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# A YANG data model to manage configurable DWDM optical interfaces
draft-ietf-ccamp-dwdm-if-param-yang-15

## Abstract

This document 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 Forward Error Correction (FEC) codes including some not yet specified (or 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 document can be used for Optical Parameters monitoring and/or configuration of Dense Wavelength Division Multiplexing (DWDM) interfaces. The use of this model does not guarantee interworking of DWDM transceivers. 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 3 September 2026.



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## 1. Introduction

This document defines a YANG model for managing single channel optical interface parameters of coherent interfaces supporting Dense Wavelength Division Multiplexing (DWDM) applications, using the approach specified in [ITU-T_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-T_G.874.1], [ITU-T_G.698.2] and [ITU-T_G.959.1] may not always be available, mode templates are used. A mode template describes transceiver characteristics in detail and can be identified by a mode-id.

This document refers to [RFC7698] use cases and is aligned to the definition of [RFC9093] and its update in [I-D.ietf-ccamp-rfc9093-bis]. Finally, the models described in here are compliant with the models described in [I-D.ietf-ccamp-optical-impairment-topology-yang] and [I-D.ietf-ccamp-wdm-tunnel-yang].

The key concept introduced by this YANG model in accordance with documents [I-D.ietf-ccamp-optical-impairment-topology-yang] and [I-D.ietf-ccamp-rfc9093-bis] is the notion of a mode. A mode is a combination of parameters and parameter ranges that is supported by a transceiver. As an example, operating a device in Quadrature Phase Shift Keying (QPSK) modulation may use a different FEC and requires less Optical Signal to Noise Ratio (OSNR) than the same transceiver operating in 16 Quadrature Amplitude Modulation (QAM16). 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. As described in [I-D.ietf-ccamp-optical-impairment-topology-yang] and modeled in [I-D.ietf-ccamp-rfc9093-bis], the list of transceiver modes (properly classified in standard, organizational and explicit modes) provide information about the transmission capabilities of an optical DWDM interface. The same approach is used in this RFC to allow the device netconf agent to export such capabilities to the client controllers.

To advertise the capability supported by an interface, a list of transceiver modes is provided by the device for each dwdm coherent module (supported-modes).

The YANG model provides a configuration attribute named "configured-mode" as a means to provision the working mode of the interface from the supported-modes listed as capabilities. Once provisioned, wdm-if-config container provides the means to configure specific parameters at run time while wdm-if-status container allow to retrieve operational state information from the module as defined in

[ITU-T_G.7710]. For example, the frequency is a parameter that can be set within min/max boundaries defined in the current mode. Laser Temperature, RX/TX optical power, RX OSNR, etc. however are read-only parameters available at run-time that can be checked against the mode boundaries and may trigger events.

## 1.1. Terminology

Refer to [RFC6566], [RFC7698], and [ITU-T_G.807] for the key terms used in this document.

The following terms are defined in [RFC7950]

* client
* server
* augment
* data model
* data node

The following terms are defined in [RFC6241]

* configuration data
* state data

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

The term DWDM Network Element refers to a physical device, which is managed as a single network element, that has Dense Wavelength Division Multiplexing capabilities.

The term DWDM Link refers to a physical optical link (fiber pair) between two DWDM Network Elements where one or multiple channels are transmitted using Dense Wavelength Division Multiplexing technology.

The term DWDM interface refers to an interface, as defined and modelled in [RFC8343], that is capable to generate and receive a signal at a specific wavelength and suitable to be transmitted over a DWDM Link.

The term ROADM in this document refers to the term "multi-degree reconfigurable optical add/drop multiplexer (MD-ROADM)" as defined in [ITU-T_G.672].

### 1.2. Tree Diagram

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

### 1.3. 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 Table 1.

| Prefix | YANG module | Reference |
|---|---|---|
| wdm-if | ietf-wdm-interface | [RFCXXXX] |
| rev | ietf-yang-revisions | [I-D.ietf-netmod-yang-module-versioning] |
| if | ietf-interfaces | [RFC8343] |
| l0-types | ietf-layer0-types | [I-D.ietf-ccamp-rfc9093-bis] |

Table 1: Prefixes and corresponding YANG modules

[Note to RFC editor: Please replace XXXX with the number assigned to the RFC along the full document once this draft becomes an RFC.]

### 1.4. Conventions

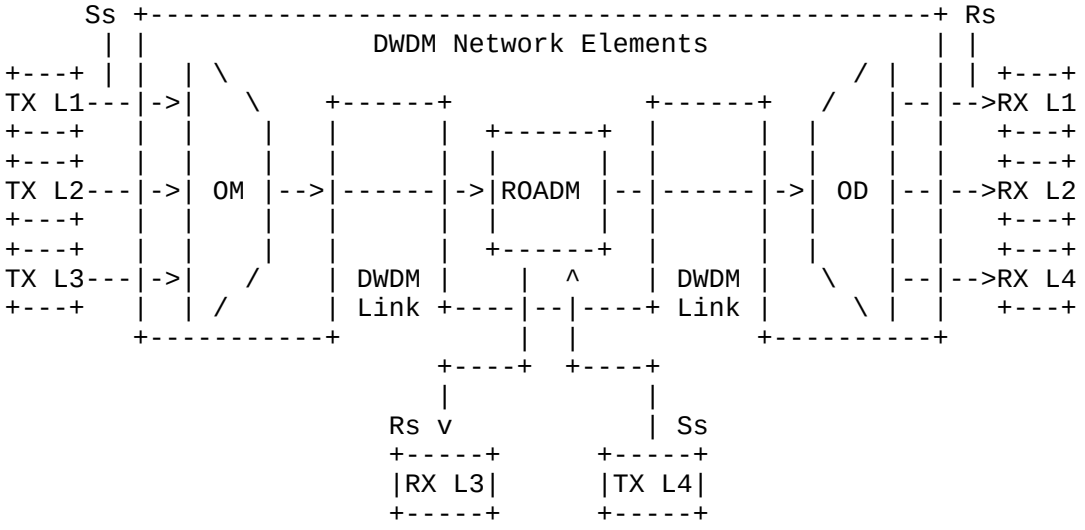
The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

This document is structured following the guidelines for documents containing YANG Data defined in [RFC8407] and its update in [I-D.ietf-netmod-rfc8407bis]

## 2. Module Description

### 2.1. Overview

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 ROADMs. Is to be noted that the TX L1 and RX L1 may be located outside the DWDM network and fitted in the packet layer network elements as pluggable modules.




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 Multiplexer

Figure 1: Transponder in WDM networks

from Fig. 5.1/[ITU-T_G.698.2]

This document introduces the ietf-wdm-interface model as an augment to the ietf-interface. It allows the client to set the operating mode of transceivers as well as other operational parameters. The YANG model also provide the container wdm-if-tca for the configuration of Threshold Crossing Alert (TCA) that can trigger stateless notification to supervise parameters and notify the client [ITU-T_G.8201].

### 2.2. YANG Module Classification

The model defined in this document is meant to be used as Device Model as per definition in [RFC8199] and [RFC8309]

### 2.3. Optical Parameters Description

The network architecture presented in Figure 1 is described in [ITU-T_G.698.2] section 5.2. The transponders are usually a combination of the TX and RX function in single interface, implementing the connectivity at Rs and Ss points in a bidirectional way.

Definitions of the optical parameters introduced in this document are listed in the YANG tree in Appendix A and described within the model definition in Section 3

### 2.4. Use Cases

The use cases are described in [I-D.ietf-ccamp-optical-impairment-topology-yang].

## 3. WDM Interface YANG Module

ietf-wdm-interface is a top level model that allow the configuration and monitoring of DWDM interfaces optical parameters. It is defined as an extension to ietf-interfaces.

```
<CODE BEGINS> file "ietf-wdm-interface.yang"
module ietf-wdm-interface {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-wdm-interface";
  prefix wdm-if;

  import ietf-yang-revisions {
    prefix "rev";
  }
  import ietf-interfaces {
    prefix if;
  }
```

```
     import ietf-layer0-types {
       prefix l0-types;
       rev:recommended-min-date 2025-11-03;
     }

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


        Editor: Dharini Hiremagalur <mailto:dharini.hiremagalur@hpe.com>
        Editor: Gabriele Galimberti <mailto:ggalimbe56@gmail.com>
        Editor: Gert Grammel <mailto:gert.grammel@hpe.com>
        Editor: Roberto Manzotti <mailto:rmanzott@cisco.com>";
     description
       "This module contains a collection of YANG definitions for
        configuring DWDM Optical interfaces.

        Copyright (c) 2025 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.

        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 (RFC 2119) (RFC 8174) when, and only when,
        they appear in all capitals, as shown here.";

     // RFC Ed. please:
     // - replace XXXX with actual RFC number of this document
     // - replace ZZZZ with the RFC number assigned to
     //   draft-ietf-ccamp-optical-impairment-topology-yang
     // - replace the revision date with the module publication date
     //   the format is (year-month-day)
     //
     // and finally delete this note.
```

```
    revision 2026-03-02 {
      description
        "Initial Version";
      reference
        "RFC XXXX: A YANG data model to manage configurable DWDM
         optical interfaces";
    }

    identity wdm-if-tca-type {
      description
        "The different types of Threshold Crossing Alert (TCA's)
         for DWDM Interfaces. Any augmentation of the list of
         tca-type MUST use this identity as base";
    }

    identity laser-linewdt-tca {
      base wdm-if-tca-type;
      description
        "The laser linewidth TCA";
    }

    identity tx-power-tca {
      base wdm-if-tca-type;
      description
        "The Interface Transmit power TCA";
    }

    identity rx-power-tca {
      base wdm-if-tca-type;
      description
        "The Interface Receive power TCA";
    }

    identity rx-pol-power-diff-tca {
      base wdm-if-tca-type;
      description
        "The X-Y power difference between the two polarizations TCA
         on the receiver interface";
    }

    identity rx-pol-skew-diff-tca {
      base wdm-if-tca-type;
      description
        "The X-Y skew between the two polarizations TCA on the
         receiver interface";
    }

    identity rx-cd-tca {
```

```
    base wdm-if-tca-type;
    description
      "The fiber chromatic dispersion (CD) TCA on the receiver
       interface";
  }

  identity rx-pmd-tca {
    base wdm-if-tca-type;
    description
      "The polarization mode dispersion (PMD) TCA on the receiver
       interface";
  }

  identity rx-pdl-tca {
    base wdm-if-tca-type;
    description
      "The polarization dependent loss (PDL) TCA on the receiver
       interface";
  }

  identity rx-frequency-offset-tca {
    base wdm-if-tca-type;
    description
      "The Frequency offset TCA ";
  }

  identity rx-osnr-tca {
    base wdm-if-tca-type;
    description
      "Optical Signal to Noise Ratio (OSNR) TCA on the receiver
       interface";
  }

  identity laser-temperature-tca {
    base wdm-if-tca-type;
    description
      "Laser temperature TCA on the transmiter laser";
  }

  identity rx-pre-fec-ber-tca {
    base wdm-if-tca-type;
    description
      "Pre-FEC Bit Error Rate (BER) TCA on the receiver
       interface";
  }

  identity rx-uncorrected-words-tca {
    base wdm-if-tca-type;
```

```
      description
        "Counter of Post-FEC uncorrected words TCA on the receiver
         interface";
    }

    identity rx-q-factor-tca {
      base wdm-if-tca-type;
      description
        "Q-factor TCA on the receiver interface";
    }

    grouping wdm-if-tca-thresholds {
      description
        "Thresholds for TCA's";
      leaf tca-type {
        type identityref {
          base wdm-if-tca-type;
        }
        mandatory true;
        description
          "type of the TCA that identify the
           performance measurement, eg tx-power-tca";
      }
      leaf tca-name {
        type string;
        mandatory true;
        description
          "A textual name of the TCA that explain its scope
           eg 'High-RX-Power'";
      }
      leaf raise-threshold {
        type l0-types:decimal-5;
        must 'current() != ../clear-threshold' {
          error-message
            "TCA raise and clear thresholds must be different";
        }
        mandatory true;
        description
          "A TCA is raised if the variable cross this threshold:
           - if raise-threshold is greater than clear-threshold
           the TCA is raised when the value exceed this threshold
           - if raise-threshold is smaller than clear-threshold, the
           TCA is raised when the value fall below this threshold";
      }
      leaf clear-threshold {
        type l0-types:decimal-5;
        must 'current() != ../raise-threshold' {
          error-message
```

```
            "TCA raise and clear thresholds must be different";
        }
        mandatory true;
        description
          "A TCA cleared when the variable cross this threshold:
           - if clear-threshold is smaller than raise-threshold
           the TCA is cleared when the value fall below this threshold
           - if clear-threshold is grater than raise-threshold, the
           TCA is cleared when the value exceed this threshold";
      }
    } // end grouping wdm-if-tca-threshold

    grouping wdm-if-tca-list {
      description
        "List of TCA's";
      leaf number-of-tcas-supported {
        type uint32;
        default "0";
        config false;
        description
          "Number of TCAs supported by this interface,
           if the implementation do not suport TCAs it SHALL leave this
           value to defualt = 0";
      }
      list tca-list {
        key "tca-id";
        description
          "List of the TCAs";
        leaf tca-id {
          type string;
          mandatory true;
          description
            "Unique Identifier of the TCA defined for the interface";
        }
        uses wdm-if-tca-thresholds;
      }
    } // end grouping wdm-if-tca-list

    grouping wdm-if-config {
      description
        "DWDM Interface Configuration parameters";
      leaf target-central-frequency {
        type l0-types:frequency-thz;
        description
          "This parameter indicates the interface Central Frequency
           configuration.";
        reference
          "ITU-T G.694.1 (10/2020): Spectral grids for WDM
```

```
            applications: DWDM frequency grid";
        }
        leaf target-tx-channel-power {
          type l0-types:power-dbm;
          description
            "This parameter indicates the terget configured TX channel
             optical power.";
        }
      } // end grouping wdm-if-node-params

      grouping wdm-if-operational {
        description
          "DWDM Interface Operational status data";
        leaf central-frequency {
          type l0-types:frequency-thz;
          config false;
          description
            "This parameter indicates the current interface Central
             Frequency.";
          reference
            "ITU-T G.694.1 (10/2020): Spectral grids for WDM
             applications: DWDM frequency grid";
        }
        leaf cur-osnr {
          type l0-types:snr-or-unknown;
          units "dB";
          default "unknown";
          config false;
          description
            "Current measured Optical Signal to Noise Ratio (OSNR),
             if not supported by the implementation SHALL
             not be present";
        }
        leaf min-osnr-margin {
          type l0-types:snr-or-unknown;
          default "unknown";
          config false;
          description
            "Optical Signal to Noise (OSNR) margin to FEC threshold, if
             not supported by the implementation SHALL remain undefined";
        }
        leaf q-margin {
          type l0-types:decimal-2-or-unknown;
          units "dB";
          default "unknown";
          config false;
          description
            "Q-factor margin to FEC threshold, if not supported by the
```

```
           implementationp SHALL remain undefined";
        reference
          "ITU-T O.201 (07/2003): Q-factor test equipment to estimate
                     the transmission performance of optical channels";
      }
      leaf q-factor {
        type l0-types:decimal-2-or-unknown;
        units "dB";
        default "unknown";
        config false;
        description
          "Current measured Q-factor of the interface,
           if not supported by the implementation SHALL
           not be present";
        reference
          "ITU-T O.201 (07/2003): Q-factor test equipment to estimate
                     the transmission performance of optical channels";
      }
      leaf uncorrected-words {
        type uint64;
        config false;
        description
          "Counter of Post-FEC uncorrected errored words,
           if not supported by the implementation SHALL
           not be present";
      }
      leaf pre-fec-ber {
        type l0-types:decimal-18-or-unknown;
        default "unknown";
        config false;
        description
          "Current measured Pre-FEC error rate,
           if not supported by the implementation SHALL
           not be present";
      }
      leaf chromatic-dispersion {
        type l0-types:decimal-2-or-unknown;
        units "ps/nm";
        default "unknown";
        config false;
        description
          "Chromatic ispersion (CD) on the receive,
           if not supported by the implementation SHALL
           not be present";
        reference
          "RFC ZZZZ: A YANG Data Model for Optical Impairment-aware
                     Topology, Section 2.4.6";
      }
```

```
        leaf polarization-mode-dispersion {
          type l0-types:decimal-2-or-unknown;
          units "ps";
          default "unknown";
          config false;
          description
            "Current polarization mode dispersion (PMD) on the receive,
             if not supported by the implementation SHALL
             not be present";
          reference
            "ITU-T G.666 (02/2011): Characteristics of polarization
                       mode dispersion compensators and of receivers that
                       compensate for polarization mode dispersion
             RFC ZZZZ: A YANG Data Model for Optical Impairment-aware
                       Topology, Section 2.4.6";
        }
        leaf polarization-dependent-loss {
          type l0-types:power-loss-or-unknown;
          default "unknown";
          config false;
          description
            "Current polarization dependent loss (PDL) on the receive,
             if not supported by the implementation SHALL
             not be present";
          reference
            "RFC ZZZZ: A YANG Data Model for Optical Impairment-aware
                       Topology, Section 2.4.6";
        }
      } // end grouping wdm-if-operational

      notification wdm-if-tca {
        description
          "A notification for a Threshold Crossing Alert (TCA)";
        leaf if-name {
          type leafref {
            path "/if:interfaces/if:interface/if:name";
          }
          mandatory true;
          description
            "Interface name";
        }
        leaf tca-type {
          type identityref {
            base wdm-if-tca-type;
          }
          mandatory true;
          description
            "The Type of TCA that have triggered the notification,
```

```
            e.g, tx-power-tca";
        }
        leaf tca-name {
          type string;
          mandatory true;
          description
            "A textual name of the TCA that have triggered the
             notification that explain its scope, eg 'TX Power Degrade'";
        }
      } // end notification wdm-if-tca

      augment "/if:interfaces" {
        description
          "Template definition for Optical Interface explicit-modes";
        container wdm-if-templates {
          config false;
          description
            "Optical Interface explicit-mode templates";
          container explicit-transceiver-modes {
            description
              "The top level container for the list of the
               transceivers' explicit modes.";
            list explicit-transceiver-mode {
              key "explicit-transceiver-mode-id";
              description
                "The list of the transceivers' explicit modes.";
              leaf explicit-transceiver-mode-id {
                type string {
                  length "64";
                }
                description
                  "The identifier of the transceivers' explicit mode.";
              }
              uses l0-types:explicit-mode;
            } // end list explicit-transceiver-mode
          } // end container explicit-transceiver-modes
        } // end container wdm-if-templates
      } // end augmentation interfaces

      augment "/if:interfaces/if:interface" {
        description
          "Parameters for an optical interface";
        container wdm-interface {
          description
            "Container for capabilities, configuration,
             current operational data for a DWDM interface";
          uses l0-types:transceiver-capabilities {
            augment "supported-modes/supported-mode/mode/"
```

```
              + "explicit-mode/explicit-mode" {
            description
              "Augment the explicit-mode container with the
               proper leafref.";
            leaf explicit-transceiver-mode-ref {
              type leafref {
                path "../../../../../../wdm-if:wdm-if-templates"
                   + "/wdm-if:explicit-transceiver-modes"
                   + "/wdm-if:explicit-transceiver-mode"
                   + "/wdm-if:explicit-transceiver-mode-id";
              }
              config false;
              mandatory true;
              description
                "The reference to the explicit transceiver
                 mode template.";
            } // end explicit-transceiver-mode-ref
          } // end augmentation explicit-mode
        } // end uses l0-types:transceiver-capabilities
        container wdm-if-config {
          description
            "Configuration parameters of this interface";
          leaf configured-mode {
            type union {
              type empty;
              type leafref {
                path "../../supported-modes/supported-mode/mode-id";
                require-instance false;
              }
            }
            default "empty";
            description
              "Reference to the configured mode for transceiver
               compatibility approach.

               The empty value is used to report that no mode has
               been configured and there is no default mode.

               When not present, the configured-mode is not reported
               by the server, this means the interface is not
               configured";
          }
          uses wdm-if-config;
        } // end container wdm-if-config
        container wdm-if-tcas {
          description
            "Threshold Crossing Alerts definition and configuration";
          uses wdm-if-tca-list;
```

```
        } // end of container wdm-if-tcas
        container wdm-if-status {
          config false;
          description
            "Current operationa status parameters of this interface";
          uses l0-types:common-transceiver-param {
            refine "tx-channel-power" {
              config false;
            }
            refine "line-coding-bitrate" {
              config false;
            }
          }
          uses wdm-if-operational;
        } // end container wdm-if-status
      } // end container wdm-interface
    } // end augmentation interface

  }
  <CODE ENDS>
```

## 4. Security Considerations

This section is modeled after the template described in Section 3.7 of [RFC8407] and the update in document [I-D.ietf-netmod-rfc8407bis].

The "ietf-wdm-interface" YANG module defines a data model that is designed to be accessed via YANG-based management protocols, such as NETCONF [RFC6241] and RESTCONF [RFC8040]. These protocols have to use a secure transport layer (e.g., SSH [RFC4252], TLS [RFC8446], and QUIC [RFC9000]) and have to use mutual authentication.

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.

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). All writable data nodes are likely to be reasonably sensitive or vulnerable in some network environments. Write operations (e.g., edit-config) and delete operations to these data nodes without proper protection or authentication can have a negative effect on network operations.

There are no particularly sensitive writable data nodes.

There are no particularly sensitive readable data nodes.

## 5. IANA Considerations

This document registers the following namespace URIs in the IETF XML registry [RFC3688]:

```
---------------------------------------------------------------------
URI: urn:ietf:params:xml:ns:yang:ietf-wdm-interface
Registrant Contact: The IESG.
XML: N/A, the requested URI is an XML namespace.
---------------------------------------------------------------------
```

This document registers the following YANG modules in the YANG Module Names registry [RFC7950]:

```
---------------------------------------------------------------------
name:      ietf-wdm-interface
namespace: urn:ietf:params:xml:ns:yang:ietf-wdm-interface
prefix:    wdm-if
reference: RFC XXXX (TDB)
---------------------------------------------------------------------
```

## 6. Acknowledgements

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## Appendix A. YANG Tree

```
  module: ietf-wdm-interface

    augment /if:interfaces:
      +--ro wdm-if-templates
         +--ro explicit-transceiver-modes
            +--ro explicit-transceiver-mode*
                    [explicit-transceiver-mode-id]
               +--ro explicit-transceiver-mode-id        string
               +--ro line-coding-bitrate?                identityref
               +--ro bitrate?                            uint16
               +--ro max-diff-group-delay?               decimal-2
               +--ro max-chromatic-dispersion?           decimal-2
               +--ro cd-penalty* [cd-value]
               |  +--ro cd-value         decimal-2
               |  +--ro penalty-value    union
               +--ro max-polarization-mode-dispersion?   decimal-2
               +--ro pmd-penalty* [pmd-value]
               |  +--ro pmd-value        decimal-2
               |  +--ro penalty-value    union
               +--ro max-polarization-dependent-loss
               |       power-loss-or-unknown
               +--ro pdl-penalty* [pdl-value]
               |  +--ro pdl-value        power-loss
```

```
            |  +--ro penalty-value    union
            +--ro available-modulation-type?          identityref
            +--ro min-osnr?                           snr
            +--ro rx-ref-channel-power?               power-dbm
            +--ro rx-channel-power-penalty* [rx-channel-power-value]
            |  +--ro rx-channel-power-value    power-dbm
            |  +--ro penalty-value             union
            +--ro min-q-factor?                       decimal-2
            +--ro available-baud-rate?                decimal64
            +--ro roll-off?                           decimal64
            +--ro min-carrier-spacing?                frequency-ghz
            +--ro available-fec-type?                 identityref
            +--ro fec-code-rate?                      decimal64
            +--ro fec-threshold?                      decimal64
            +--ro in-band-osnr?                       snr
            +--ro out-of-band-osnr?                   snr
            +--ro tx-polarization-power-difference?   power-ratio
            +--ro polarization-skew?                  decimal-2
    augment /if:interfaces/if:interface:
      +--rw wdm-interface
         +--ro supported-modes!
         |  +--ro supported-mode* [mode-id]
         |     +--ro mode-id                     string
         |     +--ro (mode)
         |        +--:(g.698.2)
         |        |  +--ro g.698.2
         |        |     +--ro standard-mode               standard-mode
         |        |     +--ro line-coding-bitrate*        identityref
         |        |     +--ro transceiver-tuning-range
         |        |     |  +--ro min-central-frequency?
         |        |     |  |       frequency-thz
         |        |     |  +--ro max-central-frequency?
         |        |     |  |       frequency-thz
         |        |     |  +--ro transceiver-tunability-granularity?
         |        |     |          frequency-ghz
         |        |     +--ro tx-channel-power-min?       power-dbm
         |        |     +--ro tx-channel-power-max?       power-dbm
         |        |     +--ro rx-channel-power-min?       power-dbm
         |        |     +--ro rx-channel-power-max?       power-dbm
         |        |     +--ro rx-total-power-max?         power-dbm
         |        +--:(organizational-mode)
         |        |  +--ro organizational-mode
         |        |     +--ro operational-mode
         |        |     |       operational-mode
         |        |     +--ro organization-identifier
         |        |     |       organization-identifier
         |        |     +--ro line-coding-bitrate*        identityref
         |        |     +--ro transceiver-tuning-range
```

```
          |        |     |  +--ro min-central-frequency?
          |        |     |  |       frequency-thz
          |        |     |  +--ro max-central-frequency?
          |        |     |  |       frequency-thz
          |        |     |  +--ro transceiver-tunability-granularity?
          |        |     |          frequency-ghz
          |        |     +--ro tx-channel-power-min?       power-dbm
          |        |     +--ro tx-channel-power-max?       power-dbm
          |        |     +--ro rx-channel-power-min?       power-dbm
          |        |     +--ro rx-channel-power-max?       power-dbm
          |        |     +--ro rx-total-power-max?         power-dbm
          |        +--:(explicit-mode)
          |           +--ro explicit-mode
          |              +--ro transceiver-tuning-range
          |              |  +--ro min-central-frequency?
          |              |  |       frequency-thz
          |              |  +--ro max-central-frequency?
          |              |  |       frequency-thz
          |              |  +--ro transceiver-tunability-granularity?
          |              |          frequency-ghz
          |              +--ro tx-channel-power-min?
          |              |       power-dbm
          |              +--ro tx-channel-power-max?
          |              |       power-dbm
          |              +--ro rx-channel-power-min?
          |              |       power-dbm
          |              +--ro rx-channel-power-max?
          |              |       power-dbm
          |              +--ro rx-total-power-max?
          |              |       power-dbm
          |              +--ro compatible-modes
          |              |  +--ro supported-application-code*
          |              |  |       -> ../../../../supported-mode/mode-id
          |              |  +--ro supported-organizational-mode*
          |              |          -> ../../../../supported-mode/mode-id
          |              +--ro explicit-transceiver-mode-ref    leafref
          +--rw wdm-if-config
          |  +--rw configured-mode?            union
          |  +--rw target-central-frequency?   l0-types:frequency-thz
          |  +--rw target-tx-channel-power?    l0-types:power-dbm
          +--rw wdm-if-tcas
          |  +--ro number-of-tcas-supported?   uint32
          |  +--rw tca-list* [tca-id]
          |     +--rw tca-id             string
          |     +--rw tca-type           identityref
          |     +--rw tca-name           string
          |     +--rw raise-threshold    l0-types:decimal-5
          |     +--rw clear-threshold    l0-types:decimal-5
```

```
         +--ro wdm-if-status
            +--ro line-coding-bitrate?            identityref
            +--ro tx-channel-power?               power-dbm-or-unknown
            +--ro rx-channel-power?               power-dbm-or-unknown
            +--ro rx-total-power?                 power-dbm-or-unknown
            +--ro central-frequency?
            |       l0-types:frequency-thz
            +--ro cur-osnr?
            |       l0-types:snr-or-unknown
            +--ro min-osnr-margin?
            |       l0-types:snr-or-unknown
            +--ro q-margin?
            |       l0-types:decimal-2-or-unknown
            +--ro q-factor?
            |       l0-types:decimal-2-or-unknown
            +--ro uncorrected-words?              uint64
            +--ro pre-fec-ber?
            |       l0-types:decimal-18-or-unknown
            +--ro chromatic-dispersion?
            |       l0-types:decimal-2-or-unknown
            +--ro polarization-mode-dispersion?
            |       l0-types:decimal-2-or-unknown
            +--ro polarization-dependent-loss?
                    l0-types:power-loss-or-unknown

    notifications:
      +---n wdm-if-tca
         +--ro if-name     -> /if:interfaces/interface/name
         +--ro tca-type    identityref
         +--ro tca-name    string
```

## Appendix B. Threshold crossing example

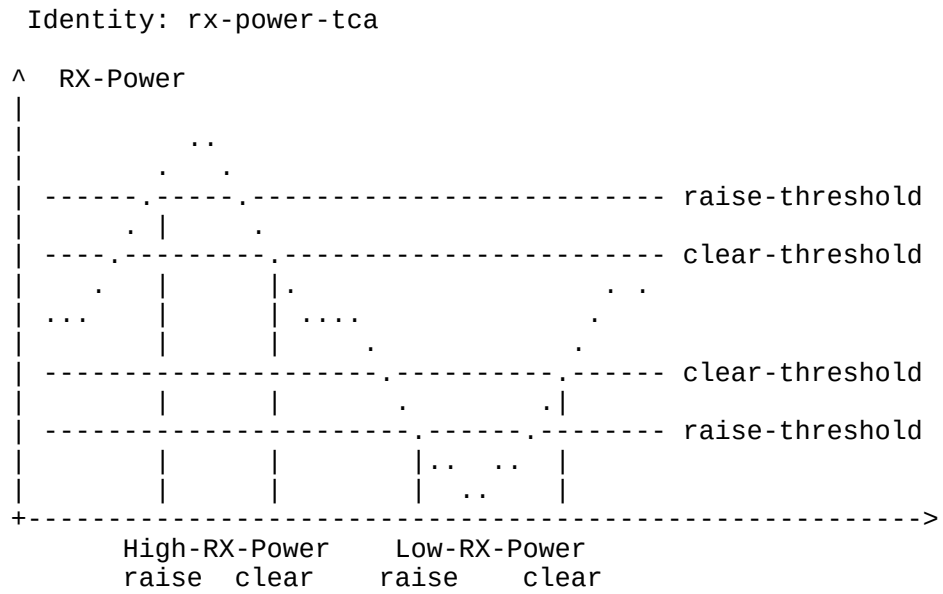


Figure 2: Example of Threshold crossing

Threshold Crossing Alarm use a hysteresis mechanism. To avoid ambiguity and TCA flipping the rise and clear thresholds are always mandatory. A check on the proper value must be done carefully. E.g. the Low-RX-Power alarm has the raise-threshold < clear-threshold while the High-RX-Power alarm has raise-threshold > clear-threshold.

## Appendix C. Applicability examples

As an example here below is the way an OpenROADM compliant equipment could be managed using the YANG models described in this document.

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-wdm-interface
    augment /if:interfaces/if:interface:
       +--rw wdm-interface
          +--rw wdm-if-config
          |  +--rw configured-mode?            union
          |  +--rw target-central-frequency?   l0-types:frequency-thz
          |  +--rw target-tx-channel-power?    l0-types:power-dbm
          +--ro wdm-if-status
             +--ro cur-osnr?
             +--ro q-factor?
             |       l0-types:decimal-2-or-unknown
             +--ro uncorrected-words?              uint64
             +--ro pre-fec-ber?
```

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