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G. Galimberti, Ed.
Nokia
D. Hiremagalur, Ed.
G. Grammel, Ed.
Juniper
R. Manzotti, Ed.
Cisco
D. Breuer, Ed.
DEUTSCHE TELEKOM AG
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A YANG data model to manage configurable DWDM optical interfaces
draft-ietf-ccamp-dwdm-if-param-yang-14

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 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 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.

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1. Introduction

This memo defines a YANG model for managing single channel optical interface parameters of coherent interfaces supporting 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-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 draft refers to [RFC7698] use cases and is aligned to the definition of [RFC9093] and its update in I-D [I-D.ietf-ccamp-rfc9093-bis]. Finally, the models described in this draft 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 I-D [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 QPSK modulation may use a different FEC and requires less OSNR than the same transceiver operating in QAM16 modulation. 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 of document Appendix C. The meaning of the symbols in these diagrams is defined in [RFC8340].

1.3. Conventions

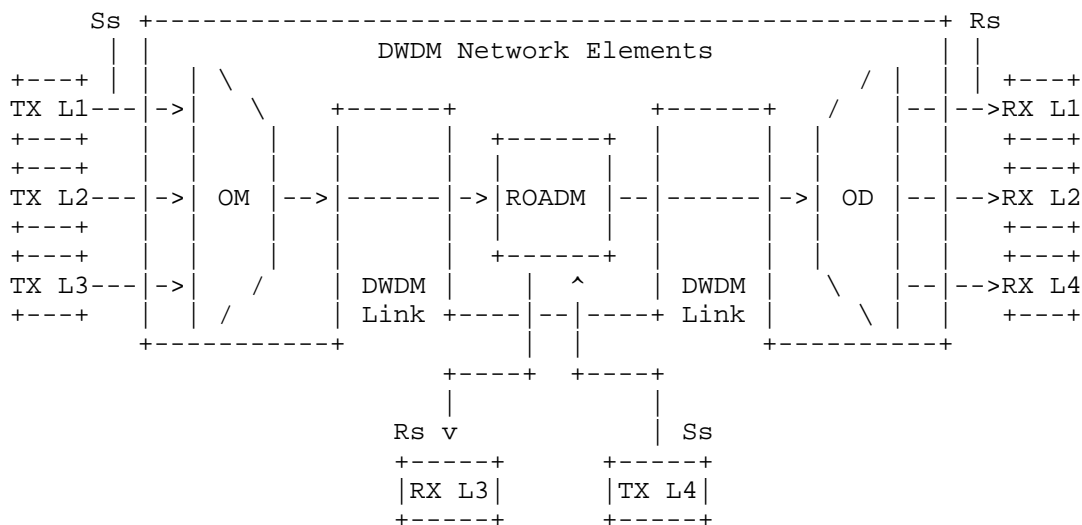
The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

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. It 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/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.

2.2. YANG Module Classification

The model defined in this RFC 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 C and described within the model definition in Section 3

2.4. Use Cases

The use cases are described in draft-ietf-ccamp-optical-impairment-topology-yang, draft-ietf-teas-actn-poi-applicability and draft-poidt-ccamp-actn-poi-pluggable-usecases-gaps.

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-interfaces {
    prefix if;
  }

  import ietf-layer0-types {
    // Requires at least revision 2025-10-10
    // will update with rev:recommended-min-date 2025-xx-yy;
    // once RFC9093bis get published
    prefix "l0-types";
  }

  organization
    "IETF CCAMP Working Group";

  contact
    "WG Web:   <https://datatracker.ietf.org/wg/ccamp/>
    WG List:  <mailto:ccamp@ietf.org>
```

Editor: Dharini Hiremagalur <mailto:dharinih@juniper.net>
Editor: Gabriele Galimberti <mailto:ggalimbe56@gmail.com>
Editor: Gert Grammel <mailto:ggrammel@juniper.net>
Editor: Roberto Manzotti <mailto:rmanzott@cisco.com>;

description

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

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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.: replace XXXX with actual RFC number and remove
// this note
// replace the revision date with the module publication date
// the format is (year-month-day)

revision "2025-10-17" {
  description
    "v1.0 Initial Version";
  reference
    "RFC XXXX: A YANG data model to manage configurable DWDM
    optical interfaces";
  // RFC Ed.: replace XXXX with actual RFC number, update date
  // information and remove this note
}
```

```
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 transmitter 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 'TX Power Degrade'";
}
leaf raise-threshold {
    type l0-types:decimal-5;
    mandatory true;
    description
        "A TCA is raised if the variable cross this threshold:
        - if raise-threshold is greater than clear-threshold
        (or clear threshold is not defined), the TCA
        is raised when the value exceed the threshold
        - if raise-threshold is smaller that clear-threshold, the
        TCA is raised when the value fall below the threshold
        - if clear-threshold is not defined the TCA raise and clear
        on the same raise-threshold";
}
leaf clear-threshold {
    type l0-types:decimal-5;
    description
        "A TCA cleared when the variable cross the threshold in the
        direction defined for raise-threshold.
        If clear-threshold is not defined the TCA raise and cleare
        on the same raise-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 default = 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.";
    }

    leaf target-tx-channel-power {
        type l0-types:power-dbm;
        description
            "This parameter indicates the target 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.";
    }

    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 remaoin 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;
          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";
          }
        }
        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
} // end module
<CODE ENDS>

```

4. Security Considerations

This section is modeled after the template described in Section 3.7 of [RFC8407] and the update in draft [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. The following subtrees and data nodes have particular sensitivities/vulnerabilities:

```
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
```

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

Italo Busi
Huawei Technologies
Email: Italo.Busi@huawei.com

7. Contributors

Ruediger Kunze
Deutsche Telekom
Winterfeldtstr. 21-27
10781 Berlin
Germany
+491702275321
RKunze@telekom.de

Dean Bogdanovic
Westford
U.S.A.
email ivandean@gmail.com

Bernd Zeuner
Deutsche Telekom
Darmstadt
Germany
email B.Zeuner@telekom.de

Massimiliano Salsi
Juniper Networks
Sunnyvale, CA, 94089
U.S.A.
email msalsi@google.com

Manuel Paul
Deutsche Telekom
Berlin
Germany
email Manuel.Paul@telekom.de

Walid Wakim
Nokia
ILLINOIS
UNITED STATES
email wakims@mac.com

Hing-Kam Lam
Fhusa
USA
kam.lam@fhusainc.com

Sergio Belotti
Nokia
Via Energy Park
20871 Vimercate (MB)

Italy
Sergio.belotti@nokia.com

Andreas Burk
Architekt Network Automation CTO Board
lund1
Versatel Deutschland GmbH Solmsstr. 73
D-60486 Frankfurt am Main
+49 69 21789246
Andreas.Burk@lund1.net

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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. 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?  10-types:frequency-thz
|      +--rw target-tx-channel-power?   10-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   10-types:decimal-5
|      +--rw clear-threshold?  10-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?
  |      10-types:frequency-thz
  +--ro cur-osnr?
  |      10-types:snr-or-unknown
  +--ro min-osnr-margin?
  |      10-types:snr-or-unknown
  +--ro q-margin?
  |      10-types:decimal-2-or-unknown
  +--ro q-factor?
  |      10-types:decimal-2-or-unknown
  +--ro uncorrected-words?      uint64
  +--ro pre-fec-ber?
  |      10-types:decimal-18-or-unknown
  +--ro chromatic-dispersion?
  |      10-types:decimal-2-or-unknown
  +--ro polarization-mode-dispersion?
  |      10-types:decimal-2-or-unknown
  +--ro polarization-dependent-loss?
  |      10-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 D. Applicability examples

As an example here below is the way an OpenROADM compliant equipment could be managed using the YANG models described in this 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-wdm-interface
  augment /if:interfaces/if:interface:
    +--rw wdm-interface
      +--rw wdm-if-config
        |   +--rw configured-mode?          union
        |   +--rw target-central-frequency?  10-types:frequency-thz
        |   +--rw target-tx-channel-power?   10-types:power-dbm
      +--ro wdm-if-status
        +--ro cur-osnr?
        +--ro q-factor?
        |   10-types:decimal-2-or-unknown
        +--ro uncorrected-words?             uint64
        +--ro pre-fec-ber?
```

Authors' Addresses

Gabriele Galimberti (editor)
Nokia
Via Melgacciata 13 c
20813 - Bovisio Masciago
Italy
Phone: +393357481947
Email: ggalimbe56@gmail.com

Dharini Hiremagalur (editor)
Juniper
1133 Innovation Way
Sunnyvale - 94089 California,
United States of America
Email: dharinih@juniper.net

Gert Grammel (editor)
Juniper
Oskar-Schlemmer Str. 15
80807 Muenchen
Germany
Phone: +49 1725186386
Email: ggrammel@juniper.net

Roberto Manzotti (editor)
Cisco
Santa Maria Molgora 48 C
20871 Vimercate
Italy

Phone: +390392091280
Email: rmanzott@cisco.com

Dirk Breuer (editor)
DEUTSCHE TELEKOM AG
Winterfeldtstr 21
10781 Berlin
Germany
Phone: +4930835358828
Email: d.breuer@telekom.de