

CCAMP Working Group
Internet-Draft
Intended status: Informational
Expires: May 5, 2021

J. Lopez de Vergara
Universidad Autonoma de Madrid
D. Perdices Burrero
Naudit HPCN
D. King
Old Dog Consulting
Y. Lee
Samsung
H. Zheng
Huawei Technologies
November 1, 2020

A YANG Data Model for Flexi-Grid Optical Networks
draft-ietf-ccamp-flexigrid-yang-08

Abstract

This document defines a YANG module for managing flexi-grid optical networks. The model defined in this document specifies a flexi-grid traffic engineering database that is used to describe the topology of a flexi-grid network. It is based on and augments existing YANG models that describe network and traffic engineering topologies.

A partner document defines a second YANG module for flexi-grid media channels, i.e., the paths from source to destination through a number of intermediate nodes.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of [BCP 78](#) and [BCP 79](#).

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at <https://datatracker.ietf.org/drafts/current/>.

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."

This Internet-Draft will expire on May 5, 2021.

Copyright Notice

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

This document is subject to [BCP 78](https://trustee.ietf.org/license-info) and the IETF Trust's Legal Provisions Relating to IETF Documents (<https://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.

Table of Contents

1.	Introduction	2
2.	Terminology	3
3.	Tree Diagram	4
3.1.	Prefixes in Data Node Names	4
4.	Example of Use	4
5.	YANG Model (Tree Structure) for Flexi-grid topology	6
6.	The YANG Code for Flexi-grid topology	23
7.	Security Considerations	57
8.	IANA Considerations	58
9.	Contributors	59
10.	Acknowledgments	60
11.	References	60
11.1.	Normative References	60
11.2.	Informative References	61
	Authors' Addresses	62

[1.](#) Introduction

The flexible grid (flexi-grid) optical network technology defined by the International Telecommunication Union Telecommunication Standardization Sector (ITU-T) and documented in Recommendation G.694.1 [[G.694.1](#)] and G.872 [[G.872](#)] provides an enhanced Dense Wavelength Division Multiplexing (DWDM) grid by defining a set of nominal central frequencies, channel spacings, and the concept of the "frequency slot". In such an environment, a data-plane connection is switched based on allocated, variable-sized frequency ranges within the optical spectrum, creating what is known as a flexible grid (flexi-grid). This technology increases both transport network scalability and flexibility, allowing the optimization of bandwidth usage.

[RFC7698] provides a framework GMPLS-Based control of flexi-grid DWDM networks while [RFC7699] defines generalized labels for the use in flexi-grid in GMPLS networks.

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. For this, it augments [RFC8340]. An application example is provided towards the end of the document to better understand their utility.

A partner document defines a second YANG module that described flexi-grid tunnels, i.e., the paths from source to destination through a number of intermediate nodes [I-D.ietf-ccamp-flexigrid-media-channel-yang].

Data types related to the optical layer are defined in [I-D.ietf-ccamp-layer0-types].

Impairment-aware traffic engineering topology is described in [I-D.ietf-ccamp-optical-impairment-topology-yang].

2. Terminology

Refer to [RFC7446] and [RFC7581] for the key terms used in this document.

The following terms are defined in [RFC7950] and are not redefined here:

- o client
- o server
- o augment
- o data model
- o data node

The following terms are defined in [\[RFC6241\]](#) and are not redefined here:

- o configuration data
- o state data

The terminology for describing YANG data models is found in [\[RFC7950\]](#).

3. Tree Diagram

A simplified graphical representation of the data model is used in this document. The meaning of the symbols in these diagrams is defined in [\[RFC8340\]](#).

3.1. Prefixes in Data Node Names

In this document, names of data nodes and other data model objects are prefixed using the standard prefix associated with the corresponding YANG imported modules, as shown in Figure 1. It uses prefixes from [\[I-D.ietf-ccamp-layer0-types\]](#), [\[RFC8345\]](#), and [\[RFC8795\]](#).

Prefix	YANG module	Reference
l0-types	ietf-layer0-types	[RFCXXXX]
flexi-grid	ietf-flexi-grid-topology	[RFCYYYY]
nw	ietf-network	[RFC8345]
nt	ietf-network-topology	[RFC8345]
tet	ietf-te-topology	[RFC8795]

Figure 1: Prefixes and Corresponding YANG modules

RFC Editor Note: Please replace XXXX with the RFC numbers assigned to [draft-ietf-ccamp-layer0-types](#). Please replace YYYY with the RFC number assigned to this document. Please remove this note.

4. 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.

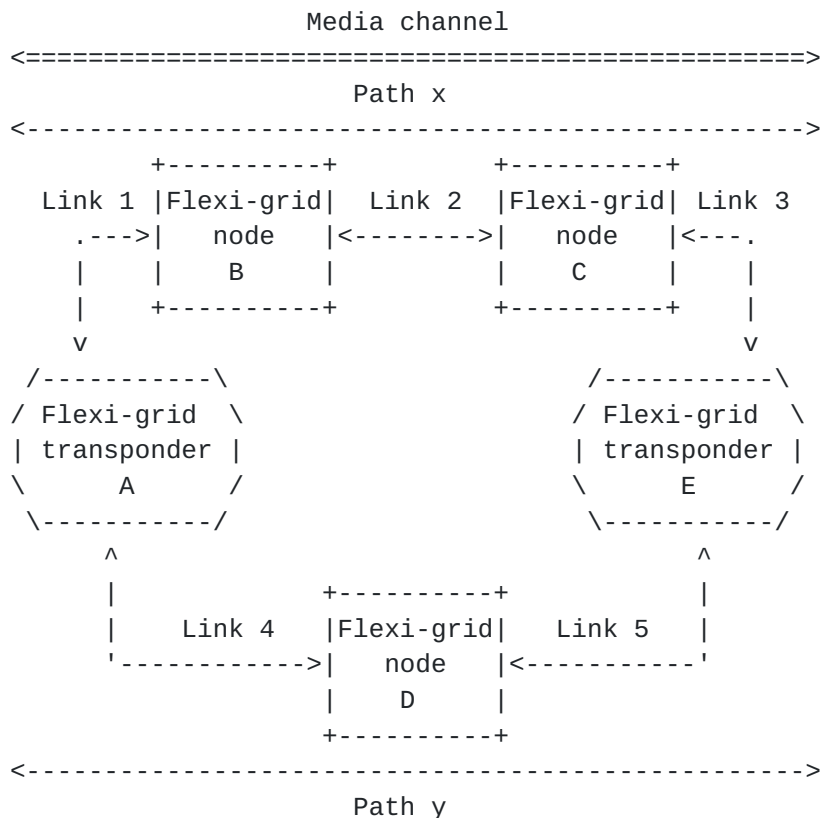


Figure 2: Topology Example

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

- o 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.
- o 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.
- o Then, we also define the links 1 to 5 that interconnect nodes and transponders, indicating which flexi-grid labels are available.

- o Other information, such as the slot frequency and granularity are also provided.
- o 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 [\[I-D.ietf-ccamp-flexigrid-media-channel-yang\]](#) to complete this example.

5. YANG Model (Tree Structure) for Flexi-grid topology

```

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/nw:node/tet:te
    /tet:te-node-attributes:
    +--rw flexi-grid-node!
  augment /nw:networks/nw:network/nw:node/tet:te
    /tet:te-node-attributes/tet:connectivity-matrices
    /tet:label-restrictions/tet:label-restriction:
    +--rw grid-type?      identityref
    +--rw priority?      uint8
    +--rw flexi-grid
      +--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:te-node-attributes/tet:connectivity-matrices
    /tet:connectivity-matrix/tet:from/tet:label-restrictions
    /tet:label-restriction:
    +--rw grid-type?      identityref
    +--rw priority?      uint8
    +--rw flexi-grid
      +--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:te-node-attributes/tet:connectivity-matrices
    /tet:connectivity-matrix/tet:to/tet:label-restrictions
    /tet:label-restriction:
    +--rw grid-type?      identityref
    +--rw priority?      uint8
    +--rw flexi-grid
      +--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:information-source-entry/tet:connectivity-matrices
    /tet:label-restrictions/tet:label-restriction:
+--ro grid-type?    identityref
+--ro priority?    uint8
+--ro flexi-grid
    +--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:
+--ro grid-type?    identityref
+--ro priority?    uint8
+--ro flexi-grid
    +--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:to/tet:label-restrictions
    /tet:label-restriction:
+--ro grid-type?    identityref
+--ro priority?    uint8
+--ro flexi-grid
    +--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:tunnel-termination-point
    /tet:local-link-connectivities/tet:label-restrictions
    /tet:label-restriction:
+--rw grid-type?    identityref
+--rw priority?    uint8
+--rw flexi-grid
    +--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:
+--rw grid-type?    identityref
+--rw priority?    uint8
```



```
+--rw flexi-grid
  +--rw slot-width-granularity?  identityref
  +--rw min-slot-width-factor?    uint16
  +--rw max-slot-width-factor?    uint16
augment /nw:networks/nw:network/nt:link/tet:te
  /tet:te-link-attributes/tet:label-restrictions
  /tet:label-restriction:
+--rw grid-type?  identityref
+--rw priority?   uint8
+--rw flexi-grid
  +--rw slot-width-granularity?  identityref
  +--rw min-slot-width-factor?    uint16
  +--rw max-slot-width-factor?    uint16
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 slot-width-granularity?  identityref
  +--ro min-slot-width-factor?    uint16
  +--ro max-slot-width-factor?    uint16
augment /nw:networks/tet:te/tet:templates/tet:link-template
  /tet:te-link-attributes/tet:label-restrictions
  /tet:label-restriction:
+--rw grid-type?  identityref
+--rw priority?   uint8
+--rw flexi-grid
  +--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:te-node-attributes/tet:connectivity-matrices
  /tet:label-restrictions/tet:label-restriction
  /tet:label-start/tet:te-label/tet:technology:
+--:(flexi-grid)
  +--rw flexi-n?  10-types:flexi-n
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:
+--:(flexi-grid)
  +--rw flexi-n?  10-types:flexi-n
augment /nw:networks/nw:network/nw:node/tet:te
  /tet:te-node-attributes/tet:connectivity-matrices
  /tet:label-restrictions/tet:label-restriction
  /tet:label-step/tet:technology:
+--:(flexi-grid)
```



```

    +--rw flexi-grid-channel-spacing?  identityref
    +--rw flexi-n-step?                  uint8
augment /nw:networks/nw:network/nw:node/tet:te
    /tet:te-node-attributes/tet:connectivity-matrices
    /tet:underlay/tet:primary-path/tet:path-element/tet:type
    /tet:label/tet:label-hop/tet:te-label/tet:technology:
+--:(flexi-grid)
  +--rw (single-or-super-channel)?
    +--:(single)
    |   +--rw flexi-n?                l0-types:flexi-n
    |   +--rw flexi-m?                l0-types:flexi-m
    +--:(super)
    +--rw subcarrier-flexi-n* [flexi-n]
    +--rw flexi-n                l0-types:flexi-n
    +--rw flexi-m?               l0-types:flexi-m
augment /nw:networks/nw:network/nw:node/tet:te
    /tet:te-node-attributes/tet:connectivity-matrices
    /tet:underlay/tet:backup-path/tet:path-element/tet:type
    /tet:label/tet:label-hop/tet:te-label/tet:technology:
+--:(flexi-grid)
  +--rw (single-or-super-channel)?
    +--:(single)
    |   +--rw flexi-n?                l0-types:flexi-n
    |   +--rw flexi-m?                l0-types:flexi-m
    +--:(super)
    +--rw subcarrier-flexi-n* [flexi-n]
    +--rw flexi-n                l0-types:flexi-n
    +--rw flexi-m?               l0-types:flexi-m
augment /nw:networks/nw:network/nw:node/tet:te
    /tet:te-node-attributes/tet:connectivity-matrices
    /tet:optimizations/tet:algorithm/tet:metric
    /tet:optimization-metric
    /tet:explicit-route-exclude-objects
    /tet:route-object-exclude-object/tet:type/tet:label
    /tet:label-hop/tet:te-label/tet:technology:
+--:(flexi-grid)
  +--rw (single-or-super-channel)?
    +--:(single)
    |   +--rw flexi-n?                l0-types:flexi-n
    |   +--rw flexi-m?                l0-types:flexi-m
    +--:(super)
    +--rw subcarrier-flexi-n* [flexi-n]
    +--rw flexi-n                l0-types:flexi-n
    +--rw flexi-m?               l0-types:flexi-m
augment /nw:networks/nw:network/nw:node/tet:te
    /tet:te-node-attributes/tet:connectivity-matrices
    /tet:optimizations/tet:algorithm/tet:metric
    /tet:optimization-metric

```



```

        /tet:explicit-route-include-objects
        /tet:route-object-include-object/tet:type/tet:label
        /tet:label-hop/tet:te-label/tet:technology:
+--:(flexi-grid)
  +--rw (single-or-super-channel)?
    +--:(single)
      | +--rw flexi-n?          l0-types:flexi-n
      | +--rw flexi-m?          l0-types:flexi-m
    +--:(super)
      +--rw subcarrier-flexi-n* [flexi-n]
        +--rw flexi-n          l0-types:flexi-n
        +--rw flexi-m?         l0-types:flexi-m
augment /nw:networks/nw:network/nw:node/tet:te
  /tet:te-node-attributes/tet:connectivity-matrices
  /tet:path-properties/tet:path-route-objects
  /tet:path-route-object/tet:type/tet:label/tet:label-hop
  /tet:te-label/tet:technology:
+--:(flexi-grid)
  +--ro (single-or-super-channel)?
    +--:(single)
      | +--ro flexi-n?          l0-types:flexi-n
      | +--ro flexi-m?          l0-types:flexi-m
    +--:(super)
      +--ro subcarrier-flexi-n* [flexi-n]
        +--ro flexi-n          l0-types:flexi-n
        +--ro flexi-m?         l0-types:flexi-m
augment /nw:networks/nw:network/nw:node/tet:te
  /tet:te-node-attributes/tet:connectivity-matrices
  /tet:connectivity-matrix/tet:from/tet:label-restrictions
  /tet:label-restriction/tet:label-start/tet:te-label
  /tet:technology:
+--:(flexi-grid)
  +--rw flexi-n?          l0-types:flexi-n
augment /nw:networks/nw:network/nw:node/tet:te
  /tet:te-node-attributes/tet:connectivity-matrices
  /tet:connectivity-matrix/tet:from/tet:label-restrictions
  /tet:label-restriction/tet:label-end/tet:te-label
  /tet:technology:
+--:(flexi-grid)
  +--rw flexi-n?          l0-types:flexi-n
augment /nw:networks/nw:network/nw:node/tet:te
  /tet:te-node-attributes/tet:connectivity-matrices
  /tet:connectivity-matrix/tet:from/tet:label-restrictions
  /tet:label-restriction/tet:label-step/tet:technology:
+--:(flexi-grid)
  +--rw flexi-grid-channel-spacing? identityref
  +--rw flexi-n-step?          uint8
augment /nw:networks/nw:network/nw:node/tet:te

```



```

        /tet:te-node-attributes/tet:connectivity-matrices
        /tet:connectivity-matrix/tet:to/tet:label-restrictions
        /tet:label-restriction/tet:label-start/tet:te-label
        /tet:technology:
+--:(flexi-grid)
  +--rw flexi-n?    10-types:flexi-n
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:
+--:(flexi-grid)
  +--rw flexi-n?    10-types:flexi-n
augment /nw:networks/nw:network/nw:node/tet:te
  /tet:te-node-attributes/tet:connectivity-matrices
  /tet:connectivity-matrix/tet:to/tet:label-restrictions
  /tet:label-restriction/tet:label-step/tet:technology:
+--:(flexi-grid)
  +--rw flexi-grid-channel-spacing?  identityref
  +--rw flexi-n-step?                uint8
augment /nw:networks/nw:network/nw:node/tet:te
  /tet:te-node-attributes/tet:connectivity-matrices
  /tet:connectivity-matrix/tet:underlay/tet:primary-path
  /tet:path-element/tet:type/tet:label/tet:label-hop
  /tet:te-label/tet:technology:
+--:(flexi-grid)
  +--rw (single-or-super-channel)?
    +--:(single)
      | +--rw flexi-n?                10-types:flexi-n
      | +--rw flexi-m?                10-types:flexi-m
    +--:(super)
      +--rw subcarrier-flexi-n* [flexi-n]
        +--rw flexi-n    10-types:flexi-n
        +--rw flexi-m?  10-types:flexi-m
augment /nw:networks/nw:network/nw:node/tet:te
  /tet:te-node-attributes/tet:connectivity-matrices
  /tet:connectivity-matrix/tet:underlay/tet:backup-path
  /tet:path-element/tet:type/tet:label/tet:label-hop
  /tet:te-label/tet:technology:
+--:(flexi-grid)
  +--rw (single-or-super-channel)?
    +--:(single)
      | +--rw flexi-n?                10-types:flexi-n
      | +--rw flexi-m?                10-types:flexi-m
    +--:(super)
      +--rw subcarrier-flexi-n* [flexi-n]
        +--rw flexi-n    10-types:flexi-n
        +--rw flexi-m?  10-types:flexi-m

```



```

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:
+--:(flexi-grid)
  +--rw (single-or-super-channel)?
    +--:(single)
      | +--rw flexi-n?                10-types:flexi-n
      | +--rw flexi-m?                10-types:flexi-m
    +--:(super)
      +--rw subcarrier-flexi-n* [flexi-n]
        +--rw flexi-n                10-types:flexi-n
        +--rw flexi-m?               10-types:flexi-m
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:
+--:(flexi-grid)
  +--rw (single-or-super-channel)?
    +--:(single)
      | +--rw flexi-n?                10-types:flexi-n
      | +--rw flexi-m?                10-types:flexi-m
    +--:(super)
      +--rw subcarrier-flexi-n* [flexi-n]
        +--rw flexi-n                10-types:flexi-n
        +--rw flexi-m?               10-types:flexi-m
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:
+--:(flexi-grid)
  +--ro (single-or-super-channel)?
    +--:(single)
      | +--ro flexi-n?                10-types:flexi-n
      | +--ro flexi-m?                10-types:flexi-m
    +--:(super)
      +--ro subcarrier-flexi-n* [flexi-n]
        +--ro flexi-n                10-types:flexi-n
        +--ro flexi-m?               10-types:flexi-m
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 flexi-n?    l0-types:flexi-n
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 flexi-n?    l0-types:flexi-n
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 flexi-grid-channel-spacing?  identityref
  +--ro flexi-n-step?                uint8
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 flexi-n?                l0-types:flexi-n
      | +--ro flexi-m?                l0-types:flexi-m
    +--:(super)
      +--ro subcarrier-flexi-n* [flexi-n]
      +--ro flexi-n    l0-types:flexi-n
      +--ro flexi-m?   l0-types:flexi-m
augment /nw:networks/nw:network/nw:node/tet:te
  /tet:information-source-entry/tet:connectivity-matrices
  /tet:underlay/tet:backup-path/tet:path-element/tet:type
  /tet:label/tet:label-hop/tet:te-label/tet:technology:
+--:(flexi-grid)
  +--ro (single-or-super-channel)?
    +--:(single)
      | +--ro flexi-n?                l0-types:flexi-n
      | +--ro flexi-m?                l0-types:flexi-m
    +--:(super)
      +--ro subcarrier-flexi-n* [flexi-n]
      +--ro flexi-n    l0-types:flexi-n
      +--ro flexi-m?   l0-types:flexi-m
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 flexi-n?                10-types:flexi-n
      | +--ro flexi-m?                10-types:flexi-m
    +--:(super)
      +--ro subcarrier-flexi-n* [flexi-n]
        +--ro flexi-n    10-types:flexi-n
        +--ro flexi-m?   10-types:flexi-m
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:
+--:(flexi-grid)
  +--ro (single-or-super-channel)?
    +--:(single)
      | +--ro flexi-n?                10-types:flexi-n
      | +--ro flexi-m?                10-types:flexi-m
    +--:(super)
      +--ro subcarrier-flexi-n* [flexi-n]
        +--ro flexi-n    10-types:flexi-n
        +--ro flexi-m?   10-types:flexi-m
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 flexi-n?                10-types:flexi-n
      | +--ro flexi-m?                10-types:flexi-m
    +--:(super)
      +--ro subcarrier-flexi-n* [flexi-n]
        +--ro flexi-n    10-types:flexi-n
        +--ro flexi-m?   10-types:flexi-m
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 flexi-n?    10-types:flexi-n

```



```

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 flexi-n?    10-types:flexi-n
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 flexi-grid-channel-spacing?  identityref
  +--ro flexi-n-step?                uint8
augment /nw:networks/nw:network/nw:node/tet:te
  /tet:information-source-entry/tet:connectivity-matrices
  /tet:connectivity-matrix/tet:to/tet:label-restrictions
  /tet:label-restriction/tet:label-start/tet:te-label
  /tet:technology:
+--:(flexi-grid)
  +--ro flexi-n?    10-types:flexi-n
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 flexi-n?    10-types:flexi-n
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 flexi-grid-channel-spacing?  identityref
  +--ro flexi-n-step?                uint8
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 flexi-n?                10-types:flexi-n
    | +--ro flexi-m?                10-types:flexi-m
    +--:(super)
      +--ro subcarrier-flexi-n* [flexi-n]
      +--ro flexi-n    10-types:flexi-n

```



```

        +--ro flexi-m?   l0-types:flexi-m
augment /nw:networks/nw:network/nw:node/tet:te
    /tet:information-source-entry/tet:connectivity-matrices
    /tet:connectivity-matrix/tet:underlay/tet:backup-path
    /tet:path-element/tet:type/tet:label/tet:label-hop
    /tet:te-label/tet:technology:
+--:(flexi-grid)
  +--ro (single-or-super-channel)?
    +--:(single)
    | +--ro flexi-n?           l0-types:flexi-n
    | +--ro flexi-m?           l0-types:flexi-m
    +--:(super)
      +--ro subcarrier-flexi-n* [flexi-n]
      +--ro flexi-n   l0-types:flexi-n
      +--ro flexi-m?   l0-types:flexi-m
augment /nw:networks/nw:network/nw:node/tet:te
    /tet:information-source-entry/tet:connectivity-matrices
    /tet:connectivity-matrix/tet:optimizations/tet:algorithm
    /tet:metric/tet:optimization-metric
    /tet:explicit-route-exclude-objects
    /tet:route-object-exclude-object/tet:type/tet:label
    /tet:label-hop/tet:te-label/tet:technology:
+--:(flexi-grid)
  +--ro (single-or-super-channel)?
    +--:(single)
    | +--ro flexi-n?           l0-types:flexi-n
    | +--ro flexi-m?           l0-types:flexi-m
    +--:(super)
      +--ro subcarrier-flexi-n* [flexi-n]
      +--ro flexi-n   l0-types:flexi-n
      +--ro flexi-m?   l0-types:flexi-m
augment /nw:networks/nw:network/nw:node/tet:te
    /tet:information-source-entry/tet:connectivity-matrices
    /tet:connectivity-matrix/tet:optimizations/tet:algorithm
    /tet:metric/tet:optimization-metric
    /tet:explicit-route-include-objects
    /tet:route-object-include-object/tet:type/tet:label
    /tet:label-hop/tet:te-label/tet:technology:
+--:(flexi-grid)
  +--ro (single-or-super-channel)?
    +--:(single)
    | +--ro flexi-n?           l0-types:flexi-n
    | +--ro flexi-m?           l0-types:flexi-m
    +--:(super)
      +--ro subcarrier-flexi-n* [flexi-n]
      +--ro flexi-n   l0-types:flexi-n
      +--ro flexi-m?   l0-types:flexi-m
augment /nw:networks/nw:network/nw:node/tet:te

```



```

    /tet:information-source-entry/tet:connectivity-matrices
    /tet:connectivity-matrix/tet:path-properties
    /tet:path-route-objects/tet:path-route-object/tet:type
    /tet:label/tet:label-hop/tet:te-label/tet:technology:
+--:(flexi-grid)
  +--ro (single-or-super-channel)?
    +--:(single)
      | +--ro flexi-n?          l0-types:flexi-n
      | +--ro flexi-m?          l0-types:flexi-m
    +--:(super)
      +--ro subcarrier-flexi-n* [flexi-n]
      +--ro flexi-n      l0-types:flexi-n
      +--ro flexi-m?     l0-types:flexi-m
augment /nw:networks/nw:network/nw:node/tet:te
  /tet:tunnel-termination-point
  /tet:local-link-connectivities/tet:label-restrictions
  /tet:label-restriction/tet:label-start/tet:te-label
  /tet:technology:
+--:(flexi-grid)
  +--rw flexi-n?      l0-types:flexi-n
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 flexi-n?      l0-types:flexi-n
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 flexi-grid-channel-spacing?  identityref
  +--rw flexi-n-step?                uint8
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 flexi-n?          l0-types:flexi-n
      | +--rw flexi-m?          l0-types:flexi-m
    +--:(super)
      +--rw subcarrier-flexi-n* [flexi-n]
      +--rw flexi-n      l0-types:flexi-n
      +--rw flexi-m?     l0-types:flexi-m

```



```
augment /nw:networks/nw:network/nw:node/tet:te
  /tet:tunnel-termination-point
  /tet:local-link-connectivities/tet:underlay
  /tet:backup-path/tet:path-element/tet:type/tet:label
  /tet:label-hop/tet:te-label/tet:technology:
+--:(flexi-grid)
  +--rw (single-or-super-channel)?
    +--:(single)
    | +--rw flexi-n?                l0-types:flexi-n
    | +--rw flexi-m?                l0-types:flexi-m
    +--:(super)
      +--rw subcarrier-flexi-n* [flexi-n]
      +--rw flexi-n                l0-types:flexi-n
      +--rw flexi-m?               l0-types:flexi-m
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 flexi-n?                l0-types:flexi-n
    | +--rw flexi-m?                l0-types:flexi-m
    +--:(super)
      +--rw subcarrier-flexi-n* [flexi-n]
      +--rw flexi-n                l0-types:flexi-n
      +--rw flexi-m?               l0-types:flexi-m
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 flexi-n?                l0-types:flexi-n
    | +--rw flexi-m?                l0-types:flexi-m
    +--:(super)
      +--rw subcarrier-flexi-n* [flexi-n]
      +--rw flexi-n                l0-types:flexi-n
      +--rw flexi-m?               l0-types:flexi-m
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 flexi-n?          l0-types:flexi-n
      | +--ro flexi-m?          l0-types:flexi-m
    +--:(super)
      +--ro subcarrier-flexi-n* [flexi-n]
      +--ro flexi-n      l0-types:flexi-n
      +--ro flexi-m?     l0-types:flexi-m
augment /nw:networks/nw:network/nw:node/tet:te
  /tet:tunnel-termination-point
  /tet:local-link-connectivities
  /tet:local-link-connectivity/tet:label-restrictions
  /tet:label-restriction/tet:label-start/tet:te-label
  /tet:technology:
+--:(flexi-grid)
  +--rw flexi-n?      l0-types:flexi-n
augment /nw:networks/nw:network/nw:node/tet:te
  /tet:tunnel-termination-point
  /tet:local-link-connectivities
  /tet:local-link-connectivity/tet:label-restrictions
  /tet:label-restriction/tet:label-end/tet:te-label
  /tet:technology:
+--:(flexi-grid)
  +--rw flexi-n?      l0-types:flexi-n
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 flexi-grid-channel-spacing?  identityref
  +--rw flexi-n-step?                 uint8
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 flexi-n?          l0-types:flexi-n
      | +--rw flexi-m?          l0-types:flexi-m
    +--:(super)

```



```

        +--rw subcarrier-flexi-n* [flexi-n]
            +--rw flexi-n      10-types:flexi-n
            +--rw flexi-m?    10-types:flexi-m
augment /nw:networks/nw:network/nw:node/tet:te
    /tet:tunnel-termination-point
    /tet:local-link-connectivities
    /tet:local-link-connectivity/tet:underlay/tet:backup-path
    /tet:path-element/tet:type/tet:label/tet:label-hop
    /tet:te-label/tet:technology:
+--:(flexi-grid)
    +--rw (single-or-super-channel)?
        +--:(single)
        |   +--rw flexi-n?          10-types:flexi-n
        |   +--rw flexi-m?          10-types:flexi-m
        +--:(super)
            +--rw subcarrier-flexi-n* [flexi-n]
                +--rw flexi-n      10-types:flexi-n
                +--rw flexi-m?    10-types:flexi-m
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:
+--:(flexi-grid)
    +--rw (single-or-super-channel)?
        +--:(single)
        |   +--rw flexi-n?          10-types:flexi-n
        |   +--rw flexi-m?          10-types:flexi-m
        +--:(super)
            +--rw subcarrier-flexi-n* [flexi-n]
                +--rw flexi-n      10-types:flexi-n
                +--rw flexi-m?    10-types:flexi-m
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:
+--:(flexi-grid)
    +--rw (single-or-super-channel)?
        +--:(single)
        |   +--rw flexi-n?          10-types:flexi-n
        |   +--rw flexi-m?          10-types:flexi-m

```



```

    +--:(super)
      +--rw subcarrier-flexi-n* [flexi-n]
        +--rw flexi-n    10-types:flexi-n
        +--rw flexi-m?   10-types:flexi-m
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 flexi-n?           10-types:flexi-n
      | +--ro flexi-m?           10-types:flexi-m
    +--:(super)
      +--ro subcarrier-flexi-n* [flexi-n]
        +--ro flexi-n    10-types:flexi-n
        +--ro flexi-m?   10-types:flexi-m
augment /nw:networks/nw:network/nt:link/tet:te
  /tet:te-link-attributes/tet:underlay/tet:primary-path
  /tet:path-element/tet:type/tet:label/tet:label-hop
  /tet:te-label/tet:technology:
+--:(flexi-grid)
  +--rw (single-or-super-channel)?
    +--:(single)
      | +--rw flexi-n?           10-types:flexi-n
      | +--rw flexi-m?           10-types:flexi-m
    +--:(super)
      +--rw subcarrier-flexi-n* [flexi-n]
        +--rw flexi-n    10-types:flexi-n
        +--rw flexi-m?   10-types:flexi-m
augment /nw:networks/nw:network/nt:link/tet:te
  /tet:te-link-attributes/tet:underlay/tet:backup-path
  /tet:path-element/tet:type/tet:label/tet:label-hop
  /tet:te-label/tet:technology:
+--:(flexi-grid)
  +--rw (single-or-super-channel)?
    +--:(single)
      | +--rw flexi-n?           10-types:flexi-n
      | +--rw flexi-m?           10-types:flexi-m
    +--:(super)
      +--rw subcarrier-flexi-n* [flexi-n]
        +--rw flexi-n    10-types:flexi-n
        +--rw flexi-m?   10-types:flexi-m
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:
    +--:(flexi-grid)
        +--rw flexi-n?    10-types:flexi-n
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:
    +--:(flexi-grid)
        +--rw flexi-n?    10-types:flexi-n
augment /nw:networks/nw:network/nt:link/tet:te
        /tet:te-link-attributes/tet:label-restrictions
        /tet:label-restriction/tet:label-step/tet:technology:
    +--:(flexi-grid)
        +--rw flexi-grid-channel-spacing?    identityref
        +--rw flexi-n-step?                  uint8
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 flexi-n?    10-types:flexi-n
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 flexi-n?    10-types:flexi-n
augment /nw:networks/nw:network/nt:link/tet:te
        /tet:information-source-entry/tet:label-restrictions
        /tet:label-restriction/tet:label-step/tet:technology:
    +--:(flexi-grid)
        +--ro flexi-grid-channel-spacing?    identityref
        +--ro flexi-n-step?                  uint8
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:
    +--:(flexi-grid)
        +--rw (single-or-super-channel)?
            +--:(single)
                | +--rw flexi-n?          10-types:flexi-n
                | +--rw flexi-m?          10-types:flexi-m
            +--:(super)
                +--rw subcarrier-flexi-n* [flexi-n]
                    +--rw flexi-n    10-types:flexi-n
                    +--rw flexi-m?    10-types:flexi-m
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:
+--:(flexi-grid)
  +--rw (single-or-super-channel)?
    +--:(single)
      | +--rw flexi-n?          l0-types:flexi-n
      | +--rw flexi-m?          l0-types:flexi-m
    +--:(super)
      +--rw subcarrier-flexi-n* [flexi-n]
        +--rw flexi-n          l0-types:flexi-n
        +--rw flexi-m?         l0-types:flexi-m
augment /nw:networks/tet:te/tet:templates/tet:link-template
  /tet:te-link-attributes/tet:label-restrictions
  /tet:label-restriction/tet:label-start/tet:te-label
  /tet:technology:
+--:(flexi-grid)
  +--rw flexi-n?          l0-types:flexi-n
augment /nw:networks/tet:te/tet:templates/tet:link-template
  /tet:te-link-attributes/tet:label-restrictions
  /tet:label-restriction/tet:label-end/tet:te-label
  /tet:technology:
+--:(flexi-grid)
  +--rw flexi-n?          l0-types:flexi-n
augment /nw:networks/tet:te/tet:templates/tet:link-template
  /tet:te-link-attributes/tet:label-restrictions
  /tet:label-restriction/tet:label-step/tet:technology:
+--:(flexi-grid)
  +--rw flexi-grid-channel-spacing? identityref
  +--rw flexi-n-step?              uint8

```

6. The YANG Code for Flexi-grid topology

```

<CODE BEGINS> file "ietf-flexi-grid-topology@2020-10-21.yang"
module ietf-flexi-grid-topology {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-flexi-grid-topology";
  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 8795: YANG Data Model for Traffic Engineering
      (TE) Topologies";
  }

  import ietf-layer0-types {
    prefix "l0-types";
    reference
      "RFC XXXX: A YANG Data Model for Layer 0 Types";
  }

/* Note: The RFC Editor will replace XXXX with the number assigned
   to the RFC once draft-ietf-ccamp-layer0-types becomes an RFC.*/

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

  Editor: Jorge E. Lopez de Vergara
        <mailto:jorge.lopez\_vergara@uam.es>

  Editor: Daniel Perdices
        <mailto:daniel.perdices@naudit.es>

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

  Editor: Daniel King
        <mailto:d.king@lancaster.ac.uk>

  Editor: Young Lee
        <mailto:younglee.tx@gmail.com>;

description
  "This module provides a YANG data model for the routing and
  wavelength assignment (RWA) Traffic Engineering (TE)
  topology in flexi-grid optical networks. The YANG model
  described in this document is a flexi-grid technology-specific
  YANG model augmenting the generic TE topology module"
```


(ietf-te-topology, [RFC 9795](#)) based on the [RFC 7698](#) and 7699.

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

Redistribution and use in source and binary forms, with or without modification, is permitted pursuant to, and subject to the license terms contained in, the Simplified BSD License set forth in [Section 4.c](#) of the IETF Trust's Legal Provisions Relating to IETF Documents (<http://trustee.ietf.org/license-info>).

This version of this YANG module is part of RFC XXXX; see the RFC itself for full legal notices.";

```
revision 2020-10-21 {
  description
    "Initial Version";
  reference
    "RFC XXXX: A YANG Data Model for Flexi-Grid Optical Networks";
    // RFC Ed.: replace XXXX with actual RFC number, update date
    // information and remove this note
}

/*
 * Data nodes
 */

augment "/nw:networks/nw:network/nw:network-types"
  + "/tet:te-topology" {
  description
    "Augment network types to define flexi-grid topology type.";
  container flexi-grid-topology {
    presence
      "Its presence identifies the flexi-grid topology type.";
    description
      "Introduce new network type for flexi-grid topology.";
  }
}

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
      "Augmentation parameters apply only for networks with
      flexi-grid topology type.";
  }
}
```



```
description "Augment TE node attributes.";
container flexi-grid-node {
  presence "The TE node is a flexi-grid node.";
  description
    "Introduce new TE node type for flexi-grid node.";
}
}

/*
 * Augment TE label range information
 */

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/"
  + "tet:label-restrictions/tet:label-restriction" {
when "../..../nw:network-types/tet:te-topology/"
  + "flexi-grid:flexi-grid-topology" {
  description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
  "Augment TE label range information for the TE node
  connectivity matrices.";
uses l0-types:flexi-grid-label-range-info;
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/"
  + "tet:connectivity-matrix/tet:from/"
  + "tet:label-restrictions/tet:label-restriction" {
when "../..../nw:network-types/tet:te-topology/"
  + "flexi-grid:flexi-grid-topology" {
  description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
  "Augment TE label range information for the source Link
  Termination Point (LTP) of the connectivity matrix entry.";
uses l0-types:flexi-grid-label-range-info;
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/"
  + "tet:connectivity-matrix/tet:to/"
  + "tet:label-restrictions/tet:label-restriction" {
when "../..../nw:network-types/tet:te-topology/"
```



```

    + "flexi-grid:flexi-grid-topology" {
      description
        "Augmentation parameters apply only for networks with
        flexi-grid topology type.";
    }
    description
      "Augment TE label range information for the destination LTP
      of the connectivity matrix entry.";
    uses l0-types:flexi-grid-label-range-info;
  }

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:information-source-entry/"
  + "tet:connectivity-matrices/tet:label-restrictions/"
  + "tet:label-restriction" {
    when "../..../nw:network-types/tet:te-topology/"
      + "flexi-grid:flexi-grid-topology" {
        description
          "Augmentation parameters apply only for networks with
          flexi-grid topology type.";
      }
    description
      "Augment TE label range information for the TE node
      connectivity matrices information source.";
    uses l0-types:flexi-grid-label-range-info;
  }

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:information-source-entry/tet:connectivity-matrices/"
  + "tet:connectivity-matrix/"
  + "tet:from/tet:label-restrictions/tet:label-restriction" {
    when "../..../nw:network-types/tet:te-topology/"
      + "flexi-grid:flexi-grid-topology" {
        description
          "Augmentation parameters apply only for networks with
          flexi-grid topology type.";
      }
    description
      "Augment TE label range information for the source LTP
      of the connectivity matrix entry information source.";
    uses l0-types:flexi-grid-label-range-info;
  }

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:information-source-entry/tet:connectivity-matrices/"
  + "tet:connectivity-matrix/"
  + "tet:to/tet:label-restrictions/tet:label-restriction" {
    when "../..../nw:network-types/tet:te-topology/"

```



```
    + "flexi-grid:flexi-grid-topology" {
      description
        "Augmentation parameters apply only for networks with
         flexi-grid topology type.";
    }
  description
    "Augment TE label range information for the destination LTP
     of the connectivity matrix entry information source.";
  uses l0-types:flexi-grid-label-range-info;
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:tunnel-termination-point/"
  + "tet:local-link-connectivities/"
  + "tet:label-restrictions/tet:label-restriction" {
  when "../.../nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
    description
      "Augmentation parameters apply only for networks with
       flexi-grid topology type.";
  }
  description
    "Augment TE label range information for the Tunnel
     Termination Point (TTP) Local Link Connectivities.";
  uses l0-types:flexi-grid-label-range-info;
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:tunnel-termination-point/"
  + "tet:local-link-connectivities/"
  + "tet:local-link-connectivity/"
  + "tet:label-restrictions/tet:label-restriction" {
  when "../.../nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
    description
      "Augmentation parameters apply only for networks with
       flexi-grid topology type.";
  }
  description
    "Augment TE label range information for the TTP
     Local Link Connectivity entry.";
  uses l0-types:flexi-grid-label-range-info;
}

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



```
    + "flexi-grid:flexi-grid-topology" {
      description
        "Augmentation parameters apply only for networks with
        flexi-grid topology type.";
    }
  description
    "Augment TE label range information for the TE link.";
  uses l0-types:flexi-grid-label-range-info;
}

augment "/nw:networks/nw:network/nt:link/tet:te/"
  + "tet:information-source-entry/"
  + "tet:label-restrictions/tet:label-restriction" {
  when "../..//../nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
    description
      "Augmentation parameters apply only for networks with
      flexi-grid topology type.";
  }
  description
    "Augment TE label range information for the TE link
    information source.";
  uses l0-types:flexi-grid-label-range-info;
}

augment "/nw:networks/tet:te/tet:templates/"
  + "tet:link-template/tet:te-link-attributes/"
  + "tet:label-restrictions/tet:label-restriction" {
  description
    "Augment TE label range information for the TE link template.";
  uses l0-types:flexi-grid-label-range-info;
}

/*
 * Augment TE label
 */

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/"
  + "tet:label-restrictions/tet:label-restriction/"
  + "tet:label-start/"
  + "tet:te-label/tet:technology" {
  when "../..//../nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
    description
      "Augmentation parameters apply only for networks with
      flexi-grid topology type.";
  }
}
```



```
description
  "Augment TE label range start for the TE node
  connectivity matrices.";
case flexi-grid {
  uses l0-types:flexi-grid-label-start-end;
}
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/"
  + "tet:label-restrictions/"
  + "tet:label-restriction/tet:label-end/"
  + "tet:te-label/tet:technology" {
when "../..//../..//../..//../..//nw:network-types/tet:te-topology/"
  + "flexi-grid:flexi-grid-topology" {
  description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
  "Augment TE label range end for the TE node
  connectivity matrices.";
case flexi-grid {
  uses l0-types:flexi-grid-label-start-end;
}
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/"
  + "tet:label-restrictions/"
  + "tet:label-restriction/tet:label-step/"
  + "tet:technology" {
when "../..//../..//../..//../..//nw:network-types/tet:te-topology/"
  + "flexi-grid:flexi-grid-topology" {
  description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
  "Augment TE label range step for the TE node
  connectivity matrices.";
case flexi-grid {
  uses l0-types:flexi-grid-label-step;
}
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/"
```



```

    + "tet:underlay/tet:primary-path/tet:path-element/"
    + "tet:type/tet:label/tet:label-hop/"
    + "tet:te-label/tet:technology" {
when "../.../.../.../.../.../.../.../.../..."
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
    "Augment TE label hop for the underlay primary path of the
    TE node connectivity matrices.";
case flexi-grid {
    uses l0-types:flexi-grid-label-hop;
}
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
    + "tet:te-node-attributes/tet:connectivity-matrices/"
    + "tet:underlay/tet:backup-path/tet:path-element/"
    + "tet:type/tet:label/tet:label-hop/"
    + "tet:te-label/tet:technology" {
when "../.../.../.../.../.../.../.../.../..."
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
    "Augment TE label hop for the underlay backup path of the
    TE node connectivity matrices.";
case flexi-grid {
    uses l0-types:flexi-grid-label-hop;
}
}

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

```



```
    + "flexi-grid:flexi-grid-topology" {
      description
        "Augmentation parameters apply only for networks with
         flexi-grid topology type.";
    }
  description
    "Augment TE label hop for the explicit route objects excluded
     by the path computation of the TE node connectivity
     matrices.";
  case flexi-grid {
    uses l0-types:flexi-grid-label-hop;
  }
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/"
  + "tet:optimizations/tet:algorithm/tet:metric/"
  + "tet:optimization-metric/"
  + "tet:explicit-route-include-objects/"
  + "tet:route-object-include-object/"
  + "tet:type/tet:label/tet:label-hop/"
  + "tet:te-label/tet:technology" {
  when "../../../../../../../../../../../"
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
    description
      "Augmentation parameters apply only for networks with
       flexi-grid topology type.";
  }
  description
    "Augment TE label hop for the explicit route objects included
     by the path computation of the TE node connectivity
     matrices.";
  case flexi-grid {
    uses l0-types:flexi-grid-label-hop;
  }
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/"
  + "tet:path-properties/tet:path-route-objects/"
  + "tet:path-route-object/tet:type/tet:label/tet:label-hop/"
  + "tet:te-label/tet:technology" {
  when "../../../../../../../../../../../"
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
    description
      "Augmentation parameters apply only for networks with
```



```
        flexi-grid topology type.";
    }
    description
        "Augment TE label hop for the computed path route objects
        of the TE node connectivity matrices.";
    case flexi-grid {
        uses l0-types:flexi-grid-label-hop;
    }
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
    + "tet:te-node-attributes/tet:connectivity-matrices/"
    + "tet:connectivity-matrix/tet:from/"
    + "tet:label-restrictions/tet:label-restriction/"
    + "tet:label-start/"
    + "tet:te-label/tet:technology" {
    when "../.../.../.../.../.../.../.../.../..."
        + "nw:network-types/tet:te-topology/"
        + "flexi-grid:flexi-grid-topology" {
        description
            "Augmentation parameters apply only for networks with
            flexi-grid topology type.";
    }
    description
        "Augment TE label range start for the source LTP
        of the connectivity matrix entry.";
    case flexi-grid {
        uses l0-types:flexi-grid-label-start-end;
    }
}

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



```
    uses l0-types:flexi-grid-label-start-end;
  }
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
+ "tet:te-node-attributes/tet:connectivity-matrices/"
+ "tet:connectivity-matrix/tet:from/"
+ "tet:label-restrictions/tet:label-restriction/"
+ "tet:label-step/"
+ "tet:technology" {
when "../.../.../.../.../.../.../.../..."
+ "nw:network-types/tet:te-topology/"
+ "flexi-grid:flexi-grid-topology" {
description
  "Augmentation parameters apply only for networks with
  flexi-grid topology type.";
}
description
  "Augment TE label range step for the source LTP
  of the connectivity matrix entry.";
case flexi-grid {
  uses l0-types:flexi-grid-label-step;
}
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
+ "tet:te-node-attributes/tet:connectivity-matrices/"
+ "tet:connectivity-matrix/tet:to/"
+ "tet:label-restrictions/tet:label-restriction/"
+ "tet:label-start/"
+ "tet:te-label/tet:technology" {
when "../.../.../.../.../.../.../.../..."
+ "nw:network-types/tet:te-topology/"
+ "flexi-grid:flexi-grid-topology" {
description
  "Augmentation parameters apply only for networks with
  flexi-grid topology type.";
}
description
  "Augment TE label range start for the destination LTP
  of the connectivity matrix entry.";
case flexi-grid {
  uses l0-types:flexi-grid-label-start-end;
}
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
+ "tet:te-node-attributes/tet:connectivity-matrices/"
```



```
    + "tet:connectivity-matrix/tet:to/"
    + "tet:label-restrictions/tet:label-restriction/"
    + "tet:label-end/"
    + "tet:te-label/tet:technology" {
when "../.../.../.../.../.../.../.../.../..."
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
    "Augment TE label range end for the destination LTP
    of the connectivity matrix entry.";
case flexi-grid {
    uses l0-types:flexi-grid-label-start-end;
}
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
    + "tet:te-node-attributes/tet:connectivity-matrices/"
    + "tet:connectivity-matrix/tet:to/"
    + "tet:label-restrictions/tet:label-restriction/"
    + "tet:label-step/"
    + "tet:technology" {
when "../.../.../.../.../.../.../.../..."
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
    "Augment TE label range step for the destination LTP
    of the connectivity matrix entry.";
case flexi-grid {
    uses l0-types:flexi-grid-label-step;
}
}

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



```
    + "flexi-grid:flexi-grid-topology" {
      description
        "Augmentation parameters apply only for networks with
         flexi-grid topology type.";
    }
  description
    "Augment TE label hop for the underlay primary path
     of the connectivity matrix entry.";
  case flexi-grid {
    uses l0-types:flexi-grid-label-hop;
  }
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/"
  + "tet:connectivity-matrix/"
  + "tet:underlay/tet:backup-path/tet:path-element/"
  + "tet:type/tet:label/tet:label-hop/"
  + "tet:te-label/tet:technology" {
  when "../../../../../../../../../../../"
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
    description
      "Augmentation parameters apply only for networks with
       flexi-grid topology type.";
  }
  description
    "Augment TE label hop for the underlay backup path
     of the connectivity matrix entry.";
  case flexi-grid {
    uses l0-types:flexi-grid-label-hop;
  }
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/"
  + "tet:connectivity-matrix/tet:optimizations/"
  + "tet:algorithm/tet:metric/tet:optimization-metric/"
  + "tet:explicit-route-exclude-objects/"
  + "tet:route-object-exclude-object/tet:type/"
  + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
  when "../../../../../../../../../../../"
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
    description
      "Augmentation parameters apply only for networks with
       flexi-grid topology type.";
  }
}
```



```

    description
      "Augment TE label hop for the explicit route objects excluded
      by the path computation of the connectivity matrix entry.";
    case flexi-grid {
      uses l0-types:flexi-grid-label-hop;
    }
  }

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/"
  + "tet:connectivity-matrix/tet:optimizations/"
  + "tet:algorithm/tet:metric/tet:optimization-metric/"
  + "tet:explicit-route-include-objects/"
  + "tet:route-object-include-object/tet:type/"
  + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
  when "../.../.../.../.../.../.../.../.../.../..."
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
    description
      "Augmentation parameters apply only for networks with
      flexi-grid topology type.";
  }
  description
    "Augment TE label hop for the explicit route objects included
    by the path computation of the connectivity matrix entry.";
  case flexi-grid {
    uses l0-types:flexi-grid-label-hop;
  }
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:te-node-attributes/tet:connectivity-matrices/"
  + "tet:connectivity-matrix/"
  + "tet:path-properties/tet:path-route-objects/"
  + "tet:path-route-object/tet:type/"
  + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
  when "../.../.../.../.../.../.../.../.../.../..."
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
    description
      "Augmentation parameters apply only for networks with
      flexi-grid topology type.";
  }
  description
    "Augment TE label hop for the computed path route objects
    of the connectivity matrix entry.";
  case flexi-grid {
    uses l0-types:flexi-grid-label-hop;
  }
}

```



```
    }
  }

  augment "/nw:networks/nw:network/nw:node/tet:te/"
    + "tet:information-source-entry/"
    + "tet:connectivity-matrices/tet:label-restrictions/"
    + "tet:label-restriction/"
    + "tet:label-start/tet:te-label/tet:technology" {
  when "../../../../../../../../../../../"
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
    description
      "Augmentation parameters apply only for networks with
        flexi-grid topology type.";
  }
  description
    "Augment TE label range start for the TE node connectivity
      matrices information source.";
  case flexi-grid {
    uses l0-types:flexi-grid-label-start-end;
  }
}

  augment "/nw:networks/nw:network/nw:node/tet:te/"
    + "tet:information-source-entry/"
    + "tet:connectivity-matrices/tet:label-restrictions/"
    + "tet:label-restriction/"
    + "tet:label-end/tet:te-label/tet:technology" {
  when "../../../../../../../../../../../"
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
    description
      "Augmentation parameters apply only for networks with
        flexi-grid topology type.";
  }
  description
    "Augment TE label range end for the TE node connectivity
      matrices information source.";
  case flexi-grid {
    uses l0-types:flexi-grid-label-start-end;
  }
}

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



```
when "../../../../../../../"
  + "nw:network-types/tet:te-topology/"
  + "flexi-grid:flexi-grid-topology" {
  description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
  "Augment TE label range step for the TE node connectivity
  matrices information source.";
case flexi-grid {
  uses l0-types:flexi-grid-label-step;
}
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:information-source-entry/tet:connectivity-matrices/"
  + "tet:underlay/tet:primary-path/tet:path-element/tet:type/"
  + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
when "../../../../../../../"
  + "nw:network-types/tet:te-topology/"
  + "flexi-grid:flexi-grid-topology" {
  description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
  "Augment TE label hop for the underlay primary path
  of the TE node connectivity matrices of the information
  source entry.";
case flexi-grid {
  uses l0-types:flexi-grid-label-hop;
}
}

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



```

        of the TE node connectivity matrices of the information
        source entry.";
    case flexi-grid {
        uses l0-types:flexi-grid-label-hop;
    }
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
+ "tet:information-source-entry/tet:connectivity-matrices/"
+ "tet:optimizations/tet:algorithm/tet:metric/"
+ "tet:optimization-metric/"
+ "tet:explicit-route-exclude-objects/"
+ "tet:route-object-exclude-object/tet:type/"
+ "tet:label/tet:label-hop/tet:te-label/tet:technology" {
when "../../../../../../../../../../../"
+ "nw:network-types/tet:te-topology/"
+ "flexi-grid:flexi-grid-topology" {
description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
    "Augment TE label hop for the explicit route objects excluded
    by the path computation of the TE node connectivity matrices
    information source.";
case flexi-grid {
    uses l0-types:flexi-grid-label-hop;
}
}

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

```



```
    case flexi-grid {
      uses l0-types:flexi-grid-label-hop;
    }
  }

  augment "/nw:networks/nw:network/nw:node/tet:te/"
    + "tet:information-source-entry/tet:connectivity-matrices/"
    + "tet:path-properties/tet:path-route-objects/"
    + "tet:path-route-object/tet:type/"
    + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
    when "../.../.../.../.../.../.../.../..."
      + "nw:network-types/tet:te-topology/"
      + "flexi-grid:flexi-grid-topology" {
      description
        "Augmentation parameters apply only for networks with
        flexi-grid topology type.";
    }
    description
      "Augment TE label hop for the computed path route objects
      of the TE node connectivity matrices information source.";
    case flexi-grid {
      uses l0-types:flexi-grid-label-hop;
    }
  }

  augment "/nw:networks/nw:network/nw:node/tet:te/"
    + "tet:information-source-entry/tet:connectivity-matrices/"
    + "tet:connectivity-matrix/"
    + "tet:from/tet:label-restrictions/"
    + "tet:label-restriction/"
    + "tet:label-start/tet:te-label/tet:technology" {
    when "../.../.../.../.../.../.../.../..."
      + "nw:network-types/tet:te-topology/"
      + "flexi-grid:flexi-grid-topology" {
      description
        "Augmentation parameters apply only for networks with
        flexi-grid topology type.";
    }
    description
      "Augment TE label range start for the source LTP
      of the connectivity matrix entry information source.";
    case flexi-grid {
      uses l0-types:flexi-grid-label-start-end;
    }
  }

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



```

    + "tet:from/tet:label-restrictions/"
    + "tet:label-restriction/"
    + "tet:label-end/tet:te-label/tet:technology" {
when "../../../../../../../../../../../"
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
    "Augment TE label range end for the source LTP
    of the connectivity matrix entry information source.";
case flexi-grid {
    uses l0-types:flexi-grid-label-start-end;
}
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
    + "tet:information-source-entry/tet:connectivity-matrices/"
    + "tet:connectivity-matrix/"
    + "tet:from/tet:label-restrictions/"
    + "tet:label-restriction/"
    + "tet:label-step/tet:technology" {
when "../../../../../../../../../../../"
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
    "Augment TE label range step for the source LTP
    of the connectivity matrix entry information source.";
case flexi-grid {
    uses l0-types:flexi-grid-label-step;
}
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
    + "tet:information-source-entry/tet:connectivity-matrices/"
    + "tet:connectivity-matrix/"
    + "tet:to/tet:label-restrictions/tet:label-restriction/"
    + "tet:label-start/tet:te-label/tet:technology" {
when "../../../../../../../../../../../"
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
description

```



```

    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
    "Augment TE label range start for the destination LTP
    of the connectivity matrix entry information source.";
case flexi-grid {
    uses 10-types:flexi-grid-label-start-end;
}
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
    + "tet:information-source-entry/tet:connectivity-matrices/"
    + "tet:connectivity-matrix/"
    + "tet:to/tet:label-restrictions/tet:label-restriction/"
    + "tet:label-end/tet:te-label/tet:technology" {
when "../.../.../.../.../.../.../.../.../.../..."
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
    "Augment TE label range end for the destination LTP
    of the connectivity matrix entry information source.";
case flexi-grid {
    uses 10-types:flexi-grid-label-start-end;
}
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
    + "tet:information-source-entry/tet:connectivity-matrices/"
    + "tet:connectivity-matrix/"
    + "tet:to/tet:label-restrictions/tet:label-restriction/"
    + "tet:label-step/tet:technology" {
when "../.../.../.../.../.../.../.../.../.../..."
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
    "Augment TE label range step for the destination LTP
    of the connectivity matrix entry information source.";
case flexi-grid {
    uses 10-types:flexi-grid-label-step;
}
}

```



```

    }
  }

  augment "/nw:networks/nw:network/nw:node/tet:te/"
    + "tet:information-source-entry/tet:connectivity-matrices/"
    + "tet:connectivity-matrix/"
    + "tet:underlay/tet:primary-path/tet:path-element/tet:type/"
    + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
    when "../.../.../.../.../.../.../.../.../..."
      + "nw:network-types/tet:te-topology/"
      + "flexi-grid:flexi-grid-topology" {
      description
        "Augmentation parameters apply only for networks with
        flexi-grid topology type.";
    }
    description
      "Augment TE label hop for the underlay primary path
      of the connectivity matrix entry information source.";
    case flexi-grid {
      uses l0-types:flexi-grid-label-hop;
    }
  }

  augment "/nw:networks/nw:network/nw:node/tet:te/"
    + "tet:information-source-entry/tet:connectivity-matrices/"
    + "tet:connectivity-matrix/"
    + "tet:underlay/tet:backup-path/tet:path-element/tet:type/"
    + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
    when "../.../.../.../.../.../.../.../.../..."
      + "nw:network-types/tet:te-topology/"
      + "flexi-grid:flexi-grid-topology" {
      description
        "Augmentation parameters apply only for networks with
        flexi-grid topology type.";
    }
    description
      "Augment TE label hop for the underlay backup path
      of the connectivity matrix entry information source.";
    case flexi-grid {
      uses l0-types:flexi-grid-label-hop;
    }
  }

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

```



```
    + "tet:explicit-route-exclude-objects/"
    + "tet:route-object-exclude-object/tet:type/"
    + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
when "../../../../../../../../../../../../../../../"
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
    "Augment TE label hop for the explicit route objects excluded
    by the path computation of the connectivity matrix entry
    information source.";
case flexi-grid {
    uses l0-types:flexi-grid-label-hop;
}
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
    + "tet:information-source-entry/tet:connectivity-matrices/"
    + "tet:connectivity-matrix/"
    + "tet:optimizations/tet:algorithm/tet:metric/"
    + "tet:optimization-metric/"
    + "tet:explicit-route-include-objects/"
    + "tet:route-object-include-object/tet:type/"
    + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
when "../../../../../../../../../../../../../../../"
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
    "Augment TE label hop for the explicit route objects included
    by the path computation of the connectivity matrix entry
    information source.";
case flexi-grid {
    uses l0-types:flexi-grid-label-hop;
}
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
    + "tet:information-source-entry/tet:connectivity-matrices/"
    + "tet:connectivity-matrix/"
    + "tet:path-properties/tet:path-route-objects/"
    + "tet:path-route-object/tet:type/"
```



```
    + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
when "../.../.../.../.../.../.../.../.../.../..."
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
    "Augment TE label hop for the computed path route objects
    of the connectivity matrix entry information source.";
case flexi-grid {
    uses l0-types:flexi-grid-label-hop;
}
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
    + "tet:tunnel-termination-point/"
    + "tet:local-link-connectivities/"
    + "tet:label-restrictions/tet:label-restriction/"
    + "tet:label-start/"
    + "tet:te-label/tet:technology" {
when "../.../.../.../.../.../.../.../..."
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
    "Augment TE label range start for the TTP
    Local Link Connectivities.";
case flexi-grid {
    uses l0-types:flexi-grid-label-start-end;
}
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
    + "tet:tunnel-termination-point/"
    + "tet:local-link-connectivities/"
    + "tet:label-restrictions/tet:label-restriction/"
    + "tet:label-end/"
    + "tet:te-label/tet:technology" {
when "../.../.../.../.../.../.../.../..."
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
description
    "Augmentation parameters apply only for networks with
```



```
        flexi-grid topology type.";
    }
    description
        "Augment TE label range end for the TTP
        Local Link Connectivities.";
    case flexi-grid {
        uses l0-types:flexi-grid-label-start-end;
    }
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
    + "tet:tunnel-termination-point/"
    + "tet:local-link-connectivities/"
    + "tet:label-restrictions/tet:label-restriction/"
    + "tet:label-step/"
    + "tet:technology"{
    when "../.../.../.../.../.../.../.../..."
        + "nw:network-types/tet:te-topology/"
        + "flexi-grid:flexi-grid-topology" {
        description
            "Augmentation parameters apply only for networks with
            flexi-grid topology type.";
    }
    description
        "Augment TE label range step for the TTP
        Local Link Connectivities.";
    case flexi-grid {
        uses l0-types:flexi-grid-label-step;
    }
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
    + "tet:tunnel-termination-point/"
    + "tet:local-link-connectivities/"
    + "tet:underlay/tet:primary-path/tet:path-element/tet:type/"
    + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
    when "../.../.../.../.../.../.../.../..."
        + "nw:network-types/tet:te-topology/"
        + "flexi-grid:flexi-grid-topology" {
        description
            "Augmentation parameters apply only for networks with
            flexi-grid topology type.";
    }
    description
        "Augment TE label hop for the underlay primary path
        of the TTP Local Link Connectivities.";
    case flexi-grid {
        uses l0-types:flexi-grid-label-hop;
    }
}
```



```

    }
  }

  augment "/nw:networks/nw:network/nw:node/tet:te/"
    + "tet:tunnel-termination-point/"
    + "tet:local-link-connectivities/"
    + "tet:underlay/tet:backup-path/tet:path-element/tet:type/"
    + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
    when "../../../../../../../../../../../"
      + "nw:network-types/tet:te-topology/"
      + "flexi-grid:flexi-grid-topology" {
      description
        "Augmentation parameters apply only for networks with
        flexi-grid topology type.";
      }
    description
      "Augment TE label hop for the underlay backup path
      of the TTP Local Link Connectivities.";
    case flexi-grid {
      uses l0-types:flexi-grid-label-hop;
    }
  }

  augment "/nw:networks/nw:network/nw:node/tet:te/"
    + "tet:tunnel-termination-point/"
    + "tet:local-link-connectivities/"
    + "tet:optimizations/tet:algorithm/tet:metric/"
    + "tet:optimization-metric/"
    + "tet:explicit-route-exclude-objects/"
    + "tet:route-object-exclude-object/tet:type/"
    + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
    when "../../../../../../../../../../../"
      + "nw:network-types/tet:te-topology/"
      + "flexi-grid:flexi-grid-topology" {
      description
        "Augmentation parameters apply only for networks with
        flexi-grid topology type.";
      }
    description
      "Augment TE label hop for the explicit route objects excluded
      by the path computation of the TTP Local Link
      Connectivities.";
    case flexi-grid {
      uses l0-types:flexi-grid-label-hop;
    }
  }

  augment "/nw:networks/nw:network/nw:node/tet:te/"

```



```

    + "tet:tunnel-termination-point/"
    + "tet:local-link-connectivities/"
    + "tet:optimizations/tet:algorithm/tet:metric/"
    + "tet:optimization-metric/"
    + "tet:explicit-route-include-objects/"
    + "tet:route-object-include-object/tet:type/"
    + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
when "../.../.../.../.../.../.../.../.../..."
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
    "Augment TE label hop for the explicit route objects included
    by the path computation of the TTP Local Link
    Connectivities.";
case flexi-grid {
    uses l0-types:flexi-grid-label-hop;
}
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
    + "tet:tunnel-termination-point/"
    + "tet:local-link-connectivities/"
    + "tet:path-properties/tet:path-route-objects/"
    + "tet:path-route-object/tet:type/"
    + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
when "../.../.../.../.../.../.../.../.../..."
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
    "Augment TE label hop for the computed path route objects
    of the TTP Local Link Connectivities.";
case flexi-grid {
    uses l0-types:flexi-grid-label-hop;
}
}

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

```



```

    + "tet:label-restrictions/tet:label-restriction/"
    + "tet:label-start/tet:te-label/tet:technology" {
when "../.../.../.../.../.../.../.../..."
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
    "Augment TE label range start for the TTP
    Local Link Connectivity entry.";
case flexi-grid {
    uses l0-types:flexi-grid-label-start-end;
}
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
    + "tet:tunnel-termination-point/"
    + "tet:local-link-connectivities/"
    + "tet:local-link-connectivity/"
    + "tet:label-restrictions/tet:label-restriction/"
    + "tet:label-end/tet:te-label/tet:technology" {
when "../.../.../.../.../.../.../.../..."
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
    "Augment TE label range end for the TTP
    Local Link Connectivity entry.";
case flexi-grid {
    uses l0-types:flexi-grid-label-start-end;
}
}

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

```



```
        "Augmentation parameters apply only for networks with
          flexi-grid topology type.";
    }
    description
      "Augment TE label range step for the TTP
        Local Link Connectivity entry.";
    case flexi-grid {
      uses l0-types:flexi-grid-label-step;
    }
  }

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:tunnel-termination-point/"
  + "tet:local-link-connectivities/"
  + "tet:local-link-connectivity/"
  + "tet:underlay/tet:primary-path/tet:path-element/tet:type/"
  + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
  when "../../../../../../../../../../../"
    + "nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
    description
      "Augmentation parameters apply only for networks with
        flexi-grid topology type.";
  }
  description
    "Augment TE label hop for the underlay primary path
      of the TTP Local Link Connectivity entry.";
  case flexi-grid {
    uses l0-types:flexi-grid-label-hop;
  }
}

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



```

    case flexi-grid {
      uses l0-types:flexi-grid-label-hop;
    }
  }

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:tunnel-termination-point/"
  + "tet:local-link-connectivities/"
  + "tet:local-link-connectivity/"
  + "tet:optimizations/tet:algorithm/tet:metric/"
  + "tet:optimization-metric/"
  + "tet:explicit-route-exclude-objects/"
  + "tet:route-object-exclude-object/tet:type/"
  + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
when "../.../.../.../.../.../.../.../.../.../"
  + "nw:network-types/tet:te-topology/"
  + "flexi-grid:flexi-grid-topology" {
  description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
  "Augment TE label hop for the explicit route objects excluded
  by the path computation of the TTP Local Link
  Connectivity entry.";
case flexi-grid {
  uses l0-types:flexi-grid-label-hop;
}
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
  + "tet:tunnel-termination-point/"
  + "tet:local-link-connectivities/"
  + "tet:local-link-connectivity/"
  + "tet:optimizations/tet:algorithm/tet:metric/"
  + "tet:optimization-metric/"
  + "tet:explicit-route-include-objects/"
  + "tet:route-object-include-object/tet:type/"
  + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
when "../.../.../.../.../.../.../.../.../.../"
  + "nw:network-types/tet:te-topology/"
  + "flexi-grid:flexi-grid-topology" {
  description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
  "Augment TE label hop for the explicit route objects included

```



```
        by the path computation of the TTP Local Link
        Connectivity entry.";
    case flexi-grid {
        uses l0-types:flexi-grid-label-hop;
    }
}

augment "/nw:networks/nw:network/nw:node/tet:te/"
+ "tet:tunnel-termination-point/"
+ "tet:local-link-connectivities/"
+ "tet:local-link-connectivity/"
+ "tet:path-properties/tet:path-route-objects/"
+ "tet:path-route-object/tet:type/"
+ "tet:label/tet:label-hop/tet:te-label/tet:technology" {
when "../../../../../../../../../../../"
+ "nw:network-types/tet:te-topology/"
+ "flexi-grid:flexi-grid-topology" {
description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
    "Augment TE label hop for the computed path route objects
    of the TTP Local Link Connectivity entry.";
case flexi-grid {
    uses l0-types:flexi-grid-label-hop;
}
}

augment "/nw:networks/nw:network/nt:link/tet:te/"
+ "tet:te-link-attributes/"
+ "tet:underlay/tet:primary-path/tet:path-element/tet:type/"
+ "tet:label/tet:label-hop/tet:te-label/tet:technology" {
when "../../../../../../../../../../../"
+ "nw:network-types/tet:te-topology/"
+ "flexi-grid:flexi-grid-topology" {
description
    "Augmentation parameters apply only for networks with
    flexi-grid topology type.";
}
description
    "Augment TE label hop for the underlay primary path
    of the TE link.";
case flexi-grid {
    uses l0-types:flexi-grid-label-hop;
}
}

augment "/nw:networks/nw:network/nt:link/tet:te/"
```



```

+ "tet:te-link-attributes/"
+ "tet:underlay/tet:backup-path/tet:path-element/tet:type/"
+ "tet:label/tet:label-hop/tet:te-label/tet:technology" {
when "../../../../../../../../../../../"
+ "nw:network-types/tet:te-topology/"
+ "flexi-grid:flexi-grid-topology" {
description
"Augmentation parameters apply only for networks with
flexi-grid topology type.";
}
description
"Augment TE label hop for the underlay backup path
of the TE link.";
case flexi-grid {
uses l0-types:flexi-grid-label-hop;
}
}

augment "/nw:networks/nw:network/nt:link/tet:te/"
+ "tet:te-link-attributes/"
+ "tet:label-restrictions/tet:label-restriction/"
+ "tet:label-start/tet:te-label/tet:technology" {
when "../../../../../../../../../../../nw:network-types/tet:te-topology/"
+ "flexi-grid:flexi-grid-topology" {
description
"Augmentation parameters apply only for networks with
flexi-grid topology type.";
}
description
"Augment TE label range start for the TE link.";
case flexi-grid {
uses l0-types:flexi-grid-label-start-end;
}
}

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

```



```

    uses l0-types:flexi-grid-label-start-end;
  }
}

augment "/nw:networks/nw:network/nt:link/tet:te/"
+ "tet:te-link-attributes/"
+ "tet:label-restrictions/tet:label-restriction/"
+ "tet:label-step/tet:technology" {
when "../..../..../..../nw:network-types/tet:te-topology/"
+ "flexi-grid:flexi-grid-topology" {
description
  "Augmentation parameters apply only for networks with
  flexi-grid topology type.";
}
description
  "Augment TE label range step for the TE link.";
case flexi-grid {
uses l0-types:flexi-grid-label-step;
}
}

augment "/nw:networks/nw:network/nt:link/tet:te/"
+ "tet:information-source-entry/"
+ "tet:label-restrictions/tet:label-restriction/"
+ "tet:label-start/tet:te-label/tet:technology" {
when "../..../..../..../nw:network-types/tet:te-topology/"
+ "flexi-grid:flexi-grid-topology" {
description
  "Augmentation parameters apply only for networks with
  flexi-grid topology type.";
}
description
  "Augment TE label range start for the TE link
  information source.";
case flexi-grid {
uses l0-types:flexi-grid-label-start-end;
}
}

augment "/nw:networks/nw:network/nt:link/tet:te/"
+ "tet:information-source-entry/"
+ "tet:label-restrictions/tet:label-restriction/"
+ "tet:label-end/tet:te-label/tet:technology" {
when "../..../..../..../nw:network-types/tet:te-topology/"
+ "flexi-grid:flexi-grid-topology" {
description
  "Augmentation parameters apply only for networks with
  flexi-grid topology type.";
}
}

```



```
    }
    description
      "Augment TE label range end for the TE link
       information source.";
    case flexi-grid {
      uses l0-types:flexi-grid-label-start-end;
    }
  }

augment "/nw:networks/nw:network/nt:link/tet:te/"
  + "tet:information-source-entry/"
  + "tet:label-restrictions/tet:label-restriction/"
  + "tet:label-step/tet:technology" {
  when "../..//../..//../nw:network-types/tet:te-topology/"
    + "flexi-grid:flexi-grid-topology" {
    description
      "Augmentation parameters apply only for networks with
       flexi-grid topology type.";
  }
  description
    "Augment TE label range step for the TE link
     information source.";
  case flexi-grid {
    uses l0-types:flexi-grid-label-step;
  }
}

augment "/nw:networks/tet:te/tet:templates/"
  + "tet:link-template/tet:te-link-attributes/"
  + "tet:underlay/tet:primary-path/tet:path-element/tet:type/"
  + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
  description
    "Augment TE label hop for the underlay primary path
     of the TE link template.";
  case flexi-grid {
    uses l0-types:flexi-grid-label-hop;
  }
}

augment "/nw:networks/tet:te/tet:templates/"
  + "tet:link-template/tet:te-link-attributes/"
  + "tet:underlay/tet:backup-path/tet:path-element/tet:type/"
  + "tet:label/tet:label-hop/tet:te-label/tet:technology" {
  description
    "Augment TE label hop for the underlay backup path
     of the TE link template.";
  case flexi-grid {
    uses l0-types:flexi-grid-label-hop;
```



```
    }
  }

  augment "/nw:networks/tet:te/tet:templates/"
    + "tet:link-template/tet:te-link-attributes/"
    + "tet:label-restrictions/tet:label-restriction/"
    + "tet:label-start/tet:te-label/tet:technology" {
    description
      "Augment TE label range start for the TE link template.";
    case flexi-grid {
      uses l0-types:flexi-grid-label-start-end;
    }
  }

  augment "/nw:networks/tet:te/tet:templates/"
    + "tet:link-template/tet:te-link-attributes/"
    + "tet:label-restrictions/tet:label-restriction/"
    + "tet:label-end/tet:te-label/tet:technology" {
    description
      "Augment TE label range end for the TE link template.";
    case flexi-grid {
      uses l0-types:flexi-grid-label-start-end;
    }
  }

  augment "/nw:networks/tet:te/tet:templates/"
    + "tet:link-template/tet:te-link-attributes/"
    + "tet:label-restrictions/tet:label-restriction/"
    + "tet:label-step/tet:technology" {
    description
      "Augment TE label range step for the TE link template.";
    case flexi-grid {
      uses l0-types:flexi-grid-label-step;
    }
  }
}
<CODE ENDS>
```

7. Security Considerations

The YANG module specified in this document defines a schema for data that is designed to be accessed via network management protocols such as NETCONF [RFC6241] or RESTCONF [RFC8040]. The lowest NETCONF layer is the secure transport layer, and the mandatory-to-implement secure transport is Secure Shell (SSH) [RFC6242]. The lowest RESTCONF layer is HTTPS, and the mandatory-to-implement secure transport is TLS [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:

```
/nw:networks/nw:network/nw:network-types/tet:te-topology  
  
/nw:networks/nw:network/nt:link/tet:te/tet:te-link-attributes  
  
/nw:networks/nw:network/nw:node/nt:termination-point/tet:te  
  
/nw:networks/nw:network/nw:node/tet:te/tet:te-node-attributes  
/te-connectivity-matrices/te-connectivity-matrix/tet:path-  
constraints/tet:te-bandwidth/tet:technology  
  
/nw:networks/nw:network/nw:node/tet:te  
/tet:tunnel-termination-point/tet:local-link-connectivities  
/tet:label-restrictions/tet:label-restriction
```

8. IANA Considerations

IANA is requested to assigned a new URI from the "IETF XML Registry" [[RFC3688](#)] as follows:

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

IANA is requested to assign a new YANG module name in the "YANG Module Names" registry [[RFC6020](#)] as follows:

Name: ietf-flexi-grid-topology
Namespace: urn:ietf:params:xml:ns:yang:ietf-flexi-grid-topology
Prefix: flexi-grid-topology
Reference: [This.I-D]

9. Contributors

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

Oscar Gonzalez de Dios
Telefonica I+D/GCTO
Email: oscar.gonzalezdedios@telefonica.com

Gabriele Galimberti
Cisco
Email: ggalimbe@cisco.com

Zafar Ali
Cisco
Email: zali@cisco.com

Daniel Michaud Vallinoto
Universidad Autonoma de Madrid
Email: TBD

Steven Hill,
MTN Group Technology
Email: Steven.Hill@mtn.com

Victor Lopez
Telefonica I+D/GCTO
Email: victor.lopezalvarez@telefonica.com

Italo Busi
Huawei

Email: Italo.Busi@huawei.com

Aihua Guo

Futurewei

Email: aihuaguo.ietf@gmail.com

10. Acknowledgments

The work presented in this document 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.

Thanks to Adrian Farrel for reviewing this document and assisting with conversion to XML.

11. References

11.1. Normative References

- [RFC3688] Mealling, M., "The IETF XML Registry", [BCP 81](#), [RFC 3688](#), DOI 10.17487/RFC3688, January 2004, <<https://www.rfc-editor.org/info/rfc3688>>.
- [RFC6020] Bjorklund, M., Ed., "YANG - A Data Modeling Language for the Network Configuration Protocol (NETCONF)", [RFC 6020](#), DOI 10.17487/RFC6020, October 2010, <<https://www.rfc-editor.org/info/rfc6020>>.
- [RFC6241] Enns, R., Ed., Bjorklund, M., Ed., Schoenwaelder, J., Ed., and A. Bierman, Ed., "Network Configuration Protocol (NETCONF)", [RFC 6241](#), DOI 10.17487/RFC6241, June 2011, <<https://www.rfc-editor.org/info/rfc6241>>.
- [RFC6242] Wasserman, M., "Using the NETCONF Protocol over Secure Shell (SSH)", [RFC 6242](#), DOI 10.17487/RFC6242, June 2011, <<https://www.rfc-editor.org/info/rfc6242>>.
- [RFC7446] Lee, Y., Ed., Bernstein, G., Ed., Li, D., and W. Imajuku, "Routing and Wavelength Assignment Information Model for Wavelength Switched Optical Networks", [RFC 7446](#), DOI 10.17487/RFC7446, February 2015, <<https://www.rfc-editor.org/info/rfc7446>>.

- [RFC7581] Bernstein, G., Ed., Lee, Y., Ed., Li, D., Imajuku, W., and J. Han, "Routing and Wavelength Assignment Information Encoding for Wavelength Switched Optical Networks", [RFC 7581](#), DOI 10.17487/RFC7581, June 2015, <<https://www.rfc-editor.org/info/rfc7581>>.
- [RFC7950] Bjorklund, M., Ed., "The YANG 1.1 Data Modeling Language", [RFC 7950](#), DOI 10.17487/RFC7950, August 2016, <<https://www.rfc-editor.org/info/rfc7950>>.
- [RFC8040] Bierman, A., Bjorklund, M., and K. Watsen, "RESTCONF Protocol", [RFC 8040](#), DOI 10.17487/RFC8040, January 2017, <<https://www.rfc-editor.org/info/rfc8040>>.
- [RFC8341] Bierman, A. and M. Bjorklund, "Network Configuration Access Control Model", STD 91, [RFC 8341](#), DOI 10.17487/RFC8341, March 2018, <<https://www.rfc-editor.org/info/rfc8341>>.
- [RFC8345] Clemm, A., Medved, J., Varga, R., Bahadur, N., Ananthakrishnan, H., and X. Liu, "A YANG Data Model for Network Topologies", [RFC 8345](#), DOI 10.17487/RFC8345, March 2018, <<https://www.rfc-editor.org/info/rfc8345>>.
- [RFC8446] Rescorla, E., "The Transport Layer Security (TLS) Protocol Version 1.3", [RFC 8446](#), DOI 10.17487/RFC8446, August 2018, <<https://www.rfc-editor.org/info/rfc8446>>.
- [RFC8795] Liu, X., Bryskin, I., Beeram, V., Saad, T., Shah, H., and O. Gonzalez de Dios, "YANG Data Model for Traffic Engineering (TE) Topologies", [RFC 8795](#), DOI 10.17487/RFC8795, August 2020, <<https://www.rfc-editor.org/info/rfc8795>>.

11.2. Informative References

- [G.694.1] International Telecommunication Union, "Spectral grids for WDM applications: DWDM frequency grid", ITUT G.872, February 2012.
- [G.872] International Telecommunication Union, "Architecture of optical transport networks", ITUT G.872, November 2010.
- [I-D.ietf-ccamp-flexigrid-media-channel-yang] Madrid, U., Perdices, D., Lopezalvarez, V., Dios, O., King, D., Lee, Y., and G. Galimberti, "YANG data model for Flexi-Grid media-channels", [draft-ietf-ccamp-flexigrid-media-channel-yang-02](#) (work in progress), March 2019.

[I-D.ietf-ccamp-layer0-types]

Zheng, H., Lee, Y., Guo, A., Lopez, V., and D. King, "A YANG Data Model for Layer 0 Types", [draft-ietf-ccamp-layer0-types-08](#) (work in progress), October 2020.

[I-D.ietf-ccamp-optical-impairment-topology-yang]

Lee, Y., Auge, L., Lopez, V., Galimberti, G., and D. Beller, "A Yang Data Model for Optical Impairment-aware Topology", [draft-ietf-ccamp-optical-impairment-topology-yang-04](#) (work in progress), September 2020.

[RFC7698] Gonzalez de Dios, O., Ed., Casellas, R., Ed., Zhang, F., Fu, X., Ceccarelli, D., and I. Hussain, "Framework and Requirements for GMPLS-Based Control of Flexi-Grid Dense Wavelength Division Multiplexing (DWDM) Networks", [RFC 7698](#), DOI 10.17487/RFC7698, November 2015, <<https://www.rfc-editor.org/info/rfc7698>>.

[RFC7699] Farrel, A., King, D., Li, Y., and F. Zhang, "Generalized Labels for the Flexi-Grid in Lambda Switch Capable (LSC) Label Switching Routers", [RFC 7699](#), DOI 10.17487/RFC7699, November 2015, <<https://www.rfc-editor.org/info/rfc7699>>.

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

Authors' Addresses

Jorge E. Lopez de Vergara Mendez
Universidad Autonoma de Madrid

Email: jorge.lopez_vergara@uam.es

Daniel Perdices Burrero
Naudit HPCN

Email: daniel.perdices@naudit.es

Daniel King
Old Dog Consulting

Email: daniel@olddog.co.uk

Young Lee
Samsung

Email: younglee.tx@gmail.co

Haomian Zheng
Huawei Technologies

Email: zhenghaomian@huawei.com