities */
+ "tet:tunnel-termination-point/
+ "tet:local-link-connectivities/
+ "tet:underlay/tet:primary-path/tet:path-element/tet:type/
+ "tet:label/tet:label-hop/tet:te-label/tet:technology"
when "/\n+ "nw:network-types/tet:te-topology/
+ "flexi-grid:flexi-grid-topology" {
  description "Augment flexi-grid TE label";
}
description "flexi-grid label.";
case flexi-grid {
  uses layer0-types:flexi-grid-path-label;
}
/* Augment label hop of underlay backup path of local-link-connectivities */
augment "ateway/networks/network/node/tet:te/"
+ "tet:tunnel-termination-point/"
+ "tet:local-link-connectivities/"
+ "tet:underlay/tet:backup-path/tet:path-element/tet:type/"
+ "tet:label/tet:label-hop/tet:te-label/tet:technology" {
when "././././././././././././././. /
+ "network-types/tet:te-topology/"
+ "flexi-grid:flexi-grid-topology" {
description "Augment flexi-grid TE label";
}
description "flexi-grid label.";
case flexi-grid {
  uses layer0-types:flexi-grid-path-label;
}
}
/* Augment label hop of route-exclude of local-link-connectivities */
augment "ateway/networks/network/node/tet:te/"
+ "tet:tunnel-termination-point/"
+ "tet:optimizations/tet:algorithm/tet:metric/"
+ "tet:optimization-metric/"
+ "tet:explicit-route-exclude-objects/"
+ "route:object-exclude-object/tet:type/"
+ "tet:label/tet:label-hop/tet:te-label/tet:technology" {
when "././././././././././././././. /
+ "network-types/tet:te-topology/"
+ "flexi-grid:flexi-grid-topology" {
description "Augment flexi-grid TE label";
}
description "flexi-grid label.";
case flexi-grid {
  uses layer0-types:flexi-grid-path-label;
}
}
/* Augment label hop of route-include of local-link-connectivities */
augment "nw:networks/nw:network/nw:node/tet:te/
 + "tet:tunnel-termination-point/
 + "tet:local-link-connectivities/
 + "tet:optimizations/tet:algorithm/tet:metric/
 + "tet:optimization-metric/
 + "tet:explicit-route-include-objects/
 + "tet:route-object-include-object/tet:type/
 + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
 when "nw:network-types/tet:te-topology/
 + "flexi-grid:flexi-grid-topology" {
 description "Augment flexi-grid TE label";
 } description "flexi-grid label.";
 case flexi-grid {
 uses layer0-types:flexi-grid-path-label;
 }
}
/* Augment label hop of path-route of local-link-connectivities */
augment "nw:networks/nw:network/nw:node/tet:te/
 + "tet:tunnel-termination-point/
 + "tet:local-link-connectivities/
 + "tet:path-properties/tet:path-route-objects/
 + "tet:path-route-object/tet:type/
 + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
 when "nw:network-types/tet:te-topology/
 + "flexi-grid:flexi-grid-topology" {
 description "Augment flexi-grid TE label";
 } description "flexi-grid label.";
 case flexi-grid {
 uses layer0-types:flexi-grid-path-label;
 }
}
/* Augment label restrictions of local-link-connectivity (LLC) */
augment "nw:networks/nw:network/nw:node/tet:te/
 + "tet:tunnel-termination-point/
 + "tet:local-link-connectivities/
 + "tet:local-link-connectivity/
 + "tet:label-restrictions/tet:label-restriction" {
 when "nw:network-types/tet:te-topology/
 + "flexi-grid:flexi-grid-topology" {
 description "Augment flexi-grid TE label";
 } description "flexi-grid label.";
 uses layer0-types:flexi-grid-label-restriction;
}
/* Augment label restrictions start of local-link-connectivity (LLC) */

augment "*/nw:networks/nw:network/nw:node/tet:te/*"
+ "tet:tunnel-termination-point/*"
+ "tet:local-link-connectivities/*"
+ "tet:local-link-connectivity/*"
+ "tet:label-restrictions/tet:label-restriction/*"

description "flexi-grid label.");

case flexi-grid {
  uses layer0-types:flexi-grid-link-label;
}
}

/* Augment label restrictions end of local-link-connectivity (LLC) */

augment "*/nw:networks/nw:network/nw:node/tet:te/*"
+ "tet:tunnel-termination-point/*"
+ "tet:local-link-connectivities/*"
+ "tet:local-link-connectivity/*"
+ "tet:label-restrictions/tet:label-restriction/*"

description "flexi-grid label.");

case flexi-grid {
  uses layer0-types:flexi-grid-link-label;
}
}

/* Augment label restrictions step of local-link-connectivity (LLC) */

augment "*/nw:networks/nw:network/nw:node/tet:te/*"
+ "tet:tunnel-termination-point/*"
+ "tet:local-link-connectivities/*"
+ "tet:local-link-connectivity/*"
+ "tet:label-restrictions/tet:label-restriction/*"

description "flexi-grid label.");

case flexi-grid {
  uses layer0-types:flexi-grid-label-step;
}
}
/* Augment label hop of underlay primary path of 
local-link-connectivity (LLC) */
 + "tet:tunnel-termination-point/"
 + "tet:local-link-connectivities/"
 + "tet:local-link-connectivity/"
 + "tet:underlay/tet:primary-path/tet:path-element/tet:type/
 + "tet:label/tet:label-hop/tet:te-label/tet:technology" { 
when "././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././.
 + "nw:network-types/tet:te-topology/
 + "flexi-grid:flexi-grid-topology" { 
 description "Augment flexi-grid TE label"; 
 }
description "flexi-grid label.";
case flexi-grid { 
 uses layer0-types:flexi-grid-path-label;
 }
}

/* Augment label hop of underlay backup path of 
local-link-connectivity (LLC) */
 + "tet:tunnel-termination-point/"
 + "tet:local-link-connectivities/"
 + "tet:local-link-connectivity/"
 + "tet:underlay/tet:backup-path/tet:path-element/tet:type/
 + "tet:label/tet:label-hop/tet:te-label/tet:technology" { 
when "./././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././.
 + "nw:network-types/tet:te-topology/
 + "flexi-grid:flexi-grid-topology" { 
 description "Augment flexi-grid TE label"; 
 }
description "flexi-grid label.";
case flexi-grid { 
 uses layer0-types:flexi-grid-path-label;
 }
}
/* Augment label hop of route-exclude of local-link-connectivity (LLC) */
augment "*/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:tunnel-termination-point/"
  + "tet:local-link-connectivities/"
  + "tet:local-link-connectivity/"
  + "tet:optimizations/tet:algorithm/tet:metric/"
  + "tet:optimization-metric/"
  + "tet:explicit-route-exclude-objects/"
  + "tet:route-object-exclude-object/tet:type/"
  + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
when "../.../.../.../.../.../.../.../.../.../
  + "nw:network-types/tet:te-topology/
  + "flexi-grid:flexi-grid-topology" {
    description "Augment flexi-grid TE label";
    }
  }
}
/* Augment label hop of route-include of local-link-connectivity (LLC) */
augment "*/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:tunnel-termination-point/"
  + "tet:local-link-connectivities/"
  + "tet:local-link-connectivity/"
  + "tet:optimizations/tet:algorithm/tet:metric/"
  + "tet:optimization-metric/"
  + "tet:explicit-route-include-objects/"
  + "tet:route-object-include-object/tet:type/"
  + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
when "../.../.../.../.../.../.../.../.../.../
  + "nw:network-types/tet:te-topology/
  + "flexi-grid:flexi-grid-topology" {
    description "Augment flexi-grid TE label";
    }
  }
}
/* Augment label hop of path-route of local-link-connectivity (LLC) */
 + "tet:tunnel-termination-point/
 + "tet:local-link-connectivities/
 + "tet:local-link-connectivity/
 + "tet:path-properties/tet:path-route-objects/
 + "tet:path-route-object/tet:type/
 + "tet:label/tet:label-hop/tet:te-label/tet:technology"
 when "././././././././././." "nw:network-types/tet:te-topology/
 + "flexi-grid:flexi-grid-topology" { 
 description "Augment flexi-grid TE label";
} description "flexi-grid label.";
case flexi-grid {
 uses layer0-types:flexi-grid-path-label;
}

/* Augment label hop of underlay primary path of TE link */
 + "tet:te-link-attributes/
 + "tet:underlay/tet:primary-path/tet:path-element/tet:type/
 + "tet:label/tet:label-hop/tet:te-label/tet:technology"
 when "././././././././././." "nw:network-types/tet:te-topology/
 + "flexi-grid:flexi-grid-topology" { 
 description "Augment flexi-grid TE label";
} description "flexi-grid label.";
case flexi-grid {
 uses layer0-types:flexi-grid-path-label;
}

/* Augment label hop of underlay backup path of TE link */
 + "tet:te-link-attributes/
 + "tet:underlay/tet:backup-path/tet:path-element/tet:type/
 + "tet:label/tet:label-hop/tet:te-label/tet:technology"
 when "././././././././././." "nw:network-types/tet:te-topology/
 + "flexi-grid:flexi-grid-topology" { 
 description "Augment flexi-grid TE label";
} description "flexi-grid label.";
case flexi-grid {
 uses layer0-types:flexi-grid-path-label;
}
/* Augment label restrictions of TE link */
augment "/nw:networks/nw:network/nt:link/tet:te/"
  + "tet:te-link-attributes/"
  + "tet:label-restrictions/tet:label-restriction" {
    when "././././././nw:network-types/tet:te-topology/"
      + "flexi-grid:flexi-grid-topology" {
        description "Augment flexi-grid TE label";
      }
    description "flexi-grid label.";
  uses layer0-types:flexi-grid-label-restriction;
}
/* Augment label restrictions start of TE link */
augment "/nw:networks/nw:network/nt:link/tet:te/"
  + "tet:te-link-attributes/"
  + "tet:label-restrictions/tet:label-restriction/
  + "tet:label-start/tet:te-label/tet:technology" {
    when "././././././nw:network-types/tet:te-topology/"
      + "flexi-grid:flexi-grid-topology" {
        description "Augment flexi-grid TE label";
      }
    description "flexi-grid label.";
    case flexi-grid {
      uses layer0-types:flexi-grid-link-label;
    }
}
/* Augment label restrictions end of TE link */
augment "/nw:networks/nw:network/nt:link/tet:te/"
  + "tet:te-link-attributes/"
  + "tet:label-restrictions/tet:label-restriction/
  + "tet:label-end/tet:te-label/tet:technology" {
    when "././././././nw:network-types/tet:te-topology/"
      + "flexi-grid:flexi-grid-topology" {
        description "Augment flexi-grid TE label";
      }
    description "flexi-grid label.";
    case flexi-grid {
      uses layer0-types:flexi-grid-link-label;
    }
}
/* Augment label restrictions step of TE link */
augment "/nw:networks/nw:network/nt:link/tet:te/"
  + "tet:te-link-attributes/"
  + "tet:label-restrictions/tet:label-restriction/
  + "tet:label-step/tet:technology" {
    when "././././././nw:network-types/tet:te-topology/"
      + "flexi-grid:flexi-grid-topology" {
        description "Augment flexi-grid TE label";
      }
    description "flexi-grid label.";
    case flexi-grid {
      uses layer0-types:flexi-grid-label-step;
    }
}
/* Augment label restrictions of TE link information-source */
augment "./nw/networks/nw:network/nt:link/tet:te/"
  + "tet:information-source-entry/
  + "tet:label-restrictions/tet:label-restriction" {
    when "./../../nw:network-types/tet:te-topology/"
      + "flexi-grid:flexi-grid-topology" {
        description "Augment flexi-grid TE label";
      }
    description "flexi-grid label.";
    uses layer0-types:flexi-grid-label-restriction;
  }
/* Augment label restrictions start of TE link information-source */
augment "./nw/networks/nw:network/nt:link/tet:te/"
  + "tet:information-source-entry/
  + "tet:label-restrictions/tet:label-restriction"
  + "tet:label-start/tet:te-label/tet:technology" {
    when "./../../nw:network-types/tet:te-topology/"
      + "flexi-grid:flexi-grid-topology" {
        description "Augment flexi-grid TE label";
      }
    description "flexi-grid label.";
    case flexi-grid {
      uses layer0-types:flexi-grid-link-label;
    }
  }
/* Augment label restrictions end of TE link information-source */
augment "./nw/networks/nw:network/nt:link/tet:te/"
  + "tet:information-source-entry/
  + "tet:label-restrictions/tet:label-restriction"
  + "tet:label-end/tet:te-label/tet:technology" {
    when "./../../nw:network-types/tet:te-topology/"
      + "flexi-grid:flexi-grid-topology" {
        description "Augment flexi-grid TE label";
      }
    description "flexi-grid label.";
    case flexi-grid {
      uses layer0-types:flexi-grid-link-label;
    }
  }
/* Augment label restrictions step of TE link information-source */
augment "./nw/networks/nw:network/nt:link/tet:te/"
  + "tet:information-source-entry/
  + "tet:label-restrictions/tet:label-restriction"
  + "tet:label-step/tet:technology" {
    when "./../../nw:network-types/tet:te-topology/"
      + "flexi-grid:flexi-grid-topology" {
        description "Augment flexi-grid TE label";
      }
    description "flexi-grid label.";
    case flexi-grid {
      uses layer0-types:flexi-grid-label-step;
    }
  }
/* Augment label hop of underlay primary path of TE link template */
augment "/nw:networks/tet:te/tet:templates/"
  + "tet:link-template/tet:te-link-attributes/
  + "tet:underlay/tet:primary-path/tet:path-element/tet:type/"
  + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
  /*
   when "././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././.ние
   + "nw:network-types/tet:te-topology/
   + "flexi-grid:flexi-grid-topology" {
     description "Augment flexi-grid TE label";
   }
  */

description "flexi-grid label.";
  case flexi-grid {
    uses layer0-types:flexi-grid-path-label;
  }
}

/* Augment label hop of underlay backup path of TE link template */
augment "/nw:networks/tet:te/tet:templates/"
  + "tet:link-template/tet:te-link-attributes/
  + "tet:underlay/tet:backup-path/tet:path-element/tet:type/"
  + "tet:label/tet:label-hop/tet:te-label/tet:technology" {  
  /*
   when "./././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././.ние
   + "nw:network-types/tet:te-topology/
   + "flexi-grid:flexi-grid-topology" {
     description "Augment flexi-grid TE label";
   }
  */

description "flexi-grid label.";
  case flexi-grid {
    uses layer0-types:flexi-grid-path-label;
  }
}

/* Augment label restrictions of TE link template */
augment "/nw:networks/tet:te/tet:templates/"
  + "tet:link-template/tet:te-link-attributes/
  + "tet:label-restrictions/tet:label-restriction" { 
  /*
   when "././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././././.ние
   + "nw:network-types/tet:te-topology/
   + "flexi-grid:flexi-grid-topology" {
     description "Augment flexi-grid TE label";
   }
  */

description "flexi-grid label.";
  uses layer0-types:flexi-grid-label-restriction;
/* Augment label restrictions start of TE link template */
+ "tet:link-template/tet:te-link-attributes/
+ "tet:label-restrictions/tet:label-restriction/
+ "tet:label-start/tet:te-label/tet:technology" {
/
    when "/nw:network-types/tet:te-topology/
+ "flexi-grid:flexi-grid-topology" {
        description "Augment flexi-grid TE label";
    }
}/*
    description "flexi-grid label.";
    case flexi-grid {
        uses layer0-types:flexi-grid-link-label;
    }
} /* Augment label restrictions end of TE link template */
+ "tet:link-template/tet:te-link-attributes/
+ "tet:label-restrictions/tet:label-restriction/
+ "tet:label-end/tet:te-label/tet:technology" {
/
    when "/nw:network-types/tet:te-topology/
+ "flexi-grid:flexi-grid-topology" {
        description "Augment flexi-grid TE label";
    }
} /*
    description "flexi-grid label.";
    case flexi-grid {
        uses layer0-types:flexi-grid-label-step;
    }
} /* Augment label restrictions step of TE link template */
+ "tet:link-template/tet:te-link-attributes/
+ "tet:label-restrictions/tet:label-restriction/
+ "tet:label-step/tet:technology" {
/
    when "/nw:network-types/tet:te-topology/
+ "flexi-grid:flexi-grid-topology" {
        description "Augment flexi-grid TE label";
    }
} /*
    description "flexi-grid label.";
    case flexi-grid {
        uses layer0-types:flexi-grid-label-step;
    }
} <CODE ENDS>
6.3. License

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, are permitted provided that the following conditions are met:

- Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
- Neither the name of Internet Society, IETF or IETF Trust, nor the names of specific contributors, may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT OWNER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

7. Security Considerations

The YANG module specified in this document defines a schema for data that is designed to be accessed via network management protocols such as NETCONF [RFC6241] or RESTCONF [RFC8040]. The lowest NETCONF layer is the secure transport layer, and the mandatory-to-implement secure transport is Secure Shell (SSH) [RFC6242]. The lowest RESTCONF layer is HTTPS, and the mandatory-to-implement secure transport is TLS [RFC8446].
The NETCONF access control model [RFC8341] provides the means to restrict access for particular NETCONF users to a preconfigured subset of all available NETCONF protocol operations and content. The NETCONF Protocol over Secure Shell (SSH) [RFC6242] describes a method for invoking and running NETCONF within a Secure Shell (SSH) session as an SSH subsystem. 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.

A number of configuration data nodes defined in this document are writable/deletable (i.e., "config true"). These data nodes may be considered sensitive or vulnerable in some network environments.

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:

```
/tet:label-restrictions/tet:label-restriction
```

8. IANA Considerations

The namespace used in the defined model has to register a URI in the IETF XML registry [RFC3688], as well as in the YANG Module Names registry [RFC6020].
9. References

9.1. Normative References


9.2. Informative References


10. Contributors

The model presented in this paper was contributed to by more people than can be listed on the author list. Additional contributors include:

- Zafar Ali, Cisco Systems
- Daniel Michaud Vallinoto, Universidad Autonoma de Madrid

11. Acknowledgments

The work presented in this Internet-Draft has been partially funded by the European Commission under the project H2020 METRO-HAUL (Metro High bandwidth, 5G Application-aware optical network, with edge storage, compute and low Latency), Grant Agreement number: 761727, and by the Spanish Ministry of Economy and Competitiveness under the project TRAFICA, MINECO/FEDER TEC2015-69417-C2-1-R.

Authors’ Addresses

Jorge E. Lopez de Vergara Mendez
Universidad Autonoma de Madrid
Escuela Politecnica Superior
C/Francisco Tomas y Valiente, 11
E-28049 Madrid, Spain

Email: jorge.lopez_vergara@uam.es

Daniel Perdices Burrero
Naudit High Performance Computing and Networking, S.L.
C/Faraday, 7
E-28049 Madrid, Spain

Email: daniel.perdices@naudit.es