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A YANG model to manage the optical interface parameters for an external transponder in a WDM network
draft-dharini-ccamp-dwdm-if-param-yang-00

Abstract

This memo defines a Yang model related to the Optical Transceiver optical parameters characterising the 100G and above interfaces. 100G and above Transceivers support coherent transmission, different modulation format, multiple FEC algorithms not yet specified by ITU-T G.698.2 [ITU.G698.2] or any other ITU-T recommendation. The use cases and the state of the Coherent transceivers is well describe in draft-many-coherent-DWDM-if-control.

The Yang model defined in this memo can be used for Optical Parameters monitoring and/or configuration of the endpoints of the multi-vendor IaDI optical link.

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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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 is to support the optical parameters specified in ITU-T G.698.2 [ITU.G698.2], plus some parameters related to full coherent transmission and not yet specified by ITU-T like modulation format, finer Grid provisioning, multiple carrier, etc. The application identifiers specified in ITU-T G.874.1 [ITU.G874.1] and the Optical Power at Transmitter and Receiver side. Note that G.874.1 encompasses vendor-specific codes, which if used would make the interface a single vendor IaDI and could still be managed.

[Editor’s note: In G.698.2 this corresponds to the optical path from point S to R; network media channel is also used and explained in draft-ietf-ccamp-flexi-grid-fwk-02]

Management will be performed at the edges of the network media channel (i.e., at the transmitters and receivers attached to the S and R reference points respectively) for the relevant parameters specified in G.698.2 [ITU.G698.2], G.798 [ITU.G798], G.874 [ITU.G874], and the performance parameters specified in G.7710/Y.1701 [ITU-T G.7710] and G.874.1 [ITU.G874.1].

G.698.2 [ITU.G698.2] is primarily intended for metro applications that include optical amplifiers. Applications are defined in G.698.2 [ITU.G698.2] using optical interface parameters at the single-channel connection points between optical transmitters and the optical multiplexer, as well as between optical receivers and the optical demultiplexer in the DWDM system. This Recommendation uses a methodology which does not explicitly specify the details of the optical network between reference point Ss and Rs, e.g., the passive and active elements or details of the design. The Recommendation currently includes unidirectional DWDM applications at 2.5 and 10 Gbit/s (with 100 GHz and 50 GHz channel frequency spacing). Work is still under way for 40, 100 and Higher Gbit/s interfaces. There is possibility for extensions to a lower channel frequency spacing. This document specifically refers also to the "application code" defined in the G.698.2 [ITU.G698.2] and included in the Application Identifier defined in G.874.1 [ITU.G874.1] and G.872 [ITU.G872], plus a few optical parameters not included in the G.698.2 application code specification.

This draft refers and supports the draft-ietf-ccamp-dwdm-if-mng-ctrl-fwk and draft-many-coherent-DWDM-if-control.

The building of a yang model describing and extending the optical parameters defined in G.698.2 [ITU.G698.2], and reflected in G.874.1 [ITU.G874.1], allows the different vendors and operator to retrieve, provision and exchange information across the G.698.2 multi-vendor IaDI in a standardised way. In addition to the parameters specified in ITU recommendations the Yang models support also the "vendor specific application identifier", the Tx and Rx power at the Ss and Rs points and the channel frequency and the detailed parameters described in G.698.2 extending them to the new 100G and higher coherent interfaces..

The Yang Model, reporting the Optical parameters and their values, characterizes the features and the performances of the optical components and allow a reliable link design in case of multi vendor optical networks.

2. The Internet-Standard Management Framework

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

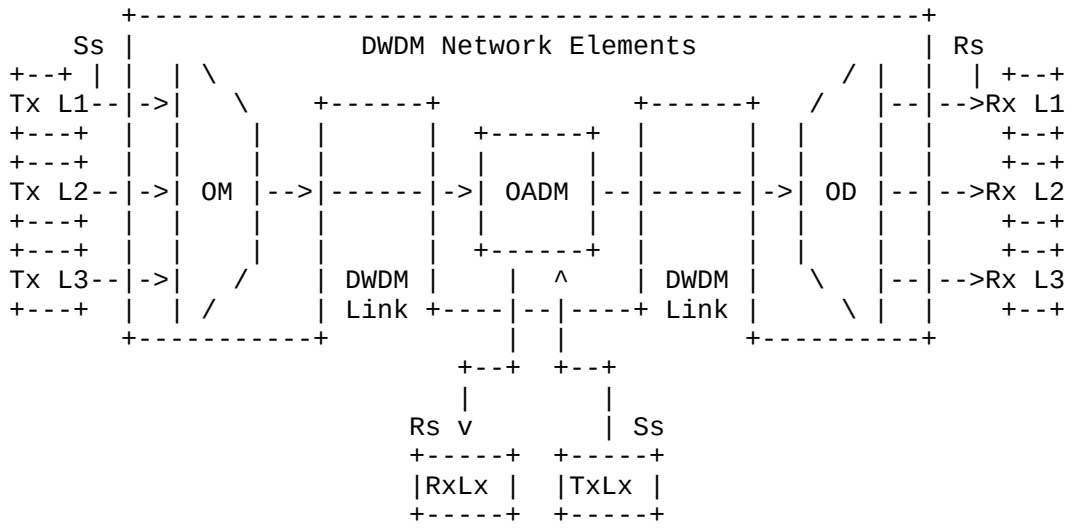
This memo specifies a Yang model for optical interfaces.

3. Conventions

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

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 and an OD (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
OADM = Optical Add Drop Mux

from Fig. 5.1/G.698.2

Figure 1: External transponder in WDM netwoks

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. The set of parameters that could be managed are defined by the "application code" notation

The definitions of the optical parameters are provided below to increase the readability of the document, where the definition is

ended by (R) the parameter can be retrieve with a read, when (W) it can be provisioned by a write, (R,W) can be either read or written.

4.1.1. Table of Application Codes

This table has a list of Application codes supported by this interface at point R are defined in G.698.2.

Application code Identifier:
The Identifier for the Application code.

Application code Type:
This parameter indicates the transceiver type of application code at Ss and Rs as defined in [ITU.G874.1], that is used by this interface Standard = 0, PROPRIETARY = 1
If Proprietary the first 6 octets of the printable string will be the OUI (organizationally unique identifier) assigned to the vendor whose implementation generated the Application Identifier Code.

Application code:
This is the application code that is defined in G.698.2 or the vendor generated code which has the OUI.

Number of Single-channel application codes Supported:
This parameter indicates the number of Single-channel application codes supported by this interface

Application code Length:
The number of octets in the Application Code.

4.1.2. Rs-Ss Configuration and operating parameters

The Rs-Ss configuration table allows configuration of Central Frequency, Power and Application codes as described in [ITU.G698.2] and G.694.1 [ITU.G694.1] and other parameters related to new high speed coherent interfaces.

Number of subcarriers:
This parameter indicates the number of subcarriers available for the super-channel in case the Transceiver can support multipla carrier Circuits.

Current Laser Output power:
This parameter report the current Transceiver Output power, it can be either a setting and measured value (R/W).

Central frequency (see G.694.1 Table 1):
This parameter indicates the Central frequency value that Ss and Rs will be set to work (in THz). See the details in Section 6/ G.694.1 or based on "n" and "k" values in case of multicarrier transceivers (R/W).

Central frequency franularity:
This parameter indicates the Central frequency granularity supported by the transceiver, this value is combined with K and n value to calculate the central frequency on the carrier or sub-carriers (R).

Current Laser Input power:
This parameter report the current Transceiver Input power (G).

Minimum channel spacing:
This is the minimum nominal difference in frequency (in GHz) between two adjacent channels (or carriers) depending on the Transceiver characteristics (R).

Bit rate / Baud rate of optical tributary signals:
Optical tributary signal bit (for NRZ signals) rate or Symbol (for Multiple bit per symbol) rate .

FEC Coding:
This parameter indicate what Forward Error Correction (FEC) code is used at Ss and Rs (R/W) (not mentioned in G.698). .

Maximum bit error ratio (BER):
This parameter indicate the maximum Bit error rate can be supported by the application at the Receiver. In case of FEC applications it is intended after the FEC correction (R) .

Wavelength Range (see G.694.1): [ITU.G694.1]
This parameter indicate minimum and maximum wavelength spectrum (R) in a definite wavelength Band (L, C and S).

Modulatoin format:
This parameter indicates the list of supported Modulation Formats and the provisioned Modulation Format. (R/W).

Inter carrier skew:
This parameter indicates, in case of multi-carrier transceivers the maximum skew between the sub-carriers supported by the transceiver (R).

4.2. Parameters at Ss

The following parameters for the interface at point S are defined in G.698.2 [ITU.G698.2].

Maximum and minimum mean channel 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. It is defined as the rhange (Max and Min) of the parameter (R/W)

Minimum and maximum central frequency:
The central frequency is the nominal single-channel frequency (in THz) on which the digital coded information of the particular optical channel is modulated by use of the NRZ line code. The central frequencies of all channels within an application lie on the frequency grid for the minimum channel spacing of the application given in ITU-T Rec. G.694.1. This parameter give the Maximum and minimum frequency interval the channel must be modulated (R)

Maximum spectral excursion:
This is the maximum acceptable difference between the nominal central frequency (in GHz) of the channel and the minus 15 dB points of the transmitter spectrum furthest from the nominal central frequency measured at point Ss. (R)

Maximum transmitter (residual) dispersion OSNR penalty (B.3/G.959.1) [ITU.G959.1]
Defines a reference receiver that this penalty is measured with. Lowest OSNR at Ss with worst case (residual) dispersion minus the Lowest OSNR at Ss with no dispersion. Lowest OSNR at Ss with no dispersion (R)

Minimum side mode suppression ratio, Minimum channel extinction ratio, Eye mask:
Although are defined in G.698.2 are not supported by this draft (R).

Current Laser Output power:
This parameter report the current Transceiver Output power, it can be either a setting and measured value (R/W) NEED TO DISCUSS ON THIS.

4.3. Interface at point Rs

The following parameters for the interface at point R are defined in G.698.2.

4.3.1. Mandatory parameters

Maximum and minimum mean input power:
The maximum and minimum values of the average received power (in dBm) at point Rs. (R)

Minimum optical signal-to-noise ratio (OSNR):
The minimum optical signal-to-noise ratio (OSNR) is the minimum value of the ratio of the signal power in the wanted channel to the highest noise power density in the range of the central frequency plus and minus the maximum spectral excursion (R)

Receiver OSNR tolerance:
The receiver OSNR tolerance is defined as the minimum value of OSNR at point Rs that can be tolerated while maintaining the maximum BER of the application. (R)

Maximum reflectance at receiver:
Although is defined in G.698.2, this parameter is not supported by this draft (R).

4.3.2. Optional parameters

Current Chromatic Dispersion (CD):
Residual Chromatic Dispersion measuread at Rx Transceiver port (R).

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

Current Quality factor (Q):
"Q" factor estimated at Rx Transceiver port (R).

4.3.3. Optical path from point Ss to Rs

The following parameters for the optical path from point S and R are defined in G.698.2 and are covered by draft-ggalimbe-ccamp-iv-yang [ITU.G698.2].

4.4. Use Cases

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

4.5. 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 application code/vendor transceiver class/ Central frequency and the output power. The module can also be used to get the list of supported application codes/transceiver class and also the Central frequency/output power/input power of the interface.

```
     module: ietf-ext-xponder-wdm-if
     augment /if:interfaces/if:interface:
         +--rw optIfOChRsSs
               +--rw if-current-application-code
               |  +--rw application-code-id    uint8
               |  +--rw application-code-type  uint8
               |  +--rw application-code-length uint8
               |  +--rw application-code?     string
               +--ro if-supported-application-codes
               |  +--ro number-application-codes-supported?   uint32
               |  +--ro application-codes-list* [application-code-id]
               |     +--ro application-code-id   uint8
               |     +--rw application-code-type  uint8
               |     +--rw application-code-length uint8
               |     +--ro application-code?    string
               +--rw output-power?                    int32
               +--ro input-power?                     int32
               +--rw central-frequency?               uint32


      notifications:
     +---n opt-if-och-central-frequency-change
     |  +--ro if-name?      leafref
     |  +--ro new-central-frequency
     |     +--ro central-frequency?   uint32
     +---n opt-if-och-application-code-change
     |  +--ro if-name?              leafref
     |  +--ro new-application-code
     |     +--ro application-code-id?   uint8
     |     +--rw application-code-type  uint8
     |     +--rw application-code-length uint8
     |     +--ro application-code?     string
```

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;
        }

        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.

           Copyright (c) 2016 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 Simplified
           BSD License set forth in Section 4.c of the IETF Trust's
           Legal Provisions Relating to IETF Documents
           (http://trustee.ietf.org/license-info).";

       revision "2016-03-17" {
              description
                  "Initial revision.";
              reference
                  "";
       }




         grouping opt-if-och-application-code  {
```

```
                description "Application code entity.";
                leaf application-code-id {
                   type uint8 {
                         range "1..255";
                   }
                   description
                         "Id for the Application code";
                }
                leaf application-code-type {
                   type uint8 {
                         range "0..1";
                }
                  description
                         "Type for the Application code
                           0 - Standard, 1 - Proprietory
                           When the Type is Proprietory, then the
                           first 6 octets of the application-code
                           will be the OUI (organizationally unique
                           identifier)";

                }
                leaf application-code-length {
                   type uint8 {
                         range "1..255";
                   }
                   description
                         "Number of octets in the Application code";

                }
                leaf application-code {
                   type string {
                         length "1..255";
                   }
                   description "This parameter indicates the
                        transceiver application code at Ss and Rs as
                        defined in [ITU.G698.2] Chapter 5.3, that
                        is/should be used by this interface.
                        The optIfOChApplicationsCodeList has all the
                        application codes supported by this
                        interface.";

                }
         }

        typedef dbm-t {
          type decimal64 {
            fraction-digits 2;
            range "-50..-30 | -10..5 | 10000000";
```

```
          }
          description "
            Amplifier Power in dBm ";
        }
         grouping opt-if-och-application-code-list {
           description "List of Application codes group.";
           leaf number-application-codes-supported {
               type uint32;
               description "Number of Application codes
                            supported by this interface";
            }
           list application-code-list {
               key "application-code-id";
               description "List of the application codes";
               uses opt-if-och-application-code;
           }
         }


        grouping opt-if-och-power {
           description "Interface optical Power";
           leaf output-power {
               type int32;
               units ".01dbm";
               description "The output power for this interface in
                            .01 dBm.
                            The setting of the output power is
                             optional";
           }

           leaf input-power {
                type int32;
                units ".01dbm";
                config false;
                description "The current input power of this
                      interface";
           }
        }

     grouping channel-ITU {
     description "channel-ITU";
     container channel-t {
           description "wavelength notation according to RFC-6205";
            leaf grid {
              type uint32;
              description "grid type e.g.: 0=reserved, 1=DWDM, 2=CWDM";
            }
            leaf channel-spacing {
```

```
              type uint32;
              description "DWDM grid e.g.: 1=100GHz, 2=50GHz, 3=25GHz";
            }
            leaf identifier {
              type uint32;
              description "Channel identifier";
            }
            leaf n {
              type uint32;
              description "N Value (Channel n-m notation)";
            }
          }
        }

      grouping channel-flex {
        description "channel-flex";
        container channel-n-m {
          description "Channel N / M Notation to describe the
                       MEdiachannel";
           leaf grid {
             type uint32;
              description "grid type e.g.: 0=reserved, 1=DWDM, 2=CWDM";
             }
           leaf channel-spacing {
             type uint32;
              description "DWDM grid e.g.: 1=100GHz, 2=50GHz, 3=25GHz";
        }
           leaf n {
              type uint32;
               description "N Value (Channel n-m notation)";
        }
           leaf m {
             type uint32;
                description "M Value (Channel n-m notation)";
          }
        }
      }


      grouping feasibility-limit-list {
        list feasibility-limit {
          key "id";
          description "Feasibility limit power / osnr pair";
          leaf id {
            type uint32;
            description "Unique Identifier";
          }
          leaf power {
```

```
            type decimal64 {
              fraction-digits 2;
            }
            units "dB";
            description "Feasibility power";
          }
          leaf osnr {
            type decimal64 {
              fraction-digits 2;
            }
            description "Feasibility Signal / Noise";
          }
        }
        description "
          Ordered list of feasibility limits
          (should match order of supported FEC types
          given in fec-type-list).
        ";

      }

      grouping power-failure-low-alarm-grp {
        description "
          Optical Power failure alarm ";
          leaf power-failure-low {
          type dbm-t;
          units "dBm";
          default -1;
          description "Power Failure Low Value";
        }
      }

          grouping opt-if-och-central-frequency {
            description "Interface Central Frequency";
              leaf  central-frequency {
                type uint32;
                description "This parameter indicate This parameter
                        indicates the frequency of this interface ";

               }
         }


          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-application-code-change {
            description "A change of Application code has been
                         detected.";
            leaf "if-name" {
                type leafref {
                    path "/if:interfaces/if:interface/if:name";
                }
                description "Interface name";
            }
            container new-application-code {
               description "The new application code for the
                   interface";
               uses opt-if-och-application-code;
            }
         }



         augment "/if:interfaces/if:interface" {
           description "Parameters for an optical interface";
           container optIfOChRsSs {
              description "RsSs path configuration for an interface";
              container if-current-application-code {
                   description "Current Application code of the
                                interface";
                   uses opt-if-och-application-code;
               }

               container if-supported-application-codes {
                   config false;
                   description "Supported Application codes of
                                the interface";
                   uses opt-if-och-application-code-list;
               }

               uses opt-if-och-power;
```

```
              uses opt-if-och-central-frequency;

            }
          }
        }
```

<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 [RFC6536] provides the means to restrict access for particular NETCONF users to a pre-configured subset of all available NETCONF protocol operation and content.

8. IANA Considerations

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

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