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YANG data model for Flexi-Grid media-channels
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Abstract

This document defines a YANG model for managing flexi-grid optical media channels, complementing the information provided by the flexi-grid TED model.
It is also grounded on other defined YANG abstract models.

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1. Introduction

Transport networks are evolving from current DWDM systems towards elastic optical networks, based on flexi-grid transmission and switching technologies [RFC7698]. Such technology aims at increasing both transport network scalability and flexibility, allowing the optimization of bandwidth usage.

While [I-D.draft-ietf-ccamp-flexigrid-yang] focuses on flexi-grid objects such as nodes, transponders and links, this document presents a YANG model for the flexi-grid media-channel. This YANG module defines the whole path from a source transponder or node to the destination through a number of intermediate nodes in the flexi-grid network.

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

2. Conventions used in this document

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

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

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

3. Flexi-grid media-channel overview

The present model defines a flexi-grid media-channel mainly composed of:

- source address
- source flexi-grid port
- source flexi-grid transponder
- destination address
- destination flexi-grid port
- destination flexi-grid transponder
- A list of links that defines the path
- Other optical attributes

Each path can be a media-channel (only defined by source and destination node) or a network media-channel (additionally needs source and destination transponders). Therefore, all the attributes are optional to support both situations.

This is achieved by a combination of the traffic engineering tunnel attributes explained in [I-D.draft-ietf-teas-yang-te] and augments when necessary. For instance, source address, source flexi-grid transponder, destination address and destination flexi-grid transponder attributes are directly taken from tunnel, whereas other attributes such as source flexi-grid port, destination flexi-grid port are defined, as they are specific for flexi-grid.

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.

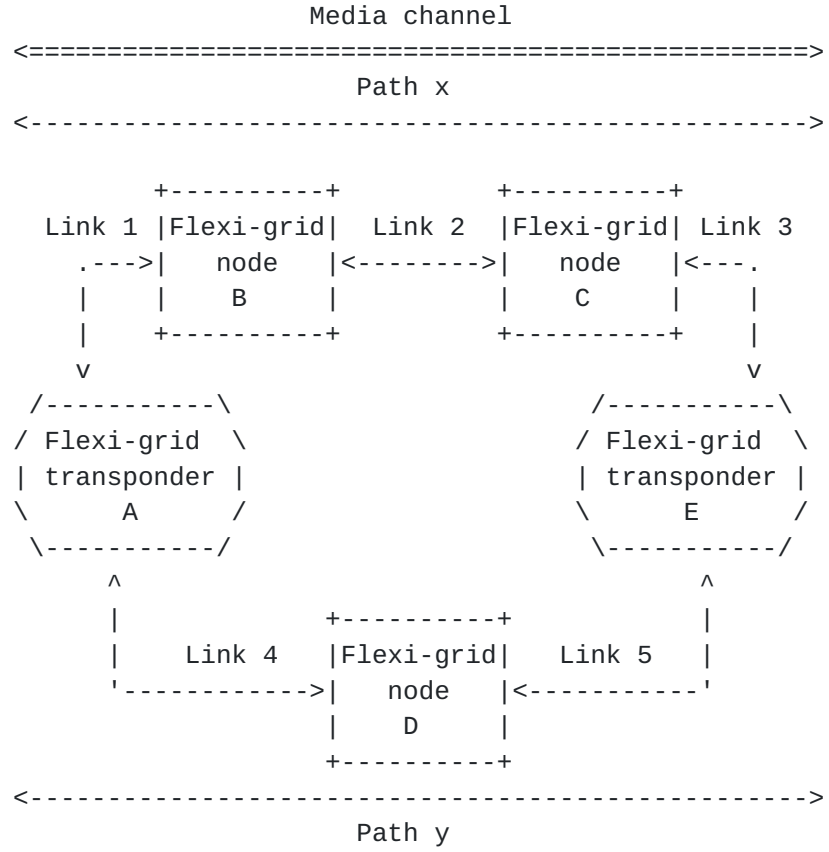

Figure 1. Topology example.

After the nodes, links and transponders have been defined using [I-D.draft-ietf-ccamp-flexigrid-yang], 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.

1. Depending on the case, it is possible to define either the source and destination node ports, or the source and destination node and transponder. In our case, we would define a network media channel, with source transponder A and source node B, and destination transponder E and destination node C. Thus, we are going to follow path x.

2. Then, for each link in the path x, we indicate which channel we are going to use, providing information about the slots, and what nodes are connected.

3. Finally, the flexi-grid TED has to be updated with each element usage status each time a media channel is created or torn down.

5. Media Channel YANG Model

5.1. YANG Model - Tree

```
module: ietf-flexi-grid-media-channel
  augment /te:te/te:tunnels/te:tunnel:
    +--rw source-port?           fg-ted:flexi-grid-node-port-ref
    +--rw destination-port?      fg-ted:flexi-grid-node-port-ref
    +--rw effective-freq-slot
       +--rw N?   int32
       +--rw M?   int32
  augment /te:te/te:tunnels/te:tunnel/te:state:
    +--ro source-port?           fg-ted:flexi-grid-node-port-ref
    +--ro destination-port?      fg-ted:flexi-grid-node-port-ref
    +--ro effective-freq-slot
       +--ro N?   int32
       +--ro M?   int32
  augment /te:te/te:lsps-state/te:lsp:
    +--ro N?                  int32
    +--ro M?                  int32
    +--ro source-port?        fg-ted:flexi-grid-node-port-ref
    +--ro destination-port?   fg-ted:flexi-grid-node-port-ref
    +--ro link?               fg-ted:flexi-grid-link-ref
    +--ro bidirectional?      boolean
```

5.2. YANG Model - Code

<CODE BEGINS> file "ietf-flexi-grid-media-channel@2018-05-08.yang"

```
module ietf-flexi-grid-media-channel {
   yang-version 1.1;

   namespace
     "urn:ietf:params:xml:ns:yang:ietf-flexi-grid-media-channel";
   prefix "fg-mc";

   import ietf-flexi-grid-ted {
      prefix "fg-ted";
   }

   import ietf-te {
      prefix "te";
   }

   import ietf-network {
      prefix "nd";
   }
   organization
      "IETF CCAMP Working Group";
   contact
      "Editor: Jorge Lopez de Vergara
                <jorge.lopez_vergara@uam.es>";

   description
      "This module contains a collection of YANG definitions for
      a Flexi-Grid media channel.

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      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).";

   revision 2018-05-08 {
      description
         "version 2.";

      reference
         "RFC XXX: A Yang Data Model for Flexi-Grid media-channels";
   }
```

```
   grouping flexi-grid-media-channel {
         description
            "Media association that represents both the topology
            (i.e., path through the media) and the resource
            (frequency slot) that it occupies.  As a topological
            construct, it represents a (effective) frequency slot
            supported by a concatenation of media elements (fibers,
            amplifiers, filters, switching matrices...).  This term
            is used to identify the end-to-end physical layer entity
            with its corresponding (one or more) frequency slots
            local at each link filters.";
         reference "rfc7698";
         leaf source-port {
            type fg-ted:flexi-grid-node-port-ref;
            description "Source port";
          }
         leaf destination-port {
            type fg-ted:flexi-grid-node-port-ref;
            description "Destination port";
          }
         container effective-freq-slot {
         description "The effective frequency slot is an attribute
            of a media channel and, being a frequency slot, it is
            described by its nominal central frequency and slot
            width";
         reference "rfc7698";
            leaf N {
               type int32;
               description
                  "Is used to determine the Nominal Central
                  Frequency. The set of nominal central frequencies
                  can be built using the following expression:
                     f = 193.1 THz + n x 0.00625 THz,
                  where 193.1 THz is ITU-T ''anchor frequency'' for
                  transmission over the C band, n is a positive or
                  negative integer including 0.";
               reference "rfc7698";
            }
            leaf M {
               type int32;
               description
                  "Is used to determine the slot width. A slot width
                  is constrained to be M x SWG (that is, M x 12.5 GHz),
                  where M is an integer greater than or equal to 1.";
               reference "rfc7698";
         }
      }
   }
```

```
   grouping link-channel-attributes {
      description
         "A link channel is one of the concatenated elements of
         the media channel.";
      leaf N {
         type int32;
         description
            "Is used to determine the Nominal Central Frequency.
            The set of nominal central frequencies can be built
            using the following expression:
               f = 193.1 THz + n x 0.00625 THz,
            where 193.1 THz is ITU-T ''anchor frequency'' for
            transmission over the C band, n is a positive or
            negative integer including 0.";
         reference "rfc7698";
      }
      leaf M {
         type int32;
            description
               "Is used to determine the slot width. A slot
               width is constrained to be M x SWG (that is,
               M x 12.5 GHz), where M is an integer greater than
               or equal to 1.";
            reference "rfc7698";
      }
      leaf source-port {
         type fg-ted:flexi-grid-node-port-ref;
         description "Source port of the link channel";
      }
      leaf destination-port {
         type fg-ted:flexi-grid-node-port-ref;
         description "Destination port of the link channel";
      }
      leaf link {
         type fg-ted:flexi-grid-link-ref;
         description "Link of the link channel";
      }
      leaf bidirectional {
         type boolean;
         description
            "Determines whether the link is bidirectional or
            not";
      }
   }
```

```
   /* Augment for media-channel */
   augment "/te:te/te:tunnels/te:tunnel" {
       when "/nd:networks/nd:network/nd:network-types/
     fg-ted:flexi-grid-network"{
          description "Augment only for Flexigrid network.";
       }
       description "Augment tunnel with media-channel config";
       uses flexi-grid-media-channel;

   }

      augment "/te:te/te:tunnels/te:tunnel/te:state" {
       when "/nd:networks/nd:network/nd:network-types/
     fg-ted:flexi-grid-network"{
          description "Augment only for Flexigrid network.";
       }
       uses flexi-grid-media-channel;
       description "Augment tunnel with media-channel state";

   }

   /* Augment for LSP */
   augment "/te:te/te:lsps-state/te:lsp" {
      when "/nd:networks/nd:network/nd:network-types/
     fg-ted:flexi-grid-network"{
          description "Augment only for Flexigrid network.";
      }
      uses link-channel-attributes;
      description "Augment LSP for paths";
   }

}

<CODE ENDS>
```

5.3. License

6. Security Considerations

The transport protocol used for sending the managed information MUST support authentication and SHOULD support encryption.

The defined data-model by itself does not create any security implications.

7. IANA Considerations

The namespace used in the defined models is currently based on the METRO-HAUL project URI. Future versions of this document could register a URI in the IETF XML registry [RFC3688], as well as in the YANG Module Names registry [RFC6020].

8. References

8.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC6020] Bjorklund, M., Ed., "YANG - A Data Modeling Language for the Network Configuration Protocol (NETCONF)", RFC 6020, October 2010.

[RFC3688] Mealling, M., "The IETF XML Registry", BCP 81, RFC 3688, January 2004.

8.2. Informative References

[RFC7698] Gonzalez de Dios, O., Casellas, R., Eds. "Framework and Requirements for GMPLS-Based Control of Flexi-Grid Dense Wavelength Division Multiplexing (DWDM) Networks", RFC7698, November 2015.

[I-D.draft-ietf-ccamp-flexigrid-yang] Lopez de Vergara, J., Perdices, D., Lopez, V., Gonzalez de Dios, O., King, D., Lee, Y., Galimberti, G., "YANG data model for Flexi-Grid Optical Networks", Internet Draft, draft-ietf-ccamp-flexigrid-yang-00, 2018.

[I-D.draft-ietf-teas-yang-te] Saad, T., Gandhi, R., Liu, X., Beeram, V., Shah, H., Bryskin, I., Chen, X., Jones, R., and B. Wen, "A YANG Data Model for Traffic Engineering Tunnels and Interfaces", draft-ietf-teas-yang-te-14, 2018.

9. Contributors

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

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

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