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RFC 9093
A YANG Data Model for Layer 0 Types

Abstract

This document defines a collection of common data types and groupings in the YANG data modeling language. These derived common types and groupings are intended to be imported by modules that model Layer 0 optical Traffic Engineering (TE) configuration and state capabilities such as Wavelength Switched Optical Networks (WSONs) and flexi-grid Dense Wavelength Division Multiplexing (DWDM) networks.

Status of This Memo

This is an Internet Standards Track document.

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Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at https://www.rfc-editor.org/info/rfc9093.

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Acknowledgements

Contributors

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1. Introduction

YANG [RFC7950] is a data modeling language used to model configuration data, state data, Remote Procedure Calls, and notifications for network management protocols such as the Network Configuration Protocol (NETCONF) [RFC6241]. The YANG language supports a small set of built-in data types and provides mechanisms to derive other types from the built-in types.

This document introduces a collection of common data types derived from the built-in YANG data types. The derived types and groupings are designed to be the common types applicable for modeling Traffic Engineering (TE) features as well as non-TE features (e.g., physical network configuration aspects) for Layer 0 optical networks in model(s) defined outside of this document. The applicability of Layer 0 types specified in this document includes Wavelength Switched Optical Networks (WSONs) [RFC6163] [ITU-Tg6982] and flexi-grid Dense Wavelength Division Multiplexing (DWDM) networks [RFC7698] [ITU-Tg6941].

1.1. Terminology and Notations

Refer to [RFC7446] and [RFC7581] for the key terms used in this document, and the terminology for describing YANG data models can be found in [RFC7950].

The YANG data model in this document conforms to the Network Management Datastore Architecture defined in [RFC8342].

1.2. Prefix 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.

Prefix	YANG module	Reference
l0-types	ietf-layer0-types	RFC 9093

Table 1: Data Node Names

The YANG module "ietf-layer0-types" (defined in Section 3) references [RFC4203], [RFC6163], [RFC6205], [RFC7698], [RFC7699], [RFC8363], [ITU-Tg6941], and [ITU-Tg6942].

2. Layer 0 Types Module Contents

This document defines a YANG module for common Layer 0 types, ietf-layer0-types. This module is used for WSON and flexi-grid DWDM networks. The "ietf-layer0-types" module contains the following YANG reusable types and groupings:

l0-grid-type:
: A base YANG identity for the grid type as defined in [RFC6163] and [RFC7698].

dwdm-ch-spc-type:
: A base YANG identity for the DWDM channel-spacing type as defined in [RFC6205].

cwdm-ch-spc-type:
: A base YANG identity for the Coarse Wavelength Division Multiplexing (CWDM) channel-spacing type as defined in [RFC6205].

wson-label-start-end:
: The WSON label range was defined in [RFC6205], and the generic topology model defines the label-start/label-end in [RFC8795]. This grouping shows the WSON-specific label-start and label-end information.

wson-label-hop:
: The WSON label range was defined in [RFC6205], and the generic topology model defines the label-hop in [RFC8795]. This grouping shows the WSON-specific label-hop information.

l0-label-range-info:
: A YANG grouping that defines the Layer 0 label range information applicable for WSON as defined in [RFC6205]. This grouping is used in the flexi-grid DWDM by adding more flexi-grid-specific parameters.

wson-label-step:
: A YANG grouping that defines label steps for WSON as defined in [RFC8776].

flexi-grid-label-start-end:
: The flexi-grid label range was defined in [RFC7698], and the generic topology model defines the label-start/label-end in [RFC8795]. This grouping shows the flexi-grid-specific label-start and label-end information.

flexi-grid-label-hop:
: The flexi-grid label range was defined in [RFC7698], and the generic topology model defines the label-hop in [RFC8795]. This grouping shows the WSON-specific label-hop information.

flexi-grid-label-range-info:
: A YANG grouping that defines flexi-grid label range information as defined in [RFC7698] and [RFC8363].

flexi-grid-label-step:
: A YANG grouping that defines flexi-grid label steps as defined in [RFC8776].

3. YANG Module for Layer 0 Types

```
<CODE BEGINS> file "ietf-layer0-types@2021-08-13.yang"

module ietf-layer0-types {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-layer0-types";
  prefix l0-types;

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

     Editor: Haomian Zheng
       <mailto:zhenghaomian@huawei.com>

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     Editor: Victor Lopez
       <mailto:victor.lopez@nokia.com>

     Editor: Daniel King
       <mailto:d.king@lancaster.ac.uk>";

  description
    "This module defines Optical Layer 0 types.  This module
     provides groupings that can be applicable to Layer 0
     Fixed Optical Networks (e.g., CWDM (Coarse Wavelength
     Division Multiplexing) and DWDM (Dense Wavelength Division
     Multiplexing)) and flexi-grid optical networks.

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     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
     (https://trustee.ietf.org/license-info).

     This version of this YANG module is part of RFC 9093; see
     the RFC itself for full legal notices.";

  revision 2021-08-13 {
    description
      "Initial version";
    reference
      "RFC 9093: A YANG Data Model for Layer 0 Types";
  }

  typedef dwdm-n {
    type int16;
```

```
    description
      "The given value 'N' is used to determine the nominal central
       frequency.

       The nominal central frequency, 'f', is defined by:
         f = 193100.000 GHz + N x channel spacing (measured in GHz),

       where 193100.000 GHz (193.100000 THz) is the ITU-T 'anchor
       frequency' for transmission over the DWDM grid, and where
       'channel spacing' is defined by the dwdm-ch-spc-type.";
    reference
      "RFC6205: Generalized Labels for Lambda-Switch-Capable (LSC)
       Label Switching Routers,
       ITU-T G.694.1 (10/2020): Spectral grids for WDM applications:
       DWDM frequency grid";
  }

  typedef cwdm-n {
    type int16;
    description
      "The given value 'N' is used to determine the nominal central
       wavelength.

       The nominal central wavelength is defined by:
         Wavelength = 1471 nm + N x channel spacing (measured in nm)

       where 1471 nm is the conventional 'anchor wavelength' for
       transmission over the CWDM grid, and where 'channel spacing'
       is defined by the cwdm-ch-spc-type.";
    reference
      "RFC 6205: Generalized Labels for Lambda-Switch-Capable (LSC)
       Label Switching Routers,
       ITU-T G.694.2 (12/2003): Spectral grids for WDM applications:
       CWDM wavelength grid";
  }

  typedef flexi-n {
    type int16;
    description
      "The given value 'N' is used to determine the nominal central
       frequency.

       The nominal central frequency, 'f', is defined by:
         f = 193100.000 GHz + N x channel spacing (measured in GHz),

       where 193100.000 GHz (193.100000 THz) is the ITU-T 'anchor
       frequency' for transmission over the DWDM grid, and where
       'channel spacing' is defined by the flexi-ch-spc-type.

       Note that the term 'channel spacing' can be substituted by the
       term 'nominal central frequency granularity' defined in
       clause 8 of ITU-T G.694.1.";
    reference
      "RFC 7698: Framework and Requirements for GMPLS-Based Control
       of Flexi-Grid Dense Wavelength Division Multiplexing (DWDM)
       Networks,
       ITU-T G.694.1 (10/2020): Spectral grids for WDM applications:
       DWDM frequency grid";
```

```
  }

  typedef flexi-m {
    type uint16;
    description
      "The given value 'M' is used to determine the slot width.

       A slot width is defined by:
         slot width = M x SWG (measured in GHz),

       where SWG is defined by the flexi-slot-width-granularity.";
    reference
      "RFC 7698: Framework and Requirements for GMPLS-Based Control
       of Flexi-Grid Dense Wavelength Division Multiplexing (DWDM)
       Networks.
       ITU-T G.694.1 (10/2020): Spectral grids for WDM applications:
       DWDM frequency grid";
  }

  identity l0-grid-type {
    description
      "Layer 0 grid type";
    reference
      "RFC 6163: Framework for GMPLS and Path Computation Element
       (PCE) Control of Wavelength Switched Optical Networks (WSONs),
       ITU-T G.694.1 (10/2020): Spectral grids for WDM applications:
       DWDM frequency grid,
       ITU-T G.694.2 (12/2003): Spectral grids for WDM applications:
       CWDM wavelength grid";
  }

  identity flexi-grid-dwdm {
    base l0-grid-type;
    description
      "Flexi-grid";
    reference
      "RFC 7698: Framework and Requirements for GMPLS-Based Control
       of Flexi-Grid Dense Wavelength Division Multiplexing (DWDM)
       Networks,
       ITU-T G.694.1 (10/2020): Spectral grids for WDM applications:
       DWDM frequency grid";
  }

  identity wson-grid-dwdm {
    base l0-grid-type;
    description
      "DWDM grid";
    reference
      "RFC 6163:Framework for GMPLS and Path Computation Element
       (PCE) Control of Wavelength Switched Optical Networks (WSONs),
       ITU-T G.694.1 (10/2020): Spectral grids for WDM applications:
       DWDM frequency grid";
  }

  identity wson-grid-cwdm {
    base l0-grid-type;
    description
      "CWDM grid";
```

```
    reference
      "RFC 6205: Generalized Labels for Lambda-Switch-Capable (LSC)
       Label Switching Routers,
       ITU-T G.694.2 (12/2003): Spectral grids for WDM applications:
       CWDM wavelength grid";
  }

  identity dwdm-ch-spc-type {
    description
      "DWDM channel-spacing type";
    reference
      "RFC 6205: Generalized Labels for Lambda-Switch-Capable (LSC)
       Label Switching Routers,
       ITU-T G.694.1 (10/2020): Spectral grids for WDM applications:
       DWDM frequency grid";
  }

  identity dwdm-100ghz {
    base dwdm-ch-spc-type;
    description
      "100 GHz channel spacing";
  }

  identity dwdm-50ghz {
    base dwdm-ch-spc-type;
    description
      "50 GHz channel spacing";
  }

  identity dwdm-25ghz {
    base dwdm-ch-spc-type;
    description
      "25 GHz channel spacing";
  }

  identity dwdm-12p5ghz {
    base dwdm-ch-spc-type;
    description
      "12.5 GHz channel spacing";
  }

  identity flexi-ch-spc-type {
    description
      "Flexi-grid channel-spacing type";
    reference
      "RFC 7698: Framework and Requirements for GMPLS-Based Control
       of Flexi-Grid Dense Wavelength Division Multiplexing (DWDM)
       Networks,
       ITU-T G.694.1 (10/2020): Spectral grids for WDM applications:
       DWDM frequency grid";
  }

  identity flexi-ch-spc-6p25ghz {
    base flexi-ch-spc-type;
    description
      "6.25 GHz channel spacing";
  }
```

```
  identity flexi-slot-width-granularity {
    description
      "Flexi-grid slot width granularity";
  }

  identity flexi-swg-12p5ghz {
    base flexi-slot-width-granularity;
    description
      "12.5 GHz slot width granularity";
  }

  identity cwdm-ch-spc-type {
    description
      "CWDM channel-spacing type";
    reference
      "RFC 6205: Generalized Labels for Lambda-Switch-Capable (LSC)
       Label Switching Routers,
       ITU-T G.694.2 (12/2003): Spectral grids for WDM applications:
       CWDM wavelength grid";
  }

  identity cwdm-20nm {
    base cwdm-ch-spc-type;
    description
      "20nm channel spacing";
  }

  /* Groupings. */

  grouping wson-label-start-end {
    description
      "The WSON label-start or label-end used to specify WSON label
       range.";
    choice grid-type {
      description
        "Label for DWDM or CWDM grid";
      case dwdm {
        leaf dwdm-n {
          when "derived-from-or-self(../../../grid-type,
                \"wson-grid-dwdm\")" {
            description
              "Valid only when grid type is DWDM.";
          }
          type l0-types:dwdm-n;
          description
            "The central frequency of DWDM.";
          reference
            "RFC 6205: Generalized Labels for Lambda-Switch-Capable
             (LSC) Label Switching Routers";
        }
      }
      case cwdm {
        leaf cwdm-n {
          when "derived-from-or-self(../../../grid-type,
                \"wson-grid-cwdm\")" {
            description
              "Valid only when grid type is CWDM.";
          }
```

```
          type l0-types:cwdm-n;
          description
            "Channel wavelength computing input.";
          reference
            "RFC 6205: Generalized Labels for Lambda-Switch-Capable
             (LSC) Label Switching Routers";
        }
      }
    }
    reference
      "RFC 6205: Generalized Labels for Lambda-Switch-Capable (LSC)
       Label Switching Routers";
  }

  grouping wson-label-hop {
    description
      "Generic label-hop information for WSON";
    choice grid-type {
      description
        "Label for DWDM or CWDM grid";
      case dwdm {
        choice single-or-super-channel {
          description
            "single or super channel";
          case single {
            leaf dwdm-n {
              type l0-types:dwdm-n;
              description
                "The given value 'N' is used to determine the
                 nominal central frequency.";
            }
          }
          case super {
            leaf-list subcarrier-dwdm-n {
              type l0-types:dwdm-n;
              description
                "The given values 'N' are used to determine the
                 nominal central frequency for each subcarrier
                 channel.";
              reference
                "ITU-T Recommendation G.694.1: Spectral grids for
                 WDM applications: DWDM frequency grid";
            }
          }
        }
      }
      case cwdm {
        leaf cwdm-n {
          type l0-types:cwdm-n;
          description
            "The given value 'N' is used to determine the nominal
             central wavelength.";
          reference
            "RFC 6205: Generalized Labels for Lambda-Switch-Capable
             (LSC) Label Switching Routers";
        }
      }
    }
```

```
    reference
      "RFC 6205: Generalized Labels for Lambda-Switch-Capable (LSC)
       Label Switching Routers";
  }

  grouping l0-label-range-info {
    description
      "Information about Layer 0 label range.";
    leaf grid-type {
      type identityref {
        base l0-grid-type;
      }
      description
        "Grid type";
    }
    leaf priority {
      type uint8;
      description
        "Priority in Interface Switching Capability Descriptor
         (ISCD).";
      reference
        "RFC 4203: OSPF Extensions in Support of Generalized
         Multi-Protocol Label Switching (GMPLS)";
    }
    reference
      "RFC 6205: Generalized Labels for Lambda-Switch-Capable (LSC)
       Label Switching Routers";
  }

  grouping wson-label-step {
    description
      "Label step information for WSON";
    choice l0-grid-type {
      description
        "Grid type: DWDM, CWDM, etc.";
      case dwdm {
        leaf wson-dwdm-channel-spacing {
          when "derived-from-or-self(../../grid-type,
                \"wson-grid-dwdm\")" {
            description
              "Valid only when grid type is DWDM.";
          }
          type identityref {
            base dwdm-ch-spc-type;
          }
          description
            "Label-step is the channel spacing (GHz), e.g., 100.000,
             50.000, 25.000, or 12.500 GHz for DWDM.";
          reference
            "RFC 6205: Generalized Labels for Lambda-Switch-Capable
             (LSC) Label Switching Routers";
        }
      }
      case cwdm {
        leaf wson-cwdm-channel-spacing {
          when "derived-from-or-self(../../grid-type,
                \"wson-grid-cwdm\")" {
            description
```

```
              "Valid only when grid type is CWDM.";
          }
          type identityref {
            base cwdm-ch-spc-type;
          }
          description
            "Label-step is the channel spacing (nm), i.e., 20 nm
             for CWDM, which is the only value defined for CWDM.";
          reference
            "RFC 6205: Generalized Labels for Lambda-Switch-Capable
             (LSC) Label Switching Routers";
        }
      }
    }
    reference
      "RFC 6205: Generalized Labels for Lambda-Switch-Capable (LSC)
       Label Switching Routers,
       ITU-T G.694.2 (12/2003): Spectral grids for WDM applications:
       CWDM wavelength grid";
  }

  grouping flexi-grid-label-start-end {
    description
      "The flexi-grid label-start or label-end used to specify
       flexi-grid label range.";
    leaf flexi-n {
      type l0-types:flexi-n;
      description
        "The given value 'N' is used to determine the nominal
         central frequency.";
    }
    reference
      "RFC 7698: Framework and Requirements for GMPLS-Based Control
       of Flexi-Grid Dense Wavelength Division Multiplexing (DWDM)
       Networks";
  }

  grouping flexi-grid-frequency-slot {
    description
      "Flexi-grid frequency slot grouping.";
    uses flexi-grid-label-start-end;
    leaf flexi-m {
      type l0-types:flexi-m;
      description
        "The given value 'M' is used to determine the slot width.";
    }
    reference
      "RFC 7698: Framework and Requirements for GMPLS-Based Control
       of Flexi-Grid Dense Wavelength Division Multiplexing (DWDM)
       Networks";
  }

  grouping flexi-grid-label-hop {
    description
      "Generic label-hop information for flexi-grid";
    choice single-or-super-channel {
      description
        "single or super channel";
```

```
      case single {
        uses flexi-grid-frequency-slot;
      }
      case super {
        list subcarrier-flexi-n {
          key "flexi-n";
          uses flexi-grid-frequency-slot;
          description
            "List of subcarrier channels for flexi-grid super
             channel.";
        }
      }
    }
    reference
      "RFC 7698: Framework and Requirements for GMPLS-Based Control
       of Flexi-Grid Dense Wavelength Division Multiplexing (DWDM)
       Networks";
  }

  grouping flexi-grid-label-range-info {
    description
      "Flexi-grid-specific label range related information";
    uses l0-label-range-info;
    container flexi-grid {
      description
        "flexi-grid definition";
      leaf slot-width-granularity {
        type identityref {
          base flexi-slot-width-granularity;
        }
        default "flexi-swg-12p5ghz";
        description
          "Minimum space between slot widths. Default is 12.500
           GHz.";
        reference
          "RFC 7698: Framework and Requirements for GMPLS-Based
           Control of Flexi-Grid Dense Wavelength Division
           Multiplexing (DWDM) Networks";
      }
      leaf min-slot-width-factor {
        type uint16 {
          range "1..max";
        }
        default "1";
        description
          "A multiplier of the slot width granularity, indicating
           the minimum slot width supported by an optical port.

           Minimum slot width is calculated by:
             Minimum slot width (GHz) =
               min-slot-width-factor * slot-width-granularity.";
        reference
          "RFC 8363: GMPLS OSPF-TE Extensions in Support of Flexi-
           Grid Dense Wavelength Division Multiplexing (DWDM)
           Networks";
      }

      leaf max-slot-width-factor {
```

```
        type uint16 {
          range "1..max";
        }
        must '. >= ../min-slot-width-factor' {
          error-message
            "Maximum slot width must be greater than or equal to
             minimum slot width.";
        }
        description
          "A multiplier of the slot width granularity, indicating
           the maximum slot width supported by an optical port.

           Maximum slot width is calculated by:
             Maximum slot width (GHz) =
               max-slot-width-factor * slot-width-granularity

           If specified, maximum slot width must be greater than or
           equal to minimum slot width.  If not specified, maximum
           slot width is equal to minimum slot width.";
        reference
          "RFC 8363: GMPLS OSPF-TE Extensions in Support of Flexi-
           Grid Dense Wavelength Division Multiplexing (DWDM)
           Networks";
      }
    }
  }

  grouping flexi-grid-label-step {
    description
      "Label step information for flexi-grid";
    leaf flexi-grid-channel-spacing {
      type identityref {
        base flexi-ch-spc-type;
      }
      default "flexi-ch-spc-6p25ghz";
      description
        "Label-step is the nominal central frequency granularity
         (GHz), e.g., 6.25 GHz.";
      reference
        "RFC 7699: Generalized Labels for the Flexi-Grid in Lambda
         Switch Capable (LSC) Label Switching Routers";
    }
    leaf flexi-n-step {
      type uint8;
      description
        "This attribute defines the multiplier for the supported
         values of 'N'.

         For example, given a grid with a nominal central frequency
         granularity of 6.25 GHz, the granularity of the supported
         values of the nominal central frequency could be 12.5 GHz.
         In this case, the values of flexi-n should be even and this
         constraint is reported by setting the flexi-n-step to 2.

         This attribute is also known as central frequency
         granularity in RFC 8363.";
      reference
        "RFC 8363: GMPLS OSPF-TE Extensions in Support of Flexi-Grid
```

```
          Dense Wavelength Division Multiplexing (DWDM) Networks";
    }
  }
}

<CODE ENDS>
```

4. Security Considerations

The YANG module specified in this document defines a schema for data that is designed to be accessed via network management protocols such as NETCONF [RFC6241] or RESTCONF [RFC8040]. The lowest NETCONF layer is the secure transport layer, and the mandatory-to-implement secure transport is Secure Shell (SSH) [RFC6242]. The lowest RESTCONF layer is HTTPS, and the mandatory-to-implement secure transport is TLS [RFC8446].

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. The NETCONF protocol over Secure Shell (SSH) specification [RFC6242] describes a method for invoking and running NETCONF within a Secure Shell (SSH) session as an SSH subsystem.

The objects in this YANG module are common data types and groupings. No object in this module can be read or written to. These definitions can be imported and used by other Layer 0 specific modules. It is critical to consider how imported definitions will be utilized and accessible via RPC operations, as the resultant schema will have data nodes that can be writable, or readable, and will have a significant effect on the network operations if used incorrectly or maliciously. All of these considerations belong in the document that defines the modules that import from this YANG module. Therefore, it is important to manage access to resultant data nodes that are considered sensitive or vulnerable in some network environments.

The security considerations spelled out in the YANG 1.1 specification [RFC7950] apply for this document as well.

5. IANA Considerations

IANA has assigned new URIs from the "IETF XML Registry" [RFC3688] as follows:

URI: urn:ietf:params:xml:ns:yang:ietf-layer0-types
Registrant Contact: The IESG
XML: N/A; the requested URI is an XML namespace.

This document registers the following YANG module in the "YANG Module Names" registry [RFC7950].

Name: ietf-layer0-types
Namespace: urn:ietf:params:xml:ns:yang:ietf-layer0-types

Prefix: l0-types
Reference: RFC 9093

6. References

6.1. Normative References

[ITU-Tg6982] ITU-T, "Amplified multichannel dense wavelength division multiplexing applications with single channel optical interfaces", ITU-T Recommendation G.698.2, November 2018.

[RFC4203] Kompella, K., Ed. and Y. Rekhter, Ed., "OSPF Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS)", RFC 4203, DOI 10.17487/RFC4203, October 2005, <https://www.rfc-editor.org/info/rfc4203>.

[RFC6163] Lee, Y., Ed., Bernstein, G., Ed., and W. Imajuku, "Framework for GMPLS and Path Computation Element (PCE) Control of Wavelength Switched Optical Networks (WSONs)", RFC 6163, DOI 10.17487/RFC6163, April 2011, <https://www.rfc-editor.org/info/rfc6163>.

[RFC6205] Otani, T., Ed. and D. Li, Ed., "Generalized Labels for Lambda-Switch-Capable (LSC) Label Switching Routers", RFC 6205, DOI 10.17487/RFC6205, March 2011, <https://www.rfc-editor.org/info/rfc6205>.

[RFC6241] Enns, R., Ed., Bjorklund, M., Ed., Schoenwaelder, J., Ed., and A. Bierman, Ed., "Network Configuration Protocol (NETCONF)", RFC 6241, DOI 10.17487/RFC6241, June 2011, <https://www.rfc-editor.org/info/rfc6241>.

[RFC6242] Wasserman, M., "Using the NETCONF Protocol over Secure Shell (SSH)", RFC 6242, DOI 10.17487/RFC6242, June 2011, <https://www.rfc-editor.org/info/rfc6242>.

[RFC7698] Gonzalez de Dios, O., Ed., Casellas, R., Ed., Zhang, F., Fu, X., Ceccarelli, D., and I. Hussain, "Framework and Requirements for GMPLS-Based Control of Flexi-Grid Dense Wavelength Division Multiplexing (DWDM) Networks", RFC 7698, DOI 10.17487/RFC7698, November 2015, <https://www.rfc-editor.org/info/rfc7698>.

[RFC7699] Farrel, A., King, D., Li, Y., and F. Zhang, "Generalized Labels for the Flexi-Grid in Lambda Switch Capable (LSC) Label Switching Routers", RFC 7699, DOI 10.17487/RFC7699, November 2015, <https://www.rfc-editor.org/info/rfc7699>.

[RFC7950] Bjorklund, M., Ed., "The YANG 1.1 Data Modeling Language", RFC 7950, DOI 10.17487/RFC7950, August 2016, <https://www.rfc-editor.org/info/rfc7950>.

[RFC8040] Bierman, A., Bjorklund, M., and K. Watsen, "RESTCONF Protocol", RFC 8040, DOI 10.17487/RFC8040, January 2017, <https://www.rfc-editor.org/info/rfc8040>.

[RFC8341] Bierman, A. and M. Bjorklund, "Network Configuration Access Control Model", STD 91, RFC 8341, DOI 10.17487/RFC8341, March 2018, <https://www.rfc-editor.org/info/rfc8341>.

[RFC8342] Bjorklund, M., Schoenwaelder, J., Shafer, P., Watsen, K., and R. Wilton, "Network Management Datastore Architecture (NMDA)", RFC 8342, DOI 10.17487/RFC8342, March 2018, <https://www.rfc-editor.org/info/rfc8342>.

[RFC8363] Zhang, X., Zheng, H., Casellas, R., Gonzalez de Dios, O., and D. Ceccarelli, "GMPLS OSPF-TE Extensions in Support of Flexi-Grid Dense Wavelength Division Multiplexing (DWDM) Networks", RFC 8363, DOI 10.17487/RFC8363, May 2018, <https://www.rfc-editor.org/info/rfc8363>.

[RFC8446] Rescorla, E., "The Transport Layer Security (TLS) Protocol Version 1.3", RFC 8446, DOI 10.17487/RFC8446, August 2018, <https://www.rfc-editor.org/info/rfc8446>.

[RFC8776] Saad, T., Gandhi, R., Liu, X., Beeram, V., and I. Bryskin, "Common YANG Data Types for Traffic Engineering", RFC 8776, DOI 10.17487/RFC8776, June 2020, <https://www.rfc-editor.org/info/rfc8776>.

[RFC8795] Liu, X., Bryskin, I., Beeram, V., Saad, T., Shah, H., and O. Gonzalez de Dios, "YANG Data Model for Traffic Engineering (TE) Topologies", RFC 8795, DOI 10.17487/RFC8795, August 2020, <https://www.rfc-editor.org/info/rfc8795>.

6.2. Informative References

[ITU-Tg6941] ITU-T, "Spectral grids for WDM applications: DWDM frequency grid", ITU-T Recommendation G.694.1, October 2020.

[ITU-Tg6942] ITU-T, "Spectral grids for WDM applications: CWDM wavelength grid", ITU-T Recommendation G.694.2, December 2003.

[RFC3688] Mealling, M., "The IETF XML Registry", BCP 81, RFC 3688, DOI 10.17487/RFC3688, January 2004, <https://www.rfc-editor.org/info/rfc3688>.

[RFC7446] Lee, Y., Ed., Bernstein, G., Ed., Li, D., and W. Imajuku, "Routing and Wavelength Assignment Information Model for Wavelength Switched Optical Networks", RFC 7446, DOI 10.17487/RFC7446, February 2015, <https://www.rfc-editor.org/info/rfc7446>.

[RFC7581] Bernstein, G., Ed., Lee, Y., Ed., Li, D., Imajuku, W., and J. Han, "Routing and Wavelength Assignment Information Encoding for Wavelength Switched Optical Networks", RFC 7581, DOI 10.17487/RFC7581, June 2015, <https://www.rfc-editor.org/info/rfc7581>.

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