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A YANG model to manage the optical interface parameters for an external transponder in a WDM network

draft-ietf-ccamp-dwdm-if-param-yang-09

Abstract

This memo defines a Yang model related to the Optical Transceiver parameters characterising coherent 100G and above interfaces. 100G and above Transceivers support coherent modulation, multiple modulation formats, multiple FEC codes including some not yet specified (or by in phase of specification by) ITU-T G.698.2 or any other ITU-T recommendation. Use cases are described in RFC7698.

The Yang model defined in this memo can be used for Optical Parameters monitoring and/or configuration of the endpoints of a multi-vendor IaDI optical link. The use of this model does not guarantee interworking of transceivers over a DWDM. Optical path feasibility and interoperability has to be determined by tools and algorithms outside the scope of this document. The purpose of this model is to program interface parameters to consistently configure the mode of operation of transceivers.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on 14 September 2023.

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1. Introduction

This memo defines a Yang model that translates and obsolete the SNMP mib module defined in draft-galikunze-ccamp-dwdm-if-snmp-mib for managing single channel optical interface parameters of DWDM applications, using the approach specified in G.698.2. This model supports parameters to characterize coherent transceivers found in current implementations to specify the mode of operation. As application identifiers like those specified in ITU-T G.874 [ITU.G874] ITU-T G.698.2 [ITU.G698.2] may not be available we use mode templates instead. A mode template describes transceiver characteristics in detail and can be identified by a mode-id.

This draft refers and supports the RFC7698.

The YANG model describing and extending the optical parameters allows different vendors and operators to retrieve, provision and exchange information across the multi-vendor IaDI interfaces in an abstract manner.

The concept introduced by this YANG model is the notion of a mode. A mode is a combination of parameters or parameter ranges that is supported by a transceiver. As an example, operating a device in QPSK mode may use a different FEC and requires less OSNR to reach the FEC limit than the same transceiver operating in QAM16 mode. Given the number of parameters and their possible combinations it is important for vendors to be able to qualify a set of combinations which is the basis to define a mode. The YANG model furthermore provides means to select one mode as current-mode from that pre-defined list of modes supported by the transceiver module. Once selected, current-opt-if-och-mode-params provide the means to configure specific parameters at run time and retrieve actual parameters from the module. For example, the frequency is a parameter that can be set within min/max boundaries set by the current mode. Laser Temperature however is a ro parameter available at run-time that can be checked against the mode boundaries and may trigger an event.

2. The Internet-Standard Management Framework

// The title and text for this section has been copied from the
// official boilerplate, and should not be modified unless the
// boilerplate text at http;//ops.ietf.org/mib-boilerplate.html has
// changed. See RFC4818 section 3.1 for a discussion of the
// boilerplate section.

For a detailed overview of the documents that describe the current Internet-Standard Management Framework, please refer to section 7 of RFC 3410 [RFC3410].

This memo specifies a Yang model for optical interfaces.

3. Conventions

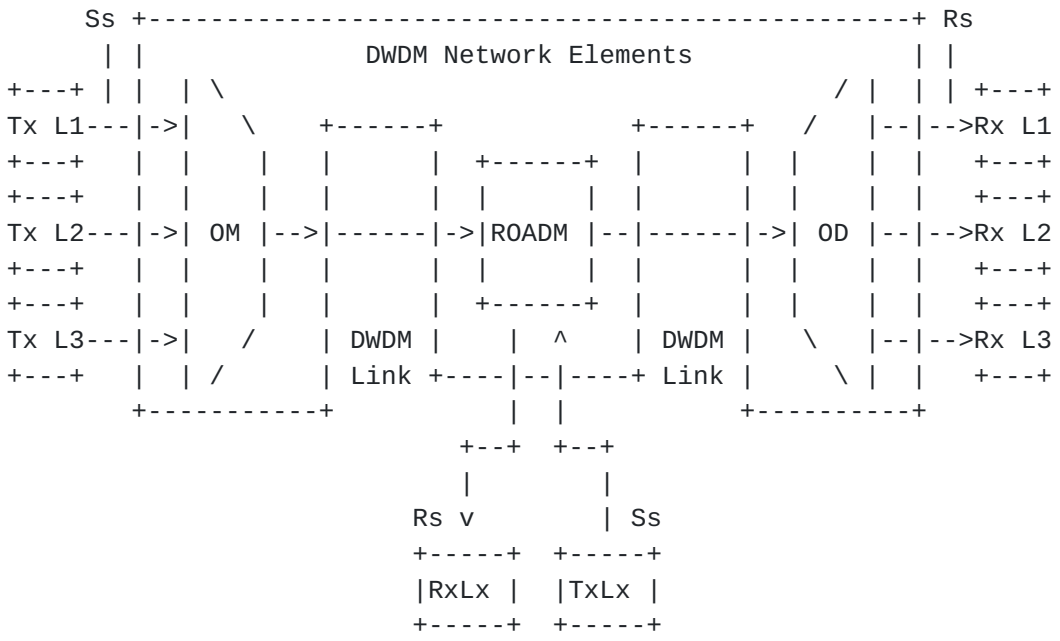
// TEMPLATE TODO This boilerplate should be used if the RFC2119 key
// words are used in the internet draft. The text in this section
// has been copied from the official boilerplate, and should not be
// modified.

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 RFC 2119 [RFC2119] In the description of OIDs the convention: Set (S) Get (G) and Trap (T) conventions will describe the action allowed by the parameter.

4. Overview

// TEMPLATE TODO The narrative part should include an overview
// section that describes the scope and field of application of the
// MIB modules defined by the specification. See RFC4181 section 3.2
// for a discussion of the Narrative section.

Figure 1 shows a set of reference points, for single-channel connection between transmitters (Tx) and receivers (Rx). Here the DWDM network elements include an OM (Optical Multiplexer) and an OD (Optical Demultiplexer) which are used as a pair with the opposing element, one or more optical amplifiers and may also include one or more OADMs.



Ss = reference point at the DWDM network element tributary output
Rs = reference point at the DWDM network element tributary input
Lx = Lambda x
OM = Optical Mux
OD = Optical Demux
ROADM = Reconfigurable Optical Add Drop Mux

Figure 1: External transponder in WDM netwoks

from Fig. 5.1/G.698.2

4.1. Optical Parameters Description

The link between the external transponders through a WDM network media channels are managed at the edges, i.e. at the transmitters (Tx) and receivers (Rx) attached to the S and R reference points respectively.

Definitions of the optical parameters are provided below to increase the readability of the document.

4.1.1. Parameters at Ss

output-power:
The mean launched power at Ss is the average power (in dBm) of a pseudo-random data sequence coupled into the DWDM link.

central frequency:
This parameter indicates the Central frequency value that Ss and Rs will be set to work (in THz)

4.1.2. Interface at point Rs

input-power:
The average received power (in dBm) at point Rs.

Curr-OSNR:
Current Optical Signal to Noise Ratio (OSNR) estimated at Rx Transceiver port.

Curr-q-factor:
"Q" factor estimated at Rx Transceiver port.

4.2. Use Cases

The use cases are described in draft-ietf-ccamp-dwdm-if-mng-ctrl-fwk

4.3. Optical Interface for external transponder in a WDM network

The ietf-ext-xponder-wdm-if is an augment to the ietf-interface. It allows the user to set the operating mode of transceivers as well as other operational parameters. The module provides also treshold settings and notifications to supervise measured parameters and notify the client.

```
module: ietf-ext-xponder-wdm-if
  augment /if:interfaces/if:interface:
    +--rw optIfOChRsSs
       +--ro if-current-mode
       |  +--ro mode-id                          string
       |  +--ro (mode)
       |     +--:(G.698.2)
       |     |  +--ro standard-mode?          standard-mode
       |     |     +--ro application-code
       |     +--:(organizational-mode)
       |     |  +--ro organizational-mode
       |     |     +--ro operational-mode?
       |     |     |       operational-mode
       |     |     +--ro organization-identifier?
       |     |     |       organization-identifier
       |     |     +--ro available-fec-type?
       |     |     |       layer0-types:fec-type
       |     |     +--ro available-modulation-type?
       |     |     |       layer0-types:modulation
       |     |     +--ro available-baud-rate?
```

```
|     |            layer0-types:available-baud-rate
|     +--:(explicit-mode)
|        +--ro explicit-mode
|           +--ro supported-modes
|           |  +--ro supported-application-codes*
|           |  |       -> ../../../mode-id
|           |  +--ro supported-organizational-modes*
|           |          -> ../../../mode-id
|           +--ro line-coding-bitrate?
|           |       layer0-types:line-coding-bitrate
|           +--ro min-central-frequency?
|           |        layer0-types:frequency-thz
|           +--ro max-central-frequency?
|           |      layer0-types:frequency-thz
|           +--ro transceiver-tunability
|           |      layer0-types:frequency-ghz
|           +--ro min-channel-input-power?
|           |           layer0-types:rx-channel-power-min;
|           +--ro max-channel-input-power?
|           |           layer0-types:rx-channel-power-max
|           +--ro total-channel-output-power?
|           |           layer0-types:rx-total-power-max
|           +--ro min-osnr-margin?
|           |           layer0-types:min-osnr
|           +--ro q-margin?
|           |           layer0-types:min-q-factor
|           +--ro available-fec-type?
|           |           layer0-types:fec-type
|           +--ro fec-code-rate?
|           |           layer0-types:fec-code-rate
|           +--ro pre-fec-ber-threshold?         decimal64
|           +--ro number-of-lasers?                 uint32
|           +--ro min-laser-temperature?            int32
|           +--ro max-laser-temperature?            int32
|           +--ro chromatic-dispersion-penalty* []
|           |  +--ro chromatic-dispersion
|           |  |       decimal64
|           |  +--ro penalty
|           |          penalty-value
|           +--ro polarization-dispersion-penalty* []
|           |  +--ro polarization-mode-dispersion
|           |  |       decimal64
|           |  +--ro penalty
|           |          penalty-value
|           +--ro max-chromatic-dispersion?
|           |          max-chromatic-dispersion
|           +--ro max-diff-group-delay?
|           |          max-diff-group-delay
```

```
|          |--ro max-polarization-dependent-loss-penalty*
|          +  +--ro max-polarization-dependent-loss?
|          |  |       power-in-db-or-null
|          |  +--ro penalty
|          |          penalty-value
|          +--ro available-modulation-type?
|          |          layer0-types:modulation
|          +--ro bitrate
|          |          layer0-types:bitrate
|          +--ro available-baud-rate?
|          |          layer0-types:available-baud-rate
|          +--ro roll-off
|                     layer0-types:roll-off
+--ro if-supported-mode
|  +--ro number-of-modes-supported?           uint32
+--ro if-supported-modes*
|  +--ro mode-id                            string
|  +--ro (mode)
|     +--:(G.698.2)
|     |  +--ro standard-mode?          standard-mode
|     +--:(organizational-mode)
|     |  +--ro organizational-mode
|     |     +--ro operational-mode?
|     |     |       operational-mode
|     |     +--ro organization-identifier?
|     |     |       organization-identifier         string
|     |     +--ro available-fec-type?
|     |     |       layer0-types:fec-type
|     |     +--ro available-modulation-type?
|     |     |       layer0-types:modulation
|     |     +--ro available-baud-rate?
|     |             layer0-types:available-baud-rate
|     +--:(explicit-mode)
|        +--ro explicit-mode
|           +--ro supported-modes
|           |  +--ro supported-application-codes*
|           |  |       -> ../../../mode-id
|           |  +--ro supported-organizational-modes*
|           |          -> ../../../mode-id
|           +--ro line-coding-bitrate?
|           |          layer0-types:line-coding-bitrate
|           +--ro min-central-frequency?
|           |          layer0-types:frequency-thz
|           +--ro max-central-frequency?
|           |          layer0-types:frequency-thz
|           +--ro transceiver-tunability
|           |          layer0-types:frequency-ghz
|           +--ro min-channel-input-power?
```

```
|          |          layer0-types:rx-channel-power-min;
|          +--ro max-channel-input-power?
|          |          layer0-types:rx-channel-power-max
|          +--ro total-channel-output-power?
|          |          layer0-types:rx-total-power-max
|          +--ro min-osnr-margin?
|          |           layer0-types:min-osnr
|          +--ro q-margin?
|          |           layer0-types:min-q-factor
|          +--ro available-fec-type?
|          |           layer0-types:fec-type
|          +--ro fec-code-rate?
|          |           layer0-types:fec-code-rate
|          +--ro pre-fec-ber-threshold?         decimal64
|          +--ro number-of-lasers?                 uint32
|          +--ro min-laser-temperature?            int32
|          +--ro max-laser-temperature?            int32
|          +--ro chromatic-dispersion-penalty* []
|          |  +--ro chromatic-dispersion
|          |  |       layer0-types:chromatic-dispersion
|          |  +--ro penalty
|          |          layer0-types:penalty-value
|          +--ro polarization-dispersion-penalty* []
|          |  +--ro polarization-mode-dispersion
|          |  |    layer0-types:polarization-mode-dispersion
|          |  +--ro penalty
|          |          layer0-types:penalty-value
|          +--ro max-chromatic-dispersion?
|          |          layer0-types:max-chromatic-dispersion
|          +--ro max-diff-group-delay?
|          |.         layer0-types:max-diff-group-delay
|          |--ro max-polarization-dependent-loss-penalty*
|          +  +--ro max-polarization-dependent-loss?
|          |  |       layer0-types:power-in-db-or-null
|          |  +--ro penalty
|          |          layer0-types:penalty-value
|          +--ro available-modulation-type?
|          |          layer0-types:modulation
|          +--ro bitrate
|          |          layer0-types:bitrate
|          +--ro available-baud-rate?
|          |          layer0-types:available-baud-rate
|          +--ro roll-off
|                     layer0-types:roll-off
|
+--rw provisioning-opt-if-och-mode-params
   +--rw provisioning-opt-if-och-mode-params
      +--rw mode-id                          string
      +--rw central-frequency?
```

```
                |          layer0-types:frequency-thz
                +--rw channel-output-power?             dbm-t
                +--ro channel-input-power?              dbm-t
                +--ro total-input-power?                dbm-t
                +--rw number-of-tcas-supported?         uint32
                +--rw mode-list* [tca-type]
                |  +--rw tca-type      layer0-types:opt-if-och-tca-types
                |  +--rw min-threshold?   int32
                |  +--rw max-threshold?   int32
                +--ro cur-osnr?                 layer0-types:snr
                +--ro cur-q-factor?                      int32
                +--ro uncorrected-words?                 uint64
                +--ro pre-fec-ber?                     decimal64
                +--ro cd-pmd-penalty
                |          layer0-types:cd-pmd-penalty
                +--ro pdl-penalty
                |          layer0-types:pdl-penalty
                +--ro diff-group-delay       max-diff-group-delay


  notifications:
    +---n opt-if-och-central-frequency-change
    |  +--ro if-name?               -> /if:interfaces/interface/name
    |  +--ro new-opt-if-och-central-frequency
    |     +--ro central-frequency?   layer0-types:frequency-thz
    +---n opt-if-och-mode-change
    |  +--ro if-name?   -> /if:interfaces/interface/name
    |  +--ro mode-id?   string
    +---n opt-if-och-min-tca
       +--ro if-name?    -> /if:interfaces/interface/name
       +--ro tca-type?   opt-if-och-tca-types
```

5. Structure of the Yang Module

ietf-ext-xponder-wdm-if is a top level model for the support of this feature.

6. Yang Module

The ietf-ext-xponder-wdm-if is defined as an extension to ietf interfaces.

```
<CODE BEGINS> file "ietf-ext-xponder-wdm-if.yang"
module ietf-ext-xponder-wdm-if {
  namespace "urn:ietf:params:xml:ns:yang:ietf-ext-xponder-wdm-if";
  prefix ietf-ext-xponder-wdm-if;

  import ietf-interfaces {
```

```
      prefix if;
    }

    import ietf-layer0-types {
      prefix "l0-types";
    }

    import ietf-layer0-types-ext {
      prefix "l0-types-ext";
    }

    organization
      "IETF CCAMP Working Group";

    contact
      "WG Web:   <http://tools.ietf.org/wg/ccamp/>
       WG List:  <mailto:ccamp@ietf.org>


       Editor:   Dharini Hiremagalur
                 <mailto:dharinih@juniper.net>";

    description
      "This module contains a collection of YANG definitions for
       configuring Optical interfaces.

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       as authors of the code.  All rights reserved.

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       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 "2023-03-13" {
      description
        "Revision 1.9";
      reference
        "";
      }

    revision "2022-10-24" {
      description
        "Revision 1.8";
      reference
```

```
        "";
      }

    revision "2022-01-10" {
      description
        "Revision 1.7";
      reference
        "";
      }

    revision "2021-06-28" {
      description
        "Revision 1.6";
      reference
        "";
      }

    revision "2020-03-09" {
      description
        "Revision 1.5";
      reference
        "";
      }

    revision "2019-11-04" {
      description
        "Revision 1.4";
      reference
        "";
      }

    revision "2019-07-08" {
      description
        "Revision 1.3";
      reference
        "";
      }
      revision "2018-10-22" {
        description
          "Revision 1.2";
        reference
          "";
      }
      revision "2018-03-06" {
        description
          "Revision 1.1";
        reference
          "";
```

```
      }
      revision "2017-03-06" {
        description
          "Revision 1.0";
        reference
          "";
      }
      revision "2016-03-17" {
        description
          "Initial revision.";
        reference
          "";
      }
  <CODE ENDS>

  <CODE BEGINS>
     typedef opt-if-och-tca-types {
        type enumeration {
          enum max-laser-linewdt {
            description "The maximum laser linewidth";
          }
          enum min-tx-power-tca {
            description "The min tx power TCA";
          }
          enum max-tx-power-tca {
            description "The min tx power TCA";
          }
          enum min-rx-power-tca{
            description "The min tx power TCA";
          }
          enum max-rx-power-tca{
            description "The min tx power TCA";
          }
          enum max-pol-power-diff-tca{
            description "The power difference between polarization
            TCA";
          }
          enum max-pol-skew-diff-tca{
            description "The skew between the two polarization TCA";
          }
          enum min-frequency-offset-tca{
            description "Min Frequency offset TCA";
          }
          enum max-frequency-offset-tca{
            description "Max Frequency offset TCA";
          }
          enum min-osnr-tca{
            description "Min OSNR TCA";
```

```
          }
          enum max-osnr-tca{
            description "Max OSNR TCA";
          }
          enum min-laser-temperature-tca{
            description "The min tx power TCA";
          }
          enum max-laser-temperature-tca{
            description "Temperature TCA";
          }
          enum min-fec-ber-tca{
            description "Min Pre Fec BER TCA";
          }
          enum max-fec-ber-tca{
            description "Max Pre Fec BER TCA";
          }
          enum min-q-tca{
            description "Min Q TCA";
          }
          enum max-q-tca {
            description "Max Q TCA";
          }
        }
        description "The different types of TCA's";
      }

      grouping opt-if-och-power {
        description "Interface optical Power";

        leaf channel-output-power {
          type layer0-types:dbm-t;
          description "The output power for this interface in .01 dBm.
                       The setting of the output power is optional";
        }

        leaf channel-input-power {
          type layer0-types:dbm-t;
          config false;
          description "The current channel input power of this
          interface";
        }

        leaf total-input-power {
          type layer0-types:dbm-t;
          config false;
          description "The total input power of this interface";
        }
      }
```

```
      grouping opt-if-och-tca-thresholds {
        description "Thresholds for TCA's";
        leaf tca-type {
          type opt-if-och-tca-types;
          description  "type of the TCA eg TX Power";
        }
        leaf min-threshold {
          type int32;
          description "A TCA is generated if the variable is less than
                       this value";
        }
        leaf max-threshold {
          type int32;
          description "A TCA is generated if the variable is more than
                       this value";
        }
      }

      grouping opt-if-och-fec {
        description "FEC type / info";

        leaf available-fec-type {
          type identityref {
          base layer0-types:fec-type;
          }
          config false;
          description "Available FEC";
        }

        leaf fec-set {
          type identityref {
          base layer0-types:fec-type;
          }
          description "FEC provisioning";
        }
        leaf fec-code-rate {
          type layer0-types:fec-code-rate
          }
          config false;
          description "FEC-code-rate";
        }
        leaf pre-fec-ber-threshold {
          type decimal64 {
             fraction-digits 18;
          }
          description " FEC BER threshold";
        }
      }
```

```
      grouping opt-if-och-central-frequency {
        description "Interface Central Frequency";
        leaf central-frequency {
          type layer0-types:frequency-thz;
          description "This parameter indicates the frequency of this
                       interface ";
        }
      }

      grouping opt-if-och-modulation-params {
        description "Optical modulation parameters for the lane";

        leaf available-modulation-type {
          type identityref {
            base modulation;
          }
          config false;
          description
            "Modulation type the specific transceiver in the list
             can support";
        }
        leaf bitrate {
          type layer0-types:bitrate;
          units "Gbit/sec";
          config false;
          description
            "The gross bitrate (e.g.,100, 200) of the optical tributary
            signal.";
        }
        leaf available-baud-rate {
          type layer0-types:available-baud-rate;
          units Bd;
          config false;
          description
            "Baud-rate the specific transceiver in
            the list can support.
            Baud-rate is the unit for
            symbol rate or modulation rate
            in symbols per second or
            pulses per second.
            It is the number of distinct symbol
            changes (signal events) made to the
            transmission medium
            per second in a digitally
            modulated signal or a line code";
        }
        leaf roll-off {
          type layer0-types:roll-off
```

```
          config false;
          description
            "the roll-off factor (beta with values from 0 to 1)
            identifies how the real signal shape exceed
            the baud rate. If=0 it is exactly matching
            the baud rate.If=1 the signal exceeds the
            50% of the baud rate at each side.";
        }
      }

      grouping opt-if-och-lane-param {
        description "Optical parameters for the lane";

        leaf number-of-lasers {
          type uint32;
          config false;
          description "Number of optical lanes/lasers of the interf.";
        }
        leaf min-laser-temperature {
          type int32;
          units ".01C";
          config false;
          description "Minimum Laser Temperature of this mode for
                       this lane";
        }
        leaf max-laser-temperature {
          type int32;
          units ".01C";
          config false;
          description "Maximum Laser Temperature of this mode for
                       this lane";
        }
        leaf max-chromatic-dispersion {
          type layer0-types:max-chromatic-dispersion;
          config false;
          description "Maximum chromatic dispersion of this mode for
                       this lane";
        }
        leaf max-diff-group-delay  {
          type layer0-types:max-diff-group-delay;
          config false;
          description "Maximum Differential group delay of this mode
                       for this lane";
        }
        list max-polarization-dependent-loss-penalty {
          config false;
          description
            "Optional penalty associated with the maximum acceptable
```

```
            accumulated polarization dependent loss.
             This list of pair pdl and penalty can be used to
             sample the function pdl = f(penalty).";
          leaf max-polarization-dependent-loss {
            type layer0-types:power-in-db-or-null;
            config false;
            mandatory true;
            description
              "Maximum acceptable accumulated polarization dependent
              loss.";
          }
          uses penalty-value;
        }
      grouping chromatic-dispersion-penalty {
        description "list of chromatic dispersion and polarization
                     dispersion penalties";
        list cd-penalties {}
          key "penalties"
          description "list of CD penalties"
        }
        leaf chromatic-dispersion {
          type decimal64;
          config false;
          description "Chromatic Dispersion of this mode for
                       this lane";
        }
        leaf penalty-value {
          type decimal64;
          config false;
          description "penalty given by CD";
        }
      }


    grouping polarization-dispersion-penalty {
        description "list of polarization
                     dispersion penalties";
        list pmd-penalties {}
          key "penalties"
          description "list of PMD penalties"
        }
        leaf polarization-mode-dispersion {
          type decimal64;
          config false;
          description "Polarization Mode Dispersion";
        }
        leaf penalty-value {
          type decimal64;
```

```
          config false;
          description "penalty given by PMD";
        }
      }

      grouping opt-if-och-tca-list {
        description "List of TCA's";
        leaf number-of-tcas-supported {
          type uint32;
          description "Number of TCAs supported by this interface";
        }
        list mode-list {
          key "tca-type";
          description "List of the TCAs";
          uses opt-if-och-tca-thresholds;
        }
      }

      grouping opt-if-och-fec-tca-thresholds {
        description "Pre FEC BER Thresholds for TCA's";
        leaf min-fec-ber-threshold {
          type decimal64 {
          fraction-digits 18;
          }
          description "Min FEC BER threshold";
        }
        leaf max-fec-ber-threshold {
          type decimal64 {
            fraction-digits 18;
          }
          description "Max FEC BER threshold";
        }
      }

      grouping opt-if-och-mode-params  {
        description "OCh mode parameters";
        leaf mode-id {
          type string { length "1..255";}
          description "ID for the OCh mode template";
        }
        leaf min-osnr-margin {
          type layer0-types:min-osnr;
          units "dB";
          config false;
          description "OSNR margin to FEC threshold";
        }
        leaf q-margin {
          type layer0-types:min-q-factor;
```

```
            units "dB";
            config false;
            description "Q-Factor margin to FEC threshold";
          }
          uses opt-if-och-central-frequency;
          uses opt-if-och-power;
          uses opt-if-och-fec-tca-thresholds;
          uses opt-if-och-tca-list;
       }

      grouping opt-if-och-statistics {
        description "OCh statistics";
        leaf cur-osnr {
          type layer0-types:snr;
          units "dB";
          config false;
          description "OSNR margin to FEC threshold";
        }
        leaf cur-q-factor {
          type int32;
          units "dB";
          config false;
          description "Q-Factor of the interface";
        }
        leaf uncorrected-words {
          type uint64;
          config false;
          description "Post-FEC errored words";
        }
        leaf pre-fec-ber {
          type decimal64 {
            fraction-digits 18;
          }
          config false;
          description "Pre-FEC errored words";
        }
      }

      grouping opt-if-och-mode  {
        description "OCh mode template";

        leaf mode-id {
          type string { length "1..255"; }
          config false;
          description "ID for the OCh mode template";
        }
        leaf (G.698.2) {
          type strings;
```

```
          config false;
          description "This parameter indicates the application
                       identifier according to G.698.2";
         uses standard-mode;

        }
        leaf (organizational-mode) {
          type strings;
          config false;
          description "This parameter indicates the operational-mode
                       of different organization";
         uses organizational-modes;
        }

        leaf (explicit-mode) {
          type strings;
          config false;
          description "This parameter indicates the operational-mode
                       of different organization";
         uses explicit-modes;
        }


      grouping standard-mode {
        description "ITU-T G.698.2 application codes";

        leaf application-code {
          type string;
          description "ITU-T G.698.2 application code e.g. DScW-ytz(v)";
          }
        }


      grouping organizational-modes {
        description "this identifies the vendor or organization
                     operational mode including the Organization Unique
                     Identifier, the i/f part number";

        leaf operational-mode {
          type string;
          description "this string is defined by the oprganization or
                       the vendor";
        }
        leaf organization-identifier {
          type string;
          description "this string identified the OUI of the vendor or
                       the organization";
        }
```

```
      leaf part-number-identifier {
        type string;
        description "this string identified the optical interfaces
                     part number or name given by the vendor or
                     the organization";
      }
    }


    grouping explicit-modes  {
      description "interface explicit-modes";

      leaf min-central-frequency {
        type layer0-types:frequency-thz;
        config false;
        description
          "his parameter indicates the minimum frequency for
                     this template";
      }
      leaf max-central-frequency {
        type layer0-types:frequency-thz;
        config false;
        description "This parameter indicates the minimum frequency
                     for this template";
      }
      leaf transceiver-tunability {
        type layer0-types:frequency-ghz;
        config false;
        description
          "This parameter indicates the transmitter frequency fine
          tuning steps e.g 3.125GHz or 0.001GHz.";
      }
      leaf min-channel-input-power {
        type layer0-types:rx-channel-power-min;
        config false;
        description "The minimum input power of this interface";
      }
      leaf max-channel-input-power {
        type layer0-types:rx-channel-power-max;
        config false;
        description "The maximum input power of this interface";
      }
      leaf total-channel-output-power {
        type layer0-types:rx-total-power-max;
        config false;
        description "The total output power of this interface";
      }
      leaf osnr-margin {
```

```
        type layer0-types:snr;
        units "dB";
        config false;
        description "OSNR margin to FEC threshold";
      }
      leaf q-margin {
        type layer0-types:min-q-factor;
        units "dB";
        config false;
        description "Q-Factor margin to FEC threshold";
      }
      uses standard-mode;
      uses organizational-modes;
      uses opt-if-och-fec;
      uses opt-if-och-lane-param;
    }

    grouping opt-if-och-mode-list {
      description "List of Mode list group";

      leaf number-of-modes-supported {
        type uint32;
        description "Number of modes supported by this interface";
      }
      list mode-list {
        key "mode-id";
        description "List of the modes";
        uses opt-if-och-mode;
      }
    }

    notification opt-if-och-central-frequency-change {
      description "A change of Central Frequency has been detected";

      leaf "if-name" {
        type leafref { path "/if:interfaces/if:interface/if:name"; }
        description "Interface name";
      }
      container new-opt-if-och-central-frequency {
        description "The new Central Frequency of the interface";
        uses opt-if-och-central-frequency;
      }
    }

    notification opt-if-och-mode-change {
      description "A change of Mode Template has been detected";

      leaf "if-name" {
```

```
        type leafref { path "/if:interfaces/if:interface/if:name"; }
        description "Interface name";
      }
      leaf mode-id {
        type string { length "1..255"; }
        description  "ID for the OCh mode template";
      }
    }

    notification opt-if-och-min-tca {
      description "A min output TCA notification";

      leaf "if-name" {
        type leafref { path "/if:interfaces/if:interface/if:name"; }
        description "Interface name";
      }
      leaf tca-type {
        type opt-if-och-tca-types;
        description "Type of TCA for eg min tx power TCA";
      }
    }

    augment "/if:interfaces/if:interface" {
      description "Parameters for an optical interface";

      container optIfOChRsSs {
        description "RsSs path configuration for an interface";

        container if-current-mode {
          description "Current mode template of the interface";
          uses opt-if-och-mode;
        }
        container if-supported-mode {
          config false;
          description "Supported mode list of this interface";
          uses opt-if-och-mode-list;
        }
        container current-opt-if-och-mode-params {
          description "Current parameters of this interface";
            uses opt-if-och-mode-params;
            uses opt-if-och-statistics;
        }
      }
    }
  }
  <CODE ENDS>
```

7. Security Considerations

The YANG module defined in this memo is designed to be accessed via the NETCONF protocol [RFC6241]. he lowest NETCONF layer is the secure transport layer and the mandatory-to-implement secure transport is SSH [RFC6242]. The NETCONF access control model [RFC8341] provides the means to restrict access for particular NETCONF users to a pre-configured subset of all available NETCONF protocol operation and content.

// TEMPLATE TODO you should explicitly list by name any readable
// objects that are sensitive or vulnerable and the associated
// security risks should be spelled out (for instance, if they might
// reveal customer information or violate personal privacy laws such
// as those of the European Union if exposed to unathorized parties).

// TEMPLATE TODO The following three boilerplate paragraphs should
// not be changed without very good reason. Changes will almost
// certainly require justification during IESG review.

8. IANA Considerations

// TEMPLATE TODO In order to comply with IESG policy as set forth in
// http://www.ietf.org/ID-Checklist.html, every Internet-Draft that
// is submitted to the IESG for publication MUST contain an IANA
// Considerations section. The requirements for this section vary
// depending what actions are required of the IANA. See "Guidelines
// for Writing an IANA Considerations Section in RFCs" [RFC8126]. and
// see [RFC4181] section 3.5 for more information on writing an IANA
// clause for a MIB module internet draft.

This document registers a URI in the IETF XML registry [RFC3688]. Following the format in [RFC3688], the following registration is requested to be made:

URI: urn:ietf:params:xml:ns:yang:ietf-interfaces:ietf-ext-xponder-wdm-if

Registrant Contact: The IESG.

XML: N/A, the requested URI is an XML namespace.

This document registers a YANG module in the YANG Module Names registry [RFC6020].

This document registers a YANG module in the YANG Module Names registry [RFC6020].

prefix: ietf-ext-xponder-wdm-if reference: RFC XXXX

9. Acknowledgements

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Appendix A. Change Log

This optional section should be removed before the internet draft is submitted to the IESG for publication as an RFC.

Note to RFC Editor: please remove this appendix before publication as an RFC.

Appendix B. Open Issues

// TEMPLATE TODO This list of issues listed in this optional section
// should be cleared and removed, and this optional section should be
// removed before the internet draft is submitted to the IESG for
// publication as an RFC.

Note to RFC Editor: please remove this appendix before publication as an RFC.

Appendix C. Applicability examples

As an examample here below is the way and OpenROADM compliant equipment could be managed using the Yang models described in thei draft.

In OpenROADM MSA there is a limited number of DWDM interfaces supported. Basically only the 100G Staircase FEC and 400G oFEC are supported and these two kind of interfaces can be easily summarized with the "mode-id" and the "application-identifier" strings.

the models below are enough to identify the interface and few working parameters:

```
   module: ietf-ext-xponder-wdm-if
    augment /if:interfaces/if:interface:
       +--rw optIfOChRsSs
          +--rw if-current-mode
          |  +--ro mode-id?                          string
          |  +--ro application-identifier?           string
          .
          .
          .
          +--rw current-opt-if-och-mode-params
             +--rw mode-id?                           string
             +--rw central-frequency?                 frequency-thz
             +--rw channel-output-power?              dbm-t
             +--ro channel-input-power?               dbm-t
             .
             .
             .
             +--ro cur-osnr?                  layer0-types:snr
             +--ro cur-q-factor?                      int32
             +--ro uncorrected-words?                 uint64
             +--ro pre-fec-ber?                       decimal64
```

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