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YANG Data Models for fine grain Optical Transport Network
draft-tan-ccamp-fgotn-yang-05

Abstract

This document defines YANG data models to describe the topology and tunnel information of a fine grain Optical Transport Network. The YANG data models defined in this document are designed to meet the requirements for efficient transmission of sub-1Gbit/s client signals in transport network.

About This Document

This note is to be removed before publishing as an RFC.

The latest revision of this draft can be found at https://YuChaode.github.io/draft-tan-ccamp-fgotn-yang/draft-tan-ccamp-fgotn-yang.html. Status information for this document may be found at https://datatracker.ietf.org/doc/draft-tan-ccamp-fgotn-yang/.

Discussion of this document takes place on the Common Control and Measurement Plane Working Group mailing list (mailto:ccamp@ietf.org), which is archived at https://mailarchive.ietf.org/arch/browse/ccamp/. Subscribe at https://www.ietf.org/mailman/listinfo/ccamp/.

Source for this draft and an issue tracker can be found at https://github.com/YuChaode/draft-tan-ccamp-fgotn-yang.

Status of This Memo

This Internet-Draft will expire on 18 July 2026.

Copyright Notice

Table of Contents

1. Introduction

Optical Transport Networks (OTN) is a mainstream layer 1 technology for the transport network. Over the years, it has continued to evolve, to improve its transport functions for the emerging requirements. The topology and tunnel information in the OTN has already been defined by generic traffic-engineering models and technology-specific models, including [I-D.ietf-ccamp-otn-topo-yang] and [I-D.ietf-ccamp-otn-tunnel-model].

In the latest version of OTN, ITU-T G.709/Y.1331 Edition 6.5 [ITU-T_G.709], the fine grain OTN (fgOTN) is introduced for the efficient transmission of low rate client signals (e.g., sub-1G).

This document presents the control interface requirements of fgOTN, and defines two YANG data models for fgOTN topology and fgOTN tunnel. The topology model can capture topological and resource-related information pertaining to fgOTN. The fgOTN tunnel YANG data model defined in this document is used for the provisioning and management of fgOTN Traffic Engineering (TE) tunnels and Label Switched Paths (LSPs).

Furthermore, this document also imports the generic Layer 1 types defined in [I-D.ietf-ccamp-layer1-types].

The YANG data models defined in this document conform to the Network Management Datastore Architecture (NMDA) defined in [RFC8342].

1.1. Terminology and Notations

Some of the key terms used in this document are listed as follow.

* fgTS: fine grain Tributary Slot.

* fgODUflex: fine grain Optical channel Data Unit flex.

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

* client

* server

* augment

* data model

* data node

The following terms are defined in [RFC6241] and are not redefined here:

* configuration data

* state data

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

1.2. Requirements Notation

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

1.3. Tree Diagram

A simplified graphical representation of the data model is used in Section 6 of this document. The meaning of the symbols in this diagram is defined in [RFC8340].

1.4. Requirements Language

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

1.5. Prefixes in Model Names

In this documents, 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 the following table.

Prefix	Yang Module	Reference
l1-types	ietf-layer1-types	[RFC YYYY]
otnt	ietf-otn-topology	[RFC ZZZZ]
te	ietf-te	[RFC KKKK]
otn-tnl	ietf-otn-tunnel	[RFC JJJJ]
fgotnt	ietf-fgotn-topology	RFC XXXX
fgotn-tnl	ietf-fgotn-tunnel	RFC XXXX

Table 1: Prefixes and corresponding YANG modules

RFC Editor Note: Please replace XXXX with the number assigned to the RFC once this draft becomes an RFC. Please replace YYYY with the RFC numbers assigned to [I-D.ietf-ccamp-layer1-types]. Please replace ZZZZ with the RFC numbers assigned to [I-D.ietf-ccamp-otn-topo-yang]. Please replace KKKK with the RFC numbers assigned to [I-D.ietf-teas-yang-te]. Please replace JJJJ with the RFC numbers assigned to [I-D.ietf-ccamp-otn-tunnel-model]. Please remove this note.

1.6. Model Tree Diagrams

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

2. Fine grain Optical Transport Network Scenarios Overview

OTN network will cover a larger scope of networks, it may include the backbone network, metro core, metro aggregation, metro access, and even the OTN CPE in the customers’ networks [ITU-T_G.709.20]. In general, the metro OTN networks support both fgODUflex and ODUk switching. At the boundary nodes (e.g., metro-core nodes) of the metro OTN networks, the fgODUflexes to other metro OTN networks are multiplexed into ODUk of backbone networks. Therefore, the backbone

OTN network could only support ODUk switching.

The typical scenarios for fgOTN is to provide low bit rate private line or private network services for customers. The interface function requirements of fgOTN mainly include topology resource reporting and service provisioning. Three scenarios that require special consideration are listed based on the characteristics of fgOTN.

2.1. Retrieve Server Tunnels Scenario of fgOTN

Figure 1 below shows an example of scenario to retrieve server tunnels for multi-domain fgOTN service. In this example, some small bandwidth fgOTN service are aggregated by the access ring (10G), and then aggregated into a bigger bandwidth in metro ring (100G). The allocation of TS to support fgOTN switching maybe different in access ring and metro ring. All link bandwidth information that supports fgOTN should be reported to MDSC by the PNC controller. E.g. there could be three ODU0 allocated in the access ring while there could be two ODU2 are allocated in the metro ring to support fgOTN switching. In this example, the server layer ODUk tunnel for fgOTN tunnel from node A to node E is ODU0, and the server layer tunnel from node E to node G is ODU2. The server layer tunnel for fgOTN tunnel will include one ODU0 tunnel and one ODU2 tunnel.

```
        +-----+
        |  A  | \                                 |
        +-----+  \            Domain 1            |      Domain 2
           |      \                               |
           |  10G  \                              |
           |        \                             |
        +-----+       +-----+         +-----+     |     +-----+
        |  B  | \     |  E  |---------|  G  |-----------|  I  |---------
        +-----+  \  / +-----+         +-----+           +-----+
                  \/    |      100G      |                 |    100G
                  /\    |                |                 |
        +-----+  /  \ +-----+         +-----+           +-----+
        |  C  | /     |  F  |---------|  H  |-----------|  J  |---------
        +-----+       +-----+         +-----+           +-----+
           |         /
           |  10G   /
           |       /
        +-----+   /
        |  D  |  /
        +-----+
```

Figure 1: The Scenario to Retrieve Server Tunnels

2.2. Multi-layer Path Splicing Scenario of fgOTN

Some operators that would like to provide the paths when there could be different switching capabilities of nodes in their LSP, so that the MDSC coordinator can clearly display multi-layer paths and the relationship between primary-path and secondary-path. In the current network, not all nodes in the operator network support fgOTN, as shown in figure 2, node f1, f2, f3 and f4 support fgOTN, node N-f5 and node N-f6 do not support fgOTN. To present the end-to-end multi-layer primary-path and secondary-path of the services on the client side, it is necessary to complete the end-to-end path splicing based on the the ODU tunnel information associated with the fgotn tunnel.

In Figure 2, assuming that the server layer ODUk tunnel for the fgOTN primary tunnel from node f1 to node f2 is ODU0, the server layer tunnel from node f2 to node f3 is ODU2, and the server layer tunnel from node f3 to node f4 is ODU1. Assuming the server layer ODUk tunnel for the fgOTN secondary tunnel from node f1 to node f2 is ODU2. We need to setup four server layer ODUk tunnels before setting up an fgODUflex tunnel with a primary path and a secondary path to provide protection. To support multi-layer path splicing, we should make some extension on the dependency tunnel structure or on the path element, such as extending the working roles and index of the tunnels.

```
                      +-----+            +-----+
                  ----|  f2 |------------|  f3 |----
                 /    +-----+            +-----+    \
                / ----------primary-path------------ \
               / /                                  \ \
            +------+                               +------+
            |  f1 |                                |  f4 |
            +------+                               +------+
               \ \                                  / /
                \ ---------secondary-path----------- /
                 \    +------+         +------+    /
                  ----| N-f5 |----------| N-f6 |----
                      +------+         +------+
```

Figure 2: Multi-layer Path Splicing Scenario of fgOTN

2.3. Hitless Bandwidth Adjustment Scenario of fgOTN

[ITU-T_G.709] defines the data plane procedure to support fgODUflex hitless resizing. The support of management of hitless resizing of fgODUflex needs to be carefully considered.

The range of fgOTN service’s Bandwidth on Demand (BoD) cannot exceed its server layer’s bandwidth.

The client needs to know how many bandwidth of a link is allocated for fgOTN. When performs hitless resizing, the client sends the fgODUflex identifier and the target bandwidth to the source node controller. After receiving the network management configuration information, the source node triggers the bandwidth adjustment. During the hitless bandwidth adjustment process, it is necessary to reserve or mark the corresponding bandwidth resources first, and then trigger the the bandwidth adjustment actions.

Another point to note is that when performing bidirectional hitless resizing for fgODUflex service, the adjustment should be initiated by the client side to a single network management system. Specifically, the adjustment is first performed in the Node 1 to Node 6 direction, and then the reverse direction (Node 6 to Node 1) is automatically triggered for adjustment.

Both single domain and multi-domain hitless resizing should be supported. For multi-domain hitless resizing scenario, both the source controller and the destination controller should report the bandwidth adjustment status to the MDSC coordinator upon completion.

```
                                        +----------+
                  ----------------------|   MDSC   |---------------------
                 /                      |          |                     \
                /                       +----------+                      \
               /                             |                             \
              /                              |                              \
        +------------+                 +------------+               +------------+
        | Controller |                 | Controller |               | Controller |
        |     1      |                 |     2      |               |     3      |
        +------------+                 +------------+               +------------+

                                    End-to-end fgOTN service
   <--------------------------------------------------------------------------------->
   +------+       +------+       +------+       +------+       +------+       +------+
   | node |-------| node |-------| node |-------| node |-------| node |-------| node |
   |  1   |-------|  2   |-------|  3   |-------|  4   |-------|  5   |-------|  6   |
   +------+       +------+   |   +------+       +------+   |   +------+       +------+
    source                   |                             |                 destination
          Domain 1           |          Domain 2           |           Domain 3
                             |                             |
```

Figure 3: Hitless Resizing Scenario of fgOTN

3. YANG Data Model for fine grain Optical Transport Network Overview

In order to provide fgOTN capabilities, this document defines two extension YANG data models augmenting to OTN topology and OTN tunnel YANG model, as defined in [I-D.ietf-ccamp-otn-topo-yang] and [I-D.ietf-ccamp-otn-tunnel-model].

As defined in Annex M of [ITU-T_G.709], fgOTN is defining a new path layer network which complements the existing OTN. Therefore:

* A single network topology instance is used to report both OTN and fgOTN topology information: fgOTN technology-specific attributes are therefore defined in the fgOTN topology model as augmentations of the OTN topology model, but without defining a new network type for fgOTN.

* The OTN tunnel model can be used to setup either an OTN or an fgOTN tunnel: fgOTN technology-specific attributes are therefore defined in the fgOTN tunnel model as augmentations of the OTN tunnel model, which are applicable only when the OTN tunnel is an fgOTN tunnel.

4. YANG Data Model for fgOTN Topology

4.1. Fine Grain OTN Topology Data Model Overview

This document aims to describe the data model for fine grain OTN topology. The YANG module presented in this document augments from OTN topology data model, i.e., the ietf-otn-topology, as specified in [I-D.ietf-ccamp-otn-topo-yang]. In section 6 of [I-D.ietf-ccamp-otn-topo-yang], the guideline for augmenting OTN topology model was provided, and in this draft, we augment the OTN topology model to describe the topology characteristics of fgOTN.

Common types, identities and groupings defined in [I-D.ietf-ccamp-layer1-types] is reused in this document.

[RFC8345] defines an abstract (generic, or base) YANG data model for network/service topologies and inventories, and provides the fundamental model for [RFC8795]. OTN topology module in [I-D.ietf-ccamp-otn-topo-yang] augments from the TE topology YANG model defined in [RFC8795]. Figure 4 shows the augmentation relationship.

```
       +--------------+      +-----------------------+
       | ietf-network |      | ietf-network-topology |
       +--------------+      +-----------------------+
                   ^             ^
                   |_____   _____|
                         | |
                         | | Augments
                +-------------------+
                | ietf-te-topology  |
                +-------------------+
                          ^
                          | Augments
                          |
                +-------------------+
                | ietf-otn-topology |
                +-------------------+
                          ^
                          | Augments
                          |
               +----------+----------+
               | ietf-fgotn-topology |
               +---------------------+
```

Figure 4: Relationship between fgOTN topology and OTN topology model

The entities, TE attributes and OTN attributes, such as nodes, termination points and links, are still applicable for describing an fgOTN topology and the model presented in this document only specifies technology-specific attributes/information. The fgOTN-specific attributes including the fgTS, can be used to represent the bandwidth and label information. At the same time, it is necessary to extend the encoding and switching-capability enumeration values in [I-D.ietf-teas-rfc8776-update] to identify that the current Tunnel Termination Point (TTP) is a termination point of an fgOTN tunnel.

4.2. Bandwidth Augmentation

Based on the OTN topology model, we augment the bandwidth information of fgOTN, including the max-link-bandwidth and unreserved-bandwidth. The augmented parameter fgotn-bandwidth is used to indicate how much of the bandwidth has been allocated for the usage of fgOTN. For example, if 2 ODU0s are allocated to support fgOTN switching switching, the fgotn-bandwidth is 2500, and the unit is Mbps.

```
augment /nw:networks/nw:network/nt:link/tet:te/tet:te-link-attributes
          /tet:max-link-bandwidth/tet:te-bandwidth/otnt:otn-bandwidth
          /otnt:odulist:
   +--rw fgotn-bandwidth?   uint16
```

The augmented fgotnlist structure is used to describe the unreserved TE bandwidth of fgOTN in the server ODUk. The odu-ts-number is used to indicate the index of server ODUk channel.

```
augment /nw:networks/nw:network/nt:link/tet:te/tet:te-link-attributes
          /tet:unreserved-bandwidth/tet:te-bandwidth
          /otnt:otn-bandwidth:
   +--rw fgotnlist* [odu-type odu-ts-number]
      +--rw odu-type           identityref
      +--rw odu-ts-number?     uint16
      +--rw fgotn-bandwidth?   uint16
```

4.3. Label Augmentation

The model augments the label-restriction list with fgOTN technology-specific label information using the otn-label-range-info grouping defined in [I-D.ietf-ccamp-layer1-types].

```
augment /nw:networks/tet:te/tet:templates/tet:link-template
        /tet:te-link-attributes/tet:label-restrictions
        /tet:label-restriction/otnt:otn-label-range:
   +--rw fgts-range* [odu-type odu-ts-number]
      +--rw odu-type           identityref
      +--rw odu-ts-number?     uint16
      +--rw fgts-reserved?     string
      +--rw fgts-unreserved?   string
```

The fgts-range list is used to describe the availability of fgOTN timeslot in the server ODUk, including the fgts-reserved and fgts-unreserved. The odu-ts-number is used to indicate the index of server ODUk channel.

5. YANG Data Model for fgOTN Tunnel

5.1. Fine Grain OTN Tunnel Data Model Overview

This document aims to describe the data model for fgOTN tunnel. The fgOTN tunnel model augments to OTN tunnel [I-D.ietf-ccamp-otn-tunnel-model] with fgOTN-specific parameters, including the bandwidth information and label information. Figure 5 shows the augmentation relationship.

```
                    +------------------+
                    |      ietf-te     |
                    +------------------+
                              ^
                              | Augments
                              |
                    +-----------------+
                    | ietf-otn-tunnel |
                    +-----------------+
                              ^
                              | Augments
                              |
                   +----------+--------+
                   | ietf-fgotn-tunnel |
                   +-------------------+
```

Figure 5: Relationship between fgOTN and OTN tunnel model

It's also worth noting that the fgOTN tunnel provisioning is usually based on the fgOTN topology. Therefore the fgOTN tunnel model is usually used together with fgOTN topology model specified in this document. The OTN tunnel model also imports a few type modules, including ietf-layer1-types and ietf-te-types.

A new identity based on odu-type should be defined for fgODUflex in an updated version of [I-D.ietf-ccamp-layer1-types] to indicate the bandwidth of fgotn tunnel.

5.2. Bandwidth Augmentation

The model augment TE bandwidth information of fgOTN tunnel.

```
augment /te:te/te:tunnels/te:tunnel/te:te-bandwidth/te:technology
        /otn-tnl:otn:
   +--rw fgoduflex-bandwidth?   string
```

The string value fgoduflex-bandwidth is used to indicate the bandwidth of this fgOTN tunnel.

5.3. Label Augmentation

The module augments TE label-hop for the explicit route objects included or excluded by the path computation of the primary-paths and secondary-paths using the fgts-numbers. The fgts-numbers is used to specify fgTS information on inter-domain ports of the routing path. When specifying the fgotn time slot in the routing constraint information, the ODU time slot must also be specified. We also augment the TE label-hop for the record route of the LSP using the fgts-numbers.

6. YANG Tree for fgOTN topology

Figure 6 below shows the tree diagram of the YANG data model defined in module "ietf-fgotn-topology" (Figure 7).

```
module: ietf-fgotn-topology

  augment /nw:networks/nw:network/nt:link/tet:te
            /tet:te-link-attributes/tet:max-link-bandwidth
            /tet:te-bandwidth/otnt:otn-bandwidth:
    +--rw fgotn-bandwidth?   uint16
  augment /nw:networks/nw:network/nt:link/tet:te
            /tet:te-link-attributes/tet:unreserved-bandwidth
            /tet:te-bandwidth/otnt:otn-bandwidth:
    +--rw fgotn-bandwidth?   uint16
    +--rw fgotnlist* [odu-type odu-ts-number]
       +--rw odu-type           identityref
       +--rw odu-ts-number      fgotnt:ts-list
       +--rw fgotn-bandwidth?   uint16
  augment /nw:networks/nw:network/nt:link/tet:te
            /tet:te-link-attributes/tet:label-restrictions
            /tet:label-restriction/otnt:otn-label-range:
    +--rw fgts-range* [odu-type odu-ts-number]
       +--rw odu-type           identityref
       +--rw odu-ts-number      fgotnt:ts-list
       +--rw fgts-reserved?     fgotnt:ts-list
       +--rw fgts-unreserved?   fgotnt:ts-list
```

Figure 6

7. YANG Data Model for fgOTN topology

```
<CODE BEGINS> file "ietf-fgotn-topology@2025-06-18.yang"
module ietf-fgotn-topology {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-fgotn-topology";
  prefix fgotnt;

  import ietf-network {
    prefix nw;
    reference
      "RFC8345: A YANG Data Model for Network Topologies";
  }
  import ietf-network-topology {
    prefix nt;
    reference
```

```
        "RFC8345: A YANG Data Model for Network Topologies";
    }
    import ietf-te-topology {
      prefix tet;
      reference
        "RFC 8795: YANG Data Model for Traffic Engineering (TE)
                   Topologies";
    }
    import ietf-layer1-types {
      prefix l1-types;
      reference
        "RFC YYYY: A YANG Data Model for Layer 1 Types";
    }

    /* Note: The RFC Editor will replace YYYY with the number assigned
       to the RFC once draft-ietf-ccamp-layer1-types becomes an RFC.*/

    import ietf-otn-topology {
      prefix otnt;
      reference
        "RFC ZZZZ: A YANG Data Model for Optical Transport Network
                   Topology";
    }

    /* Note: The RFC Editor will replace ZZZZ with the number assigned
       to the RFC once draft-ietf-ccamp-otn-topo-yang becomes an RFC.*/

    organization
      "Internet Engineering Task Force (IETF) CCAMP WG";
    contact
      "
        ID-draft editor:
          Yanxia Tan (tanyx11@chinaunicom.cn);
          Yanlei Zheng (zhengyanlei@chinaunicom.cn);
          Italo Busi (italo.busi@huawei.com);
          Chaode Yu (yuchaode@huawei.com);
          Xing Zhao (zhaoxing@caict.ac.cn);
      ";
    description
      "This module defines a YANG data model for fgOTN-specific
       extension based on existing network topology models. The model
       fully conforms to the Network Management Datastore Architecture
       (NMDA).

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        the RFC itself for full legal notices.

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        NOT', 'SHOULD', 'SHOULD NOT', 'RECOMMENDED', 'NOT RECOMMENDED',
        'MAY', and 'OPTIONAL' in this document are to be interpreted as
        described in BCP 14 (RFC 2119) (RFC 8174) when, and only when,
        they appear in all capitals, as shown here.";

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

     revision 2026-01-14 {
       description
         "initial version";
       reference
         "RFC XXXX: YANG Data Models for fine grain Optical Transport
                    Network";
     }

     typedef ts-list {
       type string {
         pattern '([1-9][0-9]{0,3}(-[1-9][0-9]{0,3})?'
               + '(,[1-9][0-9]{0,3}(-[1-9][0-9]{0,3})?)*)';
       }
       description
         "A list of Tributary Slots (TS) ranging between 1 and 4095.

          If multiple values or ranges are given, they all MUST be
          disjoint and MUST be in ascending order.

          For example 1-20,25,50-1000.";
       reference
         "RFC 7139: GMPLS Signaling Extensions for Control
                    of Evolving G.709 Optical Transport Networks";
     }

     augment "/nw:networks/nw:network/nt:link/tet:te"
           + "/tet:te-link-attributes/tet:max-link-bandwidth"
           + "/tet:te-bandwidth/otnt:otn-bandwidth" {
```

```
       description
         "specific augmentation of fgOTN link on maximum link
          bandwidth";
       leaf fgotn-bandwidth {
         type uint16;
         description
           "It is used to indicate how much of the bandwidth has been
            allocated for the usage of fgOTN.";
       }
     }

     augment "/nw:networks/nw:network/nt:link/tet:te"
           + "/tet:te-link-attributes/tet:unreserved-bandwidth"
           + "/tet:te-bandwidth/otnt:otn-bandwidth" {
       description
         "specific augmentation of fgOTN link on unreserved link
          bandwidth";
       leaf fgotn-bandwidth {
         type uint16;
         description
           "The unreserved bandwidth of fgOTN before the server ODUk
            is set up";
       }
       list fgotnlist {
         key "odu-type odu-ts-number";
         description
           "This structure is used to describe the unsreserved
            bandwidth of fgOTN in the server ODUk";
         leaf odu-type {
           type identityref {
             base l1-types:odu-type;
           }
           description
             "The granularity of server ODUk";
         }
         leaf odu-ts-number {
           type fgotnt:ts-list;
           description
             "The index of server ODUk channel";
         }
         leaf fgotn-bandwidth {
           type uint16;
           description
             "The unreserved bandwidth of fgOTN in this server ODUk";
         }
       }
     }
```

```
     augment "/nw:networks/nw:network/nt:link/tet:te"
           + "/tet:te-link-attributes/tet:label-restrictions"
           + "/tet:label-restriction/otnt:otn-label-range" {
       description
         "specific augmentation of fgOTN label";
       list fgts-range {
         key "odu-type odu-ts-number";
         description
           "This structure is used to describe the availability of
            fgOTN timeslot in the server ODUk";
         leaf odu-type {
           type identityref {
             base l1-types:odu-type;
           }
           description
             "The granularity of server ODUk";
         }
         leaf odu-ts-number {
           type fgotnt:ts-list;
           description
             "The index of server ODUk channel";
         }
         leaf fgts-reserved {
           type fgotnt:ts-list;
           description
             "The reserved fgOTN timeslot in this server ODUk";
         }
         leaf fgts-unreserved {
           type fgotnt:ts-list;
           description
             "The unreserved fgOTN timeslot in this server ODUk";
         }
       }
     }
   }
   <CODE ENDS>
```

Figure 7: fgOTN topology YANG module

8. YANG Tree for fgOTN tunnel

Figure 8 below shows the tree diagram of the YANG data model defined in module "ietf-fgotn-tunnel" (Figure 9).

```
   module: ietf-fgotn-tunnel

     augment /te:te/te:tunnels/te:tunnel/te:te-bandwidth/te:technology
               /otn-tnl:otn:
       +--rw fgoduflex-bandwidth?   string
     augment /te:te/te:tunnels/te:tunnel/te:primary-paths
               /te:primary-path/te:explicit-route-objects
               /te:route-object-include-exclude/te:type/te:label
               /te:label-hop/te:te-label/te:technology/otn-tnl:otn
               /otn-tnl:otn-label:
       +--rw fgts-numbers?   string
     augment /te:te/te:tunnels/te:tunnel/te:primary-paths
               /te:primary-path/te:primary-reverse-path
               /te:explicit-route-objects
               /te:route-object-include-exclude/te:type/te:label
               /te:label-hop/te:te-label/te:technology/otn-tnl:otn
               /otn-tnl:otn-label:
       +--rw fgts-numbers?   string
     augment /te:te/te:tunnels/te:tunnel/te:secondary-paths
               /te:secondary-path/te:explicit-route-objects
               /te:route-object-include-exclude/te:type/te:label
               /te:label-hop/te:te-label/te:technology/otn-tnl:otn
               /otn-tnl:otn-label:
       +--rw fgts-numbers?   string
     augment /te:te/te:tunnels/te:tunnel/te:secondary-reverse-paths
               /te:secondary-reverse-path/te:explicit-route-objects
               /te:route-object-include-exclude/te:type/te:label
               /te:label-hop/te:te-label/te:technology/otn-tnl:otn
               /otn-tnl:otn-label:
       +--rw fgts-numbers?   string
     augment /te:te/te:lsps/te:lsp/te:lsp-actual-route-information
               /te:lsp-actual-route-information/te:type/te:label
               /te:label-hop/te:te-label/te:technology/otn-tnl:otn
               /otn-tnl:otn-label:
       +--ro fgts-numbers?   string
```

Figure 8

9. YANG Data Model for fgOTN tunnel

```
   <CODE BEGINS> file "ietf-fgotn-tunnel@2025-06-18.yang"
   module ietf-fgotn-tunnel {
     /* TODO: FIXME */
     yang-version 1.1;

     namespace "urn:ietf:params:xml:ns:yang:ietf-fgotn-tunnel";
     prefix "fgotn-tnl";
```

```
     import ietf-te {
       prefix "te";
       reference
         "RFC KKKK: A YANG Data Model for Traffic Engineering Tunnels,
                    Label Switched Paths and Interfaces";
     }

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

     import ietf-otn-tunnel {
       prefix "otn-tnl";
       reference  "RFC JJJJ: OTN Tunnel YANG Model";
     }

     /* Note: The RFC Editor will replace JJJJ with the number assigned
        to the RFC once draft-ietf-ccamp-otn-tunnel-model becomes
        an RFC.*/

     organization
       "Internet Engineering Task Force (IETF) CCAMP WG";
     contact
       "
         ID-draft editor:
           Yanxia Tan (tanyx11@chinaunicom.cn);
           Yanlei Zheng (zhengyanlei@chinaunicom.cn);
           Italo Busi (italo.busi@huawei.com);
           Chaode Yu (yuchaode@huawei.com);
           Xing Zhao (zhaoxing@caict.ac.cn);
       ";

     description
       "This module defines a YANG data model for fgOTN-specific
        extension based on existing network topology models. The model
        fully conforms to the Network Management Datastore Architecture
        (NMDA).

        Copyright (c) 2024 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 Revised BSD License
        set forth in Section 4.c of the IETF Trust’s Legal Provisions
        Relating to IETF Documents
        (https://trustee.ietf.org/license-info).

        This version of this YANG module is part of RFC XXXX; see
```

```
        the RFC itself for full legal notices.";

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

     revision 2025-06-18 {
       description
         "initial version";
       reference
         "RFC XXXX: YANG Data Models for fine grain Optical Transport
                    Network";
     }

     augment "/te:te/te:tunnels/te:tunnel/"
           + "te:te-bandwidth/te:technology/otn-tnl:otn" {
       description
         "augmentation of fgOTN tunnel on bandwidth structure";
       leaf fgoduflex-bandwidth {
         type string;
         description
           "Augment TE bandwidth of the fgOTN tunnel";
       }
     }

     augment "/te:te/te:tunnels/te:tunnel/"
           + "te:primary-paths/te:primary-path/"
           + "te:explicit-route-objects/"
           + "te:route-object-include-exclude/te:type/te:label/"
           + "te:label-hop/te:te-label/te:technology/otn-tnl:otn" +
             "/otn-tnl:otn-label" {
       description
         "augmentation of fgOTN label";
       leaf fgts-numbers {
         type string;
         description
           "Augment fgOTN timeslot information of this label hop";
       }
     }

     augment "/te:te/te:tunnels/te:tunnel/te:primary-paths" +
             "/te:primary-path/te:primary-reverse-path" +
             "/te:explicit-route-objects" +
             "/te:route-object-include-exclude/te:type/te:label" +
             "/te:label-hop/te:te-label/te:technology/otn-tnl:otn" +
             "/otn-tnl:otn-label" {
       description
```

```
         "augmentation of fgOTN label";
       leaf fgts-numbers {
         type string;
         description
           "Augment fgOTN timeslot information of this label hop";
       }
     }

     augment "/te:te/te:tunnels/te:tunnel/te:secondary-paths" +
             "/te:secondary-path/te:explicit-route-objects" +
             "/te:route-object-include-exclude/te:type/te:label" +
             "/te:label-hop/te:te-label/te:technology/otn-tnl:otn" +
             "/otn-tnl:otn-label" {
       description
         "augmentation of fgOTN label";
       leaf fgts-numbers {
         type string;
         description
           "fgOTN timeslot information of this label hop";
       }
     }

     augment "/te:te/te:tunnels/te:tunnel/te:secondary-reverse-paths" +
             "/te:secondary-reverse-path/te:explicit-route-objects" +
             "/te:route-object-include-exclude/te:type/te:label" +
             "/te:label-hop/te:te-label/te:technology/otn-tnl:otn" +
             "/otn-tnl:otn-label" {
       description
         "augmentation of fgOTN label";
       leaf fgts-numbers {
         type string;
         description
           "fgOTN timeslot information of this label hop";
       }
     }

     augment "/te:te/te:lsps/te:lsp/te:lsp-actual-route-information" +
             "/te:lsp-actual-route-information/te:type/te:label" +
             "/te:label-hop/te:te-label/te:technology/otn-tnl:otn" +
             "/otn-tnl:otn-label" {
       description
         "augmentation of fgOTN label";
       leaf fgts-numbers {
         type string;
         description
           "fgOTN timeslot information of this label hop";
       }
     }
```

```
}
<CODE ENDS>
```

Figure 9: fgOTN tunnel YANG module

10. Manageability Considerations

<Add any manageability considerations>

11. Security Considerations

<Add any security considerations>

12. IANA Considerations

<Add any IANA considerations>

13. References

13.1. Normative References

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Appendix A. Multi-domain fgOTN Hitless Resizing Process

The process of multi-domain fgOTN hitless resizing include six steps. Both the source and destination controllers should report the hitless bandwidth adjustment status to the MDSC coordinator. To be noted that, the resizing process is divided into two directions, and the resizing is considered successful when both directions have been adjusted.

Step 1: The MDSC coordinator sends an resizing command to the source node (Node1) via Controller 1.

Step 2: Controller 1 will report a bandwidth adjustment starting status notification, e.g. ietf-te-types:lsp-path-modifying, to the MDSC.

Step 3: Node 1 to node 6 will modify their configuration in the forward direction through data plane node by node. The detail of this process can reference to Annex O.2 of [ITU-T_G.709].

Step 4: After the resizing from node1 to node6 was completed, Controller 1 will report an ending status notification, e.g. ietf-te-types:lsp-path-modified, to MDSC.

Step 5: At the same time, the reverse direction bandwidth resizing will be triggered auotmatically by the data plane in node 6. Controller 3 needs to report an bandwidth adjustment starting status notification, ietf-te-types:lsp-path-modifying, to the MDSC.

Step 6: After the reverse direction (Node 6 to Node 1) resizing is completed, Controller 3 will report an ending status notification, ietf-te-types:lsp-path-modified, to MDSC.

During the whole process, all domain controllers, including the intermediate domain Controller 2, need to report the notifications of topology and tunnel resource changes to the MDSC.

Acknowledgments

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