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A YANG Data Model for Microwave Radio Link
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Abstract

This document defines a YANG data model for control and management of radio link interfaces and their connectivity to packet (typically Ethernet) interfaces in a microwave/millimeter wave node. The data nodes for management of the interface protection functionality is broken out into a separate and generic YANG data model in order to make it available for other interface types as well. This document obsoletes RFC 8561.

About This Document

This note is to be removed before publishing as an RFC.

The latest revision of this draft can be found at https://example.com/LATEST. Status information for this document may be found at https://datatracker.ietf.org/doc/draft-ybam-ccamp-rfc8561bis/.

Discussion of this document takes place on the CCAMP Working Group mailing list (mailto:WG@example.com), which is archived at https://example.com/WG.

Source for this draft and an issue tracker can be found at https://github.com/USER/REPO.

Status of This Memo

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

This Internet-Draft will expire on 3 September 2026.

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Table of Contents

1. Introduction

This document defines a YANG data model for management and control of the radio link interface(s) and the relationship to packet (typically Ethernet) and/or Time-Division Multiplexing (TDM) interfaces in a microwave/millimeter wave node. The ETSI EN 302 217 series defines the characteristics and requirements of microwave/millimeter wave equipment and antennas. Specifically, ETSI EN 302 217-2 [EN302217-2] specifies the essential parameters for systems operating from 1.4 GHz to 86 GHz. The data model includes configuration and state data according to the new Network Management Datastore Architecture [RFC8342].

The design of the data model follows the framework for management and control of microwave and millimeter wave interface parameters defined in [RFC8432]. This framework identifies the need and the scope of the YANG data model, use cases, and requirements that the model needs to support. Moreover, it provides a detailed gap analysis to identify the missing parameters and functionalities of the existing and established models to support the specified use cases and requirements, and based on that, it recommends how the gaps should be filled with the development of the new model. According to the conclusion of the gap analysis, the structure of the data model is based on the structure defined in [RFC8561], and it augments [RFC8343] to align with the same structure for management of the packet interfaces. More specifically, the model will include interface layering to manage the capacity provided by a radio link terminal for the associated Ethernet and TDM interfaces, using the principles for interface layering described in [RFC8343] as a basis.

The data nodes for management of the interface protection functionality is broken out into a separate and generic YANG data module in order to make it also available for other interface types.

The designed YANG data model uses established microwave equipment and radio standards, such as ETSI EN 302 217-2; the IETF Radio Link Model [RFC8561]; and the ONF Microwave Model [ONF-model], as the basis for the definition of the detailed leafs/parameters, and it proposes new ones to cover identified gaps, which are analyzed in [RFC8432].

1.1. Terminology and Definitions

The following terms are used in this document:

Carrier Termination (CT) is an interface for the capacity provided over the air by a single carrier. It is typically defined by its transmitting and receiving frequencies.

Radio Link Terminal (RLT) is an interface providing packet capacity and/or TDM capacity to the associated Ethernet and/or TDM interfaces in a node and is used for setting up a transport service over a microwave/millimeter wave link.

The following acronyms are used in this document:

ACM Adaptive Coding Modulation

ATPC Automatic Transmitter Power Control

BBE Background Block Error

BER Bit Error Ratio

BPSK Binary Phase-Shift Keying

CM Coding Modulation

CT Carrier Termination

ES Errored Seconds

IF Intermediate Frequency

MIMO Multiple Input Multiple Output

RF Radio Frequency

RLT Radio Link Terminal

QAM Quadrature Amplitude Modulation

QPSK Quadrature Phase-Shift Keying

RTPC Remote Transmit Power Control

SES Severely Errored Seconds

TDM Time-Division Multiplexing

UAS Unavailable Seconds

XPIC Cross Polarization Interference Cancellation

1.2. Tree Structure

A simplified graphical representation of the data model is used in Section 1.4 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
mrl	ietf-microwave-radio-link	This document
yang	ietf-yang-types	[RFC9911]
ianaift	iana-if-type	[IANA-if-type-module]
if	ietf-interfaces	[RFC8343]
ifprot	ietf-interface-protection	This document
mw-types	ietf-microwave-types	This document

Table 1: Prefixes for imported YANG modules

Microwave Radio Link YANG Data Model

1.4. YANG Tree

```
=============== NOTE: '\' line wrapping per RFC 8792 ================

module: ietf-microwave-radio-link
  +--rw radio-link-protection-groups
  |  +--rw protection-group* [name]
  |     +---x manual-switch-working
  |     +---x manual-switch-protection
  |     +---x forced-switch
  |     +---x lockout-of-protection
  |     +---x freeze
  |     +---x exercise
  |     +---x clear
  |     +--rw name                              string
  |     +--rw protection-architecture-type?     identityref
```

```
|     +--rw members*                          if:interface-ref
|     +--rw operation-type?                   enumeration
|     +--rw working-entity*                   if:interface-ref
|     +--rw revertive-wait-to-restore?        uint16
|     +--rw hold-off-timer?                   uint16
|     +--ro status?                           identityref
+--rw xpic-pairs {xpic}?
|  +--rw xpic-pair* [name]
|     +--rw name       string
|     +--rw enabled?   boolean
|     +--rw members*   if:interface-ref
+--rw mimo-groups {mimo}?
   +--rw mimo-group* [name]
      +--rw name       string
      +--rw enabled?   boolean
      +--rw members*   if:interface-ref

augment /if:interfaces/if:interface:
  +--rw id?                      string
  +--rw (mode-option)
  |  x--:(mode)
  |  |  x--rw mode                identityref
  |  +--:(rlt-mode)
  |     +--rw rlt-mode
  |        +--rw num-bonded-carriers        uint32
  |        +--rw num-protecting-carriers    uint32
  +--rw carrier-terminations*   if:interface-ref
  +--rw rlp-groups*
  |       -> /radio-link-protection-groups/protection-group/name
  +--rw xpic-pairs*             -> /xpic-pairs/xpic-pair/name
  |       {xpic}?
  +--rw mimo-groups*            -> /mimo-groups/mimo-group/name
  |       {mimo}?
  +--rw tdm-connections* [tdm-type] {tdm}?
  |  +--rw tdm-type           identityref
  |  +--rw tdm-connections    uint16
  +--rw header-compression {header-compression}?
     +--ro supported-profile* [name]
     |  +--ro name           string
     |  +--ro description?   string
     +--rw configured-profile?   -> ../supported-profile/name
     +--rw enabled?              boolean
     +--ro oper-status?          enumeration
augment /if:interfaces/if:interface:
  +--rw carrier-id?                    string
  +--rw tx-enabled?                    boolean
  +--ro tx-oper-status?                enumeration
  +--rw tx-frequency                   uint32
```

```
      +--ro actual-rx-frequency?            uint32
      +--rw channel-separation              uint32
      +--ro actual-transmitted-level?       power
      +--ro actual-tx-cm?                   identityref
      +--ro actual-snir?                    decimal64
      +--rw (freq-or-distance)
      |  +--:(rx-frequency)
      |  |  +--rw rx-frequency?             uint32
      |  +--:(duplex-distance)
      |     +--rw duplex-distance?          int32
      +--ro actual-duplex-distance?         uint32
      +--rw polarization?                   enumeration
      +--rw (power-mode)
      |  +--:(rtpc)
      |  |  +--rw rtpc
      |  |     +--rw maximum-nominal-power    mw-types:power
      |  +--:(atpc)
      |     +--rw atpc
      |        +--rw maximum-nominal-power    mw-types:power
      |        +--rw minimum-nominal-power    mw-types:power
      |        +--rw atpc-lower-threshold     mw-types:power
      |        +--rw atpc-upper-threshold     mw-types:power
      +--ro actual-received-level?          mw-types:power
      +--rw (coding-modulation-mode)
      |  +--:(single)
      |  |  +--rw single
      |  |     +--rw selected-cm    identityref
      |  +--:(adaptive)
      |     +--rw adaptive
      |        +--rw selected-min-acm        identityref
      |        +--rw selected-max-acm        identityref
      |        +--rw reference-modulation?   identityref
      +--ro actual-xpi?                     decimal64 {xpic}?
      +--rw ct-performance-thresholds
      |  +--rw received-level-alarm-threshold?      mw-types:power
      |  +--rw transmitted-level-alarm-threshold?   mw-types:power
      |  +--rw ber-alarm-threshold?                 enumeration
      +--rw if-loop?                        enumeration
      +--rw rf-loop?                        enumeration
      +--ro capabilities
      |  +--ro min-tx-frequency?          uint32
      |  +--ro max-tx-frequency?          uint32
      |  +--ro min-rx-frequency?          uint32
      |  +--ro max-rx-frequency?          uint32
      |  +--ro minimum-power?             mw-types:power
      |  +--ro maximum-available-power?   mw-types:power
      |  +--ro available-min-acm?         identityref
      |  +--ro available-max-acm?         identityref
```

```
      |  +--ro acm-profile-list*
      |          [profile-channel-separation-id profile-coding-\
                                                    modulation-id]
      |     +--ro profile-channel-separation-id      uint32
      |     +--ro profile-coding-modulation-id       identityref
      |     +--ro modulation-scheme?                 uint8
      |     +--ro nominal-tx-capacity?               uint32
      |     +--ro support-as-fixed-modulation?       boolean
      |     +--ro support-as-reference-modulation?   boolean
      |     +--ro max-tx-power?                      mw-types:power
      |     +--ro min-tx-power?                      mw-types:power
      |     +--ro lower-acm-profile-ptr
      |     |  +--ro profile-coding-modulation-id-ref?    leafref
      |     |  +--ro profile-channel-separation-id-ref?   leafref
      |     +--ro upper-acm-profile-ptr
      |        +--ro profile-coding-modulation-id-ref?    leafref
      |        +--ro profile-channel-separation-id-ref?   leafref
      +--ro error-performance-statistics
      |  +--ro bbe?   yang:counter32
      |  +--ro es?    yang:counter32
      |  +--ro ses?   yang:counter32
      |  +--ro uas?   yang:counter32
      +--ro radio-performance-statistics
         +--ro min-rltm?   mw-types:power
         +--ro max-rltm?   mw-types:power
         +--ro min-tltm?   mw-types:power
         +--ro max-tltm?   mw-types:power
```

1.5. Explanation of the Microwave Data Model

The leafs in the Interface Management Module augmented by RLT and CT are not always applicable.

"/interfaces/interface/enabled" is not applicable for RLT. Enable and disable of an interface is done in the constituent CTs.

The packet-related measurements "in-octets", "in-unicast-pkts", "in-broadcast-pkts", "in-multicast-pkts", "in-discards", "in-errors", "in-unknown-protos", "out-octets", "out-unicast-pkts", "out-broadcast-pkts", "out-multicast-pkts", "out-discards", and "out-errors" are not within the scope of the microwave radio link domain and therefore are not applicable for RLT and CT.

2. Microwave Radio Link YANG Data Model

This module imports typedefs and modules from [RFC9911], [RFC8343] and [RFC7224], and it references [TR102311], [EN302217-1], [EN301129], and [G.826].

```
<CODE BEGINS> file "ietf-microwave-radio-link@2026-03-02.yang"
module ietf-microwave-radio-link {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-microwave-radio-link";
  prefix mrl;

  import ietf-yang-types {
    prefix yang;
    reference
      "RFC 9911";
  }
  import iana-if-type {
    prefix ianaift;
  }
  import ietf-interfaces {
    prefix if;
    reference
      "RFC 8343";
  }
  import ietf-interface-protection {
    prefix ifprot;
    reference
      "RFC 8561";
  }
  import ietf-microwave-types {
    prefix mw-types;
    reference
      "RFC 8561";
  }

  organization
    "Internet Engineering Task Force (IETF) CCAMP WG";
  contact
    "WG List: <mailto:ccamp@ietf.org>

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  description
    "This YANG module defines a YANG data model for control
     and management of radio link interfaces and their
     connectivity to packet (typically Ethernet) interfaces
     in a microwave/millimeter wave node. The data
     nodes for management of the interface protection
```

```
      functionality is broken out into a separate and generic
      YANG data model in order to make it available for other
      interface types as well. This is a YANG module for the
      entities in a generic microwave system.


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

      This version of this YANG module is part of RFC 8561bis;
      see the RFC itself for full legal notices.";

  // RFC Ed.: replace 8561bis with actual RFC number and remove
  // this note
  // replace the revision date with the module publication date
  // the format is (year-month-day)

  revision 2026-03-02 {
    description
      "TBD";
    reference
      "RFC XXXX: A YANG Data Model for Microwave Radio Link";
  }
  revision 2019-06-19 {
    description
      "Initial revision.";
    reference
      "RFC 8561: A YANG Data Model for Microwave Radio Link";
  }

  /*
   * Features
   */

  feature xpic {
    description
      "Indicates that the device supports XPIC.";
    reference
      "ETSI TR 102 311";
  }
```

```
    feature mimo {
      description
        "Indicates that the device supports MIMO.";
      reference
        "ETSI TR 102 311";
    }

    feature tdm {
      description
        "Indicates that the device supports TDM.";
    }

    feature header-compression {
      description
        "Indicates that the device supports Header Compression
         profiles.";
    }

    /*
     * Typedefs
     */

    grouping acm-profile {
      description
        "acm-profile";
      leaf modulation-scheme {
        type uint8;
        description
          "It is the logarithm base two of the number of points in the
           transmitted constellation.  E.G.:  value would be 2 for
           4QAM, 10 fo 1024QAM, and 12 for 4096QAM.";
      }
      leaf nominal-tx-capacity {
        type uint32;
        description
          "The nominal radio link capacity associated to this
           acm-profile.";
      }
      leaf support-as-fixed-modulation {
        type boolean;
        description
          "True when the profile can be used in single
           coding-modulation-mode.";
      }
      leaf support-as-reference-modulation {
        type boolean;
        description
          " 'true' when the profile can be used to configure the
```

```
            reference-modulation in adaptive coding-modulation-mode.
            Otherwise the value is 'false' and the reference-modulation
            to use cannot be configured
            (it could be selected automatically by the system).
          ";
      }
      leaf max-tx-power {
        type mw-types:power;
        description
          "The maximum transmitted power when the carrier termination
           is operating this acm-profile.  Used to configure
           transmitted power.";
      }
      leaf min-tx-power {
        type mw-types:power;
        description
          "The minimum transmitted power when the carrier termination
           is operating this acm-profile.  Used to configure
           transmitted power.";
      }
    }

    /*
     * Radio Link Terminal (RLT)
     */

    augment "/if:interfaces/if:interface" {
      when "derived-from-or-self(if:type,"
         + "'ianaift:microwaveRadioLinkTerminal')";
      description
        "Addition of data nodes for the radio link terminal to
         the standard Interface data model, for interfaces of
         the type 'microwaveRadioLinkTerminal'.";
      leaf id {
        type string;
        description
          "Descriptive identity of the near-end radio link terminal
           transmitted to be used by the far-end RLT for RLT
           connectivity check.
           Does not need to be configured if RLT connectivity check is
           not used by the far-end RLT.";
      }
      leaf far-end-id-check-enabled {
        type boolean;
        description
          "'true' value when the RLT connectivity check is used.
           'false' if the RLT connectivity check is not used.";
      }
```

```
        leaf expected-far-end-id {
          when "../far-end-id-check-enabled = 'true'";
          type string;
          description
            "Descriptive identity of the radio link terminal expected
             from far-end RLT and used for RLT connectivity check
             (i.e., to check that the expected value is the same as the
             value received from the far-end RLT).
             By default it is the same as the 'id'.";
        }
        choice mode-option {
          mandatory true;
          description
            "A description of the mode in which the radio link
             terminal is configured in terms of:
             - number of bonded carrier terminations;
             - number of protecting carrier terminations.";
          leaf mode {
            type identityref {
              base mw-types:rlt-mode;
            }
            mandatory true;
            status deprecated;
            description
              "A description of the mode in which the radio link
               terminal is configured.  The format is X plus Y.
               X represents the number of bonded carrier terminations.
               Y represents the number of protecting carrier
               terminations.

               This attribute has been deprecated: the rlt-mode container
               which provide flexible definitions of number of bonded
               carriers and protecting carriers should be used instead.";
          }
          container rlt-mode {
            description
              "This grouping provides a flexible definition of number
               of bonded carriers and protecting carriers of a radio
               link.";
            uses mw-types:rlt-mode;
          }
        }
        leaf-list carrier-terminations {
          type if:interface-ref;
          must "derived-from-or-self(/if:interfaces/if:interface"
             + "[if:name = current()]"
             + "/if:type, 'ianaift:microwaveCarrierTermination')" {
            description
```

```
            "The type of interface must be
             'microwaveCarrierTermination'.";
        }
        min-elements 1;
        description
          "A list of references to carrier terminations
           included in the radio link terminal.";
      }
      leaf-list rlp-groups {
        type leafref {
          path "/mrl:radio-link-protection-groups/"
             + "mrl:protection-group/mrl:name";
        }
        description
          "A list of references to the carrier termination
           groups configured for radio link protection in this
           radio link terminal.";
      }
      leaf-list xpic-pairs {
        if-feature "xpic";
        type leafref {
          path "/mrl:xpic-pairs/mrl:xpic-pair/mrl:name";
        }
        description
          "A list of references to the XPIC pairs used in this
           radio link terminal.  One pair can be used by two
           terminals.";
        reference
          "ETSI TR 102 311";
      }
      leaf-list mimo-groups {
        if-feature "mimo";
        type leafref {
          path "/mrl:mimo-groups/mrl:mimo-group/mrl:name";
        }
        description
          "A reference to the MIMO group used in this
           radio link terminal.  One group can be used by more
           than one terminal.";
        reference
          "ETSI TR 102 311";
      }
      list tdm-connections {
        if-feature "tdm";
        key "tdm-type";
        description
          "A list stating the number of active TDM connections
           of a specified tdm-type that is configured to be
```

```
           supported by the RLT.";
        leaf tdm-type {
          type identityref {
            base mw-types:tdm-type;
          }
          description
            "The type of TDM connection, which also indicates
             the supported capacity.";
        }
        leaf tdm-connections {
          type uint16;
          mandatory true;
          description
            "Number of connections of the specified type.";
        }
      }
      container header-compression {
        if-feature "header-compression";
        description
          "Configuration of Header Compression ";
        list supported-profile {
          key "name";
          config false;
          description
            "The list of header compression profiles supported by the
             RLT.
             Header compression is typically vendor proprietary and it
             is assumed there is no ambition to change that. For this
             reason the list provides only generic attributes to be
             augmented by vendor with proprietary implementation
             attributes.";
          leaf name {
            type string;
            description
              "A name that uniquely identifies the header compression
               profile in an RLT.";
          }
          leaf description {
            type string;
            description
              "Detailed description of the profile.";
          }
        }
        leaf configured-profile {
          type leafref {
            path "../mrl:supported-profile/mrl:name";
            require-instance false;
          }
```

```
          description
            "Select the profile of header compression to be used.";
        }
        leaf enabled {
          type boolean;
          description
            "Disables (false) or enables (true) the header
             compression.";
        }
        leaf oper-status {
          type enumeration {
            enum off {
              description
                "Header compression is off.";
            }
            enum on {
              description
                "Header compression is on.";
            }
          }
          config false;
          description
            "Shows the operative status of the header compression.";
        }
      }
    }

    /*
     * Carrier Termination
     */

    augment "/if:interfaces/if:interface" {
      when "derived-from-or-self(if:type,"
         + "'ianaift:microwaveCarrierTermination')";
      description
        "Addition of data nodes for carrier termination to
         the standard Interface data model, for interfaces
         of the type 'microwaveCarrierTermination'.";
      leaf carrier-id {
        type string;
        default "A";
        description
          "ID of the carrier (e.g., A, B, C, or D) transmitted
           to be used in XPIC and MIMO configurations by the far-end
           CT for CT connectivity check.";
      }
      leaf far-end-carrier-id-check-enabled {
        type boolean;
```

```
        description
          "'true' value when the CT connectivity check is used.
           'false' if the CT connectivity check is not used.";
      }
      leaf expected-far-end-carrier-id {
        when "../far-end-carrier-id-check-enabled = 'true'";
        type string;
        description
          "Descriptive identity of the carrier expected from far-end
           CT (e.g., A, B, C, or D) to check that it's connected to
           the correct near-end CT.
           By default it is the same as the carrier-id.";
      }
      leaf tx-enabled {
        type boolean;
        default "false";
        description
          "Disables (false) or enables (true) the transmitter.
           Only applicable when the interface is enabled
           (interface:enabled = true); otherwise, it's always
           disabled.";
      }
      leaf tx-oper-status {
        type enumeration {
          enum off {
            description
              "Transmitter is off.";
          }
          enum on {
            description
              "Transmitter is on.";
          }
          enum standby {
            description
              "Transmitter is in standby.";
          }
        }
        config false;
        description
          "Shows the operative status of the transmitter.";
      }
      uses mw-types:common-microwave-properties;
      choice freq-or-distance {
        mandatory true;
        description
          "A choice to configure rx-frequency directly or compute
           it as duplex-distance subtracted from tx-frequency.";
        leaf rx-frequency {
```

```
          type uint32;
          units "kHz";
          description
            "Selected receiver frequency.";
        }
        leaf duplex-distance {
          type int32;
          units "kHz";
          description
            "Distance between transmitter and receiver frequencies.";
        }
      }
      leaf actual-duplex-distance {
        type uint32;
        units "kHz";
        config false;
        description
          "Computed distance between Tx and Rx frequencies.";
      }
      leaf polarization {
        type enumeration {
          enum horizontal {
            description
              "Horizontal polarization.";
          }
          enum vertical {
            description
              "Vertical polarization.";
          }
          enum not-specified {
            description
              "Polarization not specified.";
          }
        }
        default "not-specified";
        description
          "Polarization - a textual description for info only.";
      }
      choice power-mode {
        mandatory true;
        description
          "A choice of RTPC or ATPC.";
        container rtpc {
          description
            "Remote Transmit Power Control (RTPC).";
          reference
            "ETSI EN 302 217-1";
          leaf maximum-nominal-power {
```

```
            type mw-types:power {
              range "-99..99";
            }
            units "dBm";
            mandatory true;
            description
              "Selected output power.";
            reference
              "ETSI EN 302 217-1";
          }
        }
        container atpc {
          description
            "Automatic Transmitter Power Control (ATPC).";
          reference
            "ETSI EN 302 217-1";
          leaf maximum-nominal-power {
            type mw-types:power {
              range "-99..99";
            }
            units "dBm";
            mandatory true;
            description
              "Nominal maximum output power.";
            reference
              "ETSI EN 302 217-1";
          }
          leaf minimum-nominal-power {
            type mw-types:power {
              range "-99..99";
            }
            units "dBm";
            mandatory true;
            description
              "Minimum output power.

               By default, minimum output power is the same as the
               system capability minimum-power.";
          }
          leaf atpc-lower-threshold {
            type mw-types:power {
              range "-99..-20";
            }
            units "dBm";
            must 'current() <= ../atpc-upper-threshold';
            mandatory true;
            description
              "The lower threshold for the input power at the
```

```
               far end, which is used in the ATPC mode.";
            reference
              "ETSI EN 302 217-1";
          }
          leaf atpc-upper-threshold {
            type mw-types:power {
              range "-99..-20";
            }
            units "dBm";
            mandatory true;
            description
              "The upper threshold for the input power at the
               far end, which is used in the ATPC mode.";
            reference
              "ETSI EN 302 217-1";
          }
        }
      }
      leaf actual-received-level {
        type mw-types:power {
          range "-99..-20";
        }
        units "dBm";
        config false;
        description
          "Actual received power level (0.1 dBm resolution).";
        reference
          "ETSI EN 301 129";
      }
      choice coding-modulation-mode {
        mandatory true;
        description
          "A selection of single or
           adaptive coding/modulation mode.";
        container single {
          description
            "A single modulation order only.";
          reference
            "ETSI EN 302 217-1";
          leaf selected-cm {
            type identityref {
              base mw-types:coding-modulation;
            }
            mandatory true;
            description
              "Selected the single coding/modulation.";
          }
        }
```

```
          container adaptive {
            description
              "Adaptive coding/modulation.";
            reference
              "ETSI EN 302 217-1";
            leaf selected-min-acm {
              type identityref {
                base mw-types:coding-modulation;
              }
              mandatory true;
              description
                "Selected minimum coding/modulation.
                 Adaptive coding/modulation shall not go
                 below this value.";
            }
            leaf selected-max-acm {
              type identityref {
                base mw-types:coding-modulation;
              }
              mandatory true;
              description
                "Selected maximum coding/modulation.
                 Adaptive coding/modulation shall not go
                 above this value.";
            }
            leaf reference-modulation {
              type identityref {
                base mw-types:coding-modulation;
              }
              description
                "the reference-modulation is the coding modulation to be
                 used in the reference mode, as defined in
                 ETSI EN 302 217-1 V3.2.2 (2020-02).
                 The reference mode identifies the operative mode which
                 characteristics (i.e. system capacity, spectral
                 efficiency class over a given channel separation) are
                 used (i.e. declared in the licensing process) in the
                 link per link coordination analysis. Its value has to be
                 between the 'selected-min-acm' and the
                 'selected-max-acm' attribute's values.
                ";
            }
          }
        }
        leaf actual-xpi {
          if-feature "xpic";
          type decimal64 {
            fraction-digits 1;
```

```
          range "0..99";
        }
        units "dB";
        config false;
        description
          "The actual carrier to cross-polar interference.
           Only valid if XPIC is enabled (0.1 dB resolution).";
        reference
          "ETSI TR 102 311";
      }
      container ct-performance-thresholds {
        description
          "Specification of thresholds for when alarms should
           be sent and cleared for various performance counters.";
        leaf received-level-alarm-threshold {
          type mw-types:power {
            range "-99..-20";
          }
          units "dBm";
          default "-99";
          description
            "An alarm is sent when the received power level is
             below the specified threshold.";
          reference
            "ETSI EN 301 129";
        }
        leaf transmitted-level-alarm-threshold {
          type mw-types:power {
            range "-99..99";
          }
          units "dBm";
          default "-99";
          description
            "An alarm is sent when the transmitted power level
             is below the specified threshold.";
          reference
            "ETSI EN 301 129";
        }
        leaf ber-alarm-threshold {
          type enumeration {
            enum 1e-9 {
              description
                "Threshold at 1e-9 (10^-9).";
            }
            enum 1e-8 {
              description
                "Threshold at 1e-8 (10^-8).";
            }
```

```
            enum 1e-7 {
              description
                "Threshold at 1e-7 (10^-7).";
            }
            enum 1e-6 {
              description
                "Threshold at 1e-6 (10^-6).";
            }
            enum 1e-5 {
              description
                "Threshold at 1e-5 (10^-5).";
            }
            enum 1e-4 {
              description
                "Threshold at 1e-4 (10^-4).";
            }
            enum 1e-3 {
              description
                "Threshold at 1e-3 (10^-3).";
            }
            enum 1e-2 {
              description
                "Threshold at 1e-2 (10^-2).";
            }
            enum 1e-1 {
              description
                "Threshold at 1e-1 (10^-1).";
            }
          }
          default "1e-6";
          description
            "Specification of at which BER an alarm should
             be raised.";
          reference
            "ETSI EN 302 217-1";
        }
      }
      leaf if-loop {
        type enumeration {
          enum disabled {
            description
              "Disables the IF Loop.";
          }
          enum client {
            description
              "Loops the signal back to the client side.";
          }
          enum radio {
```

```
            description
              "Loops the signal back to the radio side.";
          }
        }
        default "disabled";
        description
          "Enable (client/radio) or disable (disabled)
           the IF Loop, which loops the signal back to
           the client side or the radio side.";
      }
      leaf rf-loop {
        type enumeration {
          enum disabled {
            description
              "Disables the RF Loop.";
          }
          enum client {
            description
              "Loops the signal back to the client side.";
          }
          enum radio {
            description
              "Loops the signal back to the radio side.";
          }
        }
        default "disabled";
        description
          "Enable (client/radio) or disable (disabled)
           the RF loop, which loops the signal back to
           the client side or the radio side.";
      }
      container capabilities {
        config false;
        description
          "Capabilities of the installed equipment and
           some selected configurations.";
        leaf min-tx-frequency {
          type uint32;
          units "kHz";
          description
            "Minimum Tx frequency possible to use.";
        }
        leaf max-tx-frequency {
          type uint32;
          units "kHz";
          description
            "Maximum Tx frequency possible to use.";
        }
```

```
          leaf min-rx-frequency {
            type uint32;
            units "kHz";
            description
              "Minimum Rx frequency possible to use.";
          }
          leaf max-rx-frequency {
            type uint32;
            units "kHz";
            description
              "Maximum Tx frequency possible to use.";
          }
          leaf minimum-power {
            type mw-types:power;
            units "dBm";
            description
              "The minimum output power supported.";
            reference
              "ETSI EN 302 217-1";
          }
          leaf maximum-available-power {
            type mw-types:power;
            units "dBm";
            description
              "The maximum output power supported.";
            reference
              "ETSI EN 302 217-1";
          }
          leaf available-min-acm {
            type identityref {
              base mw-types:coding-modulation;
            }
            description
              "Minimum coding-modulation possible to use.";
          }
          leaf available-max-acm {
            type identityref {
              base mw-types:coding-modulation;
            }
            description
              "Maximum coding-modulation possible to use.";
          }
          list acm-profile-list {
            key "profile-channel-separation-id "
              + "profile-coding-modulation-id";
            description
              "A list of acm-profile.
               Each acm-profile is identified by a channel-separation and
```

```
          coding-modulation values as supported by the carrier
          termination and defines the parameter's values of each
          transmission acm profile.
          Basically, the list contains all acm profiles supported by
          the device.  Profiles are organized into profile chains
          for each different channel separation value available. The
          chains are formed by the lower-acm-profile-ptr and
          upper-acm-profile-ptr pointers.  The sequence in the list
          reflects the sequence of profiles that are operated by the
          device according to the fading conditions, from the clear
          sky down to the persistent rain, and vice versa. The
          channel-separation and selected-cm configuration
          parameters (or the selected-min-acm/selected-max-acm
          pair) must address one of the profiles in the list.";
        leaf profile-channel-separation-id {
          type uint32;
          description
            "Uniquely identifies the acm profile (together with
             'profile-coding-modulation-id').  It could be used to
             allow the configuration of the channel-separation
             value.";
        }
        leaf profile-coding-modulation-id {
          type identityref {
            base mw-types:coding-modulation;
          }
          description
            "Uniquely identifies the acm profile (together with
             'profile-channel-separation-id').  It could be used to
             allow the configuration of the selected-cm (single
             mode) or selected-min-acm/selected-max-acm (adaptive
             mode).";
        }
        uses acm-profile;
        container lower-acm-profile-ptr {
          description
            "Together with the upper-acm-profile-ptr parameters it
             creates a chain of acm profiles related to a specific
             channel separation value.  Specifically it references
             the next lower acm-profile, while upper-acm-profile-ptr
             references the next higher profile.  The lowest profile
             in the chain, shall not instantiate this container.  The
             acm-profile-list can contain multiple chains related to
             different channel separation values supported by the
             device.";
          leaf profile-coding-modulation-id-ref {
            type leafref {
              path "../../../acm-profile-list"
```

```
                + "/profile-coding-modulation-id";
            }
            description
              "A reference to an acm-profile to give an order in
               acm-profile-list.  This is the reference to the
               'profile-coding-modulation-id' key of the next lower
               acm-profile in the list respect to the current one.";
          }
          leaf profile-channel-separation-id-ref {
            type leafref {
              path "../../.."
                 + "/acm-profile-list[profile-coding-modulation-id="
                 + "current()/../profile-coding-modulation-id-ref]"
                 + "/profile-channel-separation-id";
            }
            description
              "A reference to an acm-profile to give an order in
               acm-profile-list.  This is the reference to the
               'profile-channel-separation-id' key of the next lower
               acm-profile in the list respect to the current one.";
          }
        }
        container upper-acm-profile-ptr {
          description
            "Together with the lower-acm-profile-ptr parameters it
             creates a chain of acm profiles related to a specific
             channel separation value.  Specifically it references
             the next higher acm-profile, while lower-acm-profile-ptr
             references the next lower profile.  The highest profile
             in the chain, shall not instantiate this container.  The
             acm-profile-list can contain multiple chains related to
             different channel separation values supported by the
             device.";
          leaf profile-coding-modulation-id-ref {
            type leafref {
              path "../../../acm-profile-list"
                 + "/profile-coding-modulation-id";
            }
            description
              "A reference to an acm-profile to give an order in
               acm-profile-list.  This is the reference to the
               'profile-coding-modulation-id' key of the next higher
               acm-profile in the list respect to the current one.";
          }
          leaf profile-channel-separation-id-ref {
            type leafref {
              path "../../.."
                 + "/acm-profile-list[profile-coding-modulation-id="
```

```
                    + "current()/../profile-coding-modulation-id-ref]"
                    + "/profile-channel-separation-id";
              }
              description
                "A reference to an acm-profile to give an order in
                 acm-profile-list.  This is the reference to the
                 'profile-channel-separation-id' key of the next higher
                 acm-profile in the list respect to the current one.";
            }
          }
        }
      }
      container error-performance-statistics {
        config false;
        description
          "ITU-T G.826 error performance statistics relevant for
           a microwave/millimeter wave carrier.";
        leaf bbe {
          type yang:counter32;
          units "number of block errors";
          description
            "Number of Background Block Errors (BBEs).  A BBE is an
             errored block not occurring as part of Severely Errored
             Seconds (SES).  Discontinuities in the value of this
             counter can occur at re-initialization of the management
             system and at other times as indicated by the value of
             'discontinuity-time' in ietf-interfaces.";
          reference
            "ITU-T G.826";
        }
        leaf es {
          type yang:counter32;
          units "seconds";
          description
            "Number of Errored Seconds (ES).  An ES is a one-second
             period with one or more errored blocks or at least one
             defect.  Discontinuities in the value of this counter
             can occur at re-initialization of the management system
             and at other times as indicated by the value of
             'discontinuity-time' in ietf-interfaces.";
          reference
            "ITU-T G.826";
        }
        leaf ses {
          type yang:counter32;
          units "seconds";
          description
            "Number of SES.  SES is a one-second period that contains
```

```
            equal or more than 30% errored blocks or at least
            one defect.  SES is a subset of ES.  Discontinuities in
            the value of this counter can occur at re-initialization
            of the management system and at other times as indicated
            by the value of 'discontinuity-time' in ietf-interfaces.";
          reference
            "ITU-T G.826";
        }
        leaf uas {
          type yang:counter32;
          units "seconds";
          description
            "Number of Unavailable Seconds (UAS); that is, the
             total time that the node has been unavailable.
             Discontinuities in the value of this counter can occur
             at re-initialization of the management system and at
             other times as indicated by the value of
             'discontinuity-time' in ietf-interfaces.";
          reference
            "ITU-T G.826";
        }
      }
      container radio-performance-statistics {
        config false;
        description
          "ETSI EN 301 129 radio physical interface statistics relevant
           for a carrier termination.";
        leaf min-rltm {
          type mw-types:power {
            range "-99..-20";
          }
          units "dBm";
          description
            "Minimum received power level.  Discontinuities in the
             value of this counter can occur at re-initialization
             of the management system and at other times as
             indicated by the value of 'discontinuity-time' in
             ietf-interfaces.";
          reference
            "ETSI EN 301 129";
        }
        leaf max-rltm {
          type mw-types:power {
            range "-99..-20";
          }
          units "dBm";
          description
            "Maximum received power level.  Discontinuities in the
```

```
            value of this counter can occur at re-initialization
            of the management system and at other times as
            indicated by the value of 'discontinuity-time' in
            ietf-interfaces.";
          reference
            "ETSI EN 301 129";
        }
        leaf min-tltm {
          type mw-types:power {
            range "-99..99";
          }
          units "dBm";
          description
            "Minimum transmitted power level.  Discontinuities
             in the value of this counter can occur at
             re-initialization of the management system and
             at other times as indicated by the value of
             'discontinuity-time' in ietf-interfaces.";
          reference
            "ETSI EN 301 129";
        }
        leaf max-tltm {
          type mw-types:power {
            range "-99..99";
          }
          units "dBm";
          description
            "Maximum transmitted power level.  Discontinuities
             in the value of this counter can occur at
             re-initialization of the management system and
             at other times as indicated by the value of
             'discontinuity-time' in ietf-interfaces.";
          reference
            "ETSI EN 301 129";
        }
      }
    }

    /*
     * Radio Link Protection Groups
     */

    container radio-link-protection-groups {
      description
        "Configuration of radio link protected groups of
         carrier terminations in a radio link.  More than one
         protected group per radio link terminal is allowed.";
      uses ifprot:protection-groups {
```

```
        refine "protection-group/members" {
          must "derived-from-or-self(/if:interfaces/if:interface"
             + "[if:name = current()]"
             + "/if:type, 'ianaift:microwaveCarrierTermination')" {
            description
              "The type of a protection member must be
               'microwaveCarrierTermination'.";
          }
        }
        refine "protection-group/working-entity" {
          must "derived-from-or-self(/if:interfaces/if:interface"
             + "[if:name = current()]"
             + "/if:type, 'ianaift:microwaveCarrierTermination')" {
            description
              "The type of a working-entity must be
               'microwaveCarrierTermination'.";
          }
        }
      }
    }

    /*
     * XPIC & MIMO groups - Configuration data nodes
     */

    container xpic-pairs {
      if-feature "xpic";
      description
        "Configuration of carrier termination pairs
         for operation in XPIC mode.";
      reference
        "ETSI TR 102 311";
      list xpic-pair {
        key "name";
        description
          "List of carrier termination pairs in XPIC mode.";
        leaf name {
          type string;
          description
            "Name used for identification of the XPIC pair.";
        }
        leaf enabled {
          type boolean;
          default "false";
          description
            "Enable(true)/disable(false) XPIC";
        }
        leaf-list members {
```

```
          type if:interface-ref;
          must "derived-from-or-self(/if:interfaces/if:interface"
             + "[if:name = current()]"
             + "/if:type, 'ianaift:microwaveCarrierTermination')" {
            description
              "The type of a member must be
               'microwaveCarrierTermination'.";
          }
          min-elements 2;
          max-elements 2;
          description
            "Association to XPIC pairs used in the radio link
             terminal.";
        }
      }
    }
    container mimo-groups {
      if-feature "mimo";
      description
        "Configuration of carrier terminations
         for operation in MIMO mode.";
      reference
        "ETSI TR 102 311";
      list mimo-group {
        key "name";
        description
          "List of carrier terminations in MIMO mode.";
        leaf name {
          type string;
          description
            "Name used for identification of the MIMO group.";
        }
        leaf enabled {
          type boolean;
          default "false";
          description
            "Enable(true)/disable(false) MIMO.";
        }
        leaf-list members {
          type if:interface-ref;
          must "derived-from-or-self(/if:interfaces/if:interface"
             + "[if:name = current()]"
             + "/if:type, 'ianaift:microwaveCarrierTermination')" {
            description
              "The type of a member must be
               'microwaveCarrierTermination'.";
          }
          min-elements 2;
```

```
          description
            "Association to a MIMO group if used in the radio
             link terminal.";
        }
      }
    }
  }
  <CODE ENDS>
```

3. Interface Protection YANG Data Model

The data nodes for management of the interface protection functionality is broken out from the Microwave Radio Link Module into a separate and generic YANG data model in order to make it also available for other interface types.

This module imports modules from [RFC8343], and it references [G.808.1].

```
<CODE BEGINS> file "ietf-interface-protection@2026-03-02.yang"
module ietf-interface-protection {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-interface-protection";
  prefix ifprot;

  import ietf-interfaces {
    prefix if;
    reference
      "RFC 8343";
  }

  organization
    "Internet Engineering Task Force (IETF) CCAMP WG";
  contact
    "WG List: <mailto:ccamp@ietf.org>

     Editors:
      Jonas Ahlberg (jonas.ahlberg@ericsson.com)
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      Marko Vaupotic (Marko.Vaupotic@aviatnet.com)";
  description
    "This is a YANG module for the entities in
     a generic interface protection mechanism.

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     authors of the code.  All rights reserved.
```

```
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        This version of this YANG module is part of RFC 8561bis; see the
        RFC itself for full legal notices.";

    // RFC Ed.: replace 8561bis with actual RFC number and remove
    // this note
    // replace the revision date with the module publication date
    // the format is (year-month-day)

    revision 2026-03-02 {
      description
        "Canonical Order and copyright updated";
      reference
        "RFC XXXX: A YANG Data Model for Microwave Radio Link";
    }
    revision 2019-06-19 {
      description
        "Initial revision.";
      reference
        "RFC 8561: A YANG Data Model for Microwave Radio Link";
    }

    /*
     * Protection architecture type identities
     */

    identity protection-architecture-type {
      description
        "protection architecture type";
      reference
        "ITU-T G.808.1";
    }

    identity one-plus-one-type {
      base protection-architecture-type;
      description
        "1+1; one interface protects
         another one interface.";
      reference
        "ITU-T G.808.1";
    }
```

```
  identity one-to-n-type {
    base protection-architecture-type;
    description
      "1:N; one interface protects
       n other interfaces.";
    reference
      "ITU-T G.808.1";
  }

  /*
   * Protection states identities
   */

  identity protection-states {
    description
      "Identities describing the status of the protection
       in a group of interfaces configured in
       a protection mode.";
  }

  identity unprotected {
    base protection-states;
    description
      "Not protected.";
  }

  identity protected {
    base protection-states;
    description
      "Protected.";
  }

  identity unable-to-protect {
    base protection-states;
    description
      "Unable to protect.";
  }

  /*
   * Protection Groups
   */

  grouping protection-groups {
    description
      "Configuration of protected groups of interfaces
       providing protection for each other.  More than one
       protected group per higher-layer interface is allowed.";
    list protection-group {
```

```
        key "name";
        description
          "List of protected groups of interfaces
           in a higher-layer interface.";
        action manual-switch-working {
          description
            "A switch action initiated by an operator command.
             It switches a normal traffic signal to the working
             transport entity.";
          reference
            "ITU-T G.808.1";
        }
        action manual-switch-protection {
          description
            "A switch action initiated by an operator command.
             It switches a normal traffic signal to the protection
             transport entity.";
          reference
            "ITU-T G.808.1";
        }
        action forced-switch {
          description
            "A switch action initiated by an operator command.
             It switches a normal traffic signal to the protection
             transport entity and forces it to remain on that
             entity even when criteria for switching back to
             the original entity are fulfilled.";
          reference
            "ITU-T G.808.1";
        }
        action lockout-of-protection {
          description
            "A switch action temporarily disables access to the
             protection transport entity for all signals.";
          reference
            "ITU-T G.808.1";
        }
        action freeze {
          description
            "A switch action temporarily prevents any switch action
             to be taken and, as such, freezes the current state.
             Until the freeze is cleared, additional near-end external
             commands are rejected, and fault condition changes and
             received Automatic Protection-Switching (APS) messages
             are ignored.";
          reference
            "ITU-T G.808.1";
        }
```

```
        action exercise {
          description
            "A switch action to test if the APS communication is
             operating correctly.  It is lower priority than any 'real'
             switch request.";
          reference
            "ITU-T G.808.1";
        }
        action clear {
          description
            "An action clears all switch commands.";
          reference
            "ITU-T G.808.1";
        }
        leaf name {
          type string;
          description
            "Name used for identification of the protection group.";
        }
        leaf protection-architecture-type {
          type identityref {
            base protection-architecture-type;
          }
          default "ifprot:one-plus-one-type";
          description
            "The type of protection architecture used, e.g., one
             interface protecting one or several other interfaces.";
          reference
            "ITU-T G.808.1";
        }
        leaf-list members {
          type if:interface-ref;
          min-elements 2;
          description
            "Association to a group of interfaces configured for
             protection and used by a higher-layer interface.";
        }
        leaf operation-type {
          type enumeration {
            enum non-revertive {
              description
                "In non-revertive operation, the traffic does not
                 return to the working interface if the switch requests
                 are terminated.";
              reference
                "ITU-T G.808.1";
            }
            enum revertive {
```

```
            description
              "In revertive operation, the traffic always
               returns to (or remains on) the working interface
               if the switch requests are terminated.";
            reference
              "ITU-T G.808.1";
          }
        }
        default "non-revertive";
        description
          "The type of protection operation, i.e., revertive
           or non-revertive operation.";
      }
      leaf-list working-entity {
        when "../operation-type = 'revertive'";
        type if:interface-ref;
        min-elements 1;
        description
          "The interfaces that the traffic normally should
           be transported over when there is no need to use the
           protecting interface.";
      }
      leaf revertive-wait-to-restore {
        when "../operation-type = 'revertive'";
        type uint16;
        units "seconds";
        default "0";
        description
          "The time to wait before switching back to the working
           interface if operation-type is revertive.";
        reference
          "ITU-T G.808.1";
      }
      leaf hold-off-timer {
        type uint16;
        units "milliseconds";
        default "0";
        description
          "Time interval after the detection of a fault and its
           confirmation as a condition requiring the protection-
           switching procedure.";
        reference
          "ITU-T G.808.1";
      }
      leaf status {
        type identityref {
          base protection-states;
        }
```

```
          config false;
          description
            "Status of the protection in a group of interfaces
             configured in a protection mode.";
          reference
            "ITU-T G.808.1";
        }
      }
    }
  }
  <CODE ENDS>
```

4. Microwave Types YANG Data Model

This module defines a collection of common data types using the YANG data modeling language. These common types are designed to be imported by other modules defined in the microwave area.

```
  <CODE BEGINS> file "ietf-microwave-types@2026-03-02.yang"
  module ietf-microwave-types {
    yang-version 1.1;
    namespace "urn:ietf:params:xml:ns:yang:ietf-microwave-types";
    prefix mw-types;

    organization
      "Internet Engineering Task Force (IETF) CCAMP WG";
    contact
      "WG List: <mailto:ccamp@ietf.org>

       Editors:
        Jonas Ahlberg (jonas.ahlberg@ericsson.com)
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        Marko Vaupotic (Marko.Vaupotic@aviatnet.com)
        Danilo Pala (danilo.pala@techmahindra.com)";
    description
      "This is a YANG module for the entities in
       a generic interface protection mechanism.

       Copyright (c) 2026 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
```

```
        (http://trustee.ietf.org/license-info).

        This version of this YANG module is part of RFC 8561bis;
        see the RFC itself for full legal notices.";

      // RFC Ed.: replace 8561bis with actual RFC number and remove
      // this note
      // replace the revision date with the module publication date
      // the format is (year-month-day)

      revision 2026-03-02 {
        description
          "TBD";
        reference
          "RFC XXXX: A YANG Data Model for Microwave Radio Link";
      }
      revision 2019-06-19 {
        description
          "Initial revision.";
        reference
          "RFC 8561: A YANG Data Model for Microwave Radio Link";
      }

      /*
       * Radio-link-terminal mode identities
       */

      identity rlt-mode {
        status deprecated;
        description
          "A description of the mode in which the radio link
           terminal is configured.  The format is X plus Y.
           X represents the number of bonded carrier terminations.
           Y represents the number of protecting carrier
           terminations.";
      }

      identity one-plus-zero {
        base rlt-mode;
        status deprecated;
        description
          "1 carrier termination only.";
      }

      identity one-plus-one {
        base rlt-mode;
        status deprecated;
        description
```

```
        "1 carrier termination
         and 1 protecting carrier termination.";
    }

    identity two-plus-zero {
      base rlt-mode;
      status deprecated;
      description
        "2 bonded carrier terminations.";
    }

    /*
     * Coding and modulation identities
     */

    identity coding-modulation {
      description
        "The coding and modulation schemes.";
    }

    identity fourth-bpsk {
      base coding-modulation;
      description
        "Fourth BPSK coding and modulation scheme.";
    }

    identity half-bpsk {
      base coding-modulation;
      description
        "Half BPSK coding and modulation scheme.";
    }

    identity half-bpsk-strong {
      base half-bpsk;
      description
        "Half BPSK strong coding and modulation scheme.";
    }

    identity half-bpsk-light {
      base half-bpsk;
      description
        "Half BPSK light coding and modulation scheme.";
    }

    identity bpsk {
      base coding-modulation;
      description
        "BPSK coding and modulation scheme.";
```

```
    }

    identity bpsk-strong {
      base bpsk;
      description
        "BPSK strong coding and modulation scheme.";
    }

    identity bpsk-light {
      base bpsk;
      description
        "BPSK light coding and modulation scheme.";
    }

    identity qpsk {
      base coding-modulation;
      description
        "QPSK coding and modulation scheme.";
    }

    identity psk-8 {
      base coding-modulation;
      description
        "8PSK coding and modulation scheme.";
    }

    identity qam-4 {
      base coding-modulation;
      description
        "4 QAM coding and modulation scheme.";
    }

    identity qam-4-strong {
      base qam-4;
      description
        "4 QAM strong coding and modulation scheme.";
    }

    identity qam-4-light {
      base qam-4;
      description
        "4 QAM light coding and modulation scheme.";
    }

    identity qam-16 {
      base coding-modulation;
      description
        "16 QAM coding and modulation scheme.";
```

```
  }

  identity qam-16-strong {
    base qam-16;
    description
      "16 QAM strong coding and modulation scheme.";
  }

  identity qam-16-light {
    base qam-16;
    description
      "16 QAM light coding and modulation scheme.";
  }

  identity qam-32 {
    base coding-modulation;
    description
      "32 QAM coding and modulation scheme.";
  }

  identity qam-32-strong {
    base qam-32;
    description
      "32 QAM strong coding and modulation scheme.";
  }

  identity qam-32-light {
    base qam-32;
    description
      "32 QAM light coding and modulation scheme.";
  }

  identity qam-64 {
    base coding-modulation;
    description
      "64 QAM coding and modulation scheme.";
  }

  identity qam-64-strong {
    base qam-64;
    description
      "64 QAM strong coding and modulation scheme.";
  }

  identity qam-64-light {
    base qam-64;
    description
      "64 QAM light coding and modulation scheme.";
```

```
    }

    identity qam-128 {
      base coding-modulation;
      description
        "128 QAM coding and modulation scheme.";
    }

    identity qam-128-strong {
      base qam-128;
      description
        "128 QAM strong coding and modulation scheme.";
    }

    identity qam-128-light {
      base qam-128;
      description
        "128 QAM light coding and modulation scheme.";
    }

    identity qam-256 {
      base coding-modulation;
      description
        "256 QAM coding and modulation scheme.";
    }

    identity qam-256-strong {
      base qam-256;
      description
        "256 QAM strong coding and modulation scheme.";
    }

    identity qam-256-light {
      base qam-256;
      description
        "256 QAM light coding and modulation scheme.";
    }

    identity qam-512 {
      base coding-modulation;
      description
        "512 QAM coding and modulation scheme.";
    }

    identity qam-512-strong {
      base qam-512;
      description
        "512 QAM strong coding and modulation scheme.";
```

```
    }

    identity qam-512-light {
      base qam-512;
      description
        "512 QAM light coding and modulation scheme.";
    }

    identity qam-1024 {
      base coding-modulation;
      description
        "1024 QAM coding and modulation scheme.";
    }

    identity qam-1024-strong {
      base qam-1024;
      description
        "1024 QAM strong coding and modulation scheme.";
    }

    identity qam-1024-light {
      base qam-1024;
      description
        "1024 QAM light coding and modulation scheme.";
    }

    identity qam-2048 {
      base coding-modulation;
      description
        "2048 QAM coding and modulation scheme.";
    }

    identity qam-2048-strong {
      base qam-2048;
      description
        "2048 QAM strong coding and modulation scheme.";
    }

    identity qam-2048-light {
      base qam-2048;
      description
        "2048 QAM light coding and modulation scheme.";
    }

    identity qam-4096 {
      base coding-modulation;
      description
        "4096 QAM coding and modulation scheme.";
```

```
  }

  identity qam-4096-strong {
    base qam-4096;
    description
      "4096 QAM strong coding and modulation scheme.";
  }

  identity qam-4096-light {
    base qam-4096;
    description
      "4096 QAM light coding and modulation scheme.";
  }

  /*
   * TDM-type identities
   */

  identity tdm-type {
    description
      "A description of the type of TDM connection,
       also indicating the supported capacity of the
       connection.";
  }

  identity E1 {
    base tdm-type;
    description
      "E1 connection, 2.048 Mbit/s.";
  }

  identity STM-1 {
    base tdm-type;
    description
      "STM-1 connection, 155.52 Mbit/s.";
  }

  typedef power {
    type decimal64 {
      fraction-digits 1;
    }
    description
      "Type used for the power values in the data nodes
       for configuration or status.";
  }

  /*
   * Radio-link-terminal mode grouping
```

```
      */

     grouping rlt-mode {
       description
         "This grouping provides a flexible definition of number
          of bonded carriers and protecting carriers of a radio
          link.";
       leaf num-bonded-carriers {
         type uint32;
         mandatory true;
         description
           "Number of bonded carriers.";
       }
       leaf num-protecting-carriers {
         type uint32;
         mandatory true;
         description
           "Number of protecting carriers.";
       }
     }

     /*
      * Common microwave properties ode grouping
      */

     grouping common-microwave-properties {
       description
         "This grouping provides a reusable set of microwave
          properties.";
       leaf tx-frequency {
         type uint32;
         units "kHz";
         mandatory true;
         description
           "Selected transmitter frequency.";
       }
       leaf actual-rx-frequency {
         type uint32;
         units "kHz";
         config false;
         description
           "Computed receiver frequency.";
       }
       leaf channel-separation {
         type uint32;
         units "kHz";
         mandatory true;
         description
```

```
            "The amount of bandwidth allocated to a carrier.  The
             distance between adjacent channels in a radio
             frequency channels arrangement";
          reference
            "ETSI EN 302 217-1";
        }
        leaf actual-transmitted-level {
          type power {
            range "-99..99";
          }
          units "dBm";
          config false;
          description
            "Actual transmitted power level (0.1 dBm resolution).";
          reference
            "ETSI EN 301 129";
        }
        leaf actual-tx-cm {
          type identityref {
            base mw-types:coding-modulation;
          }
          config false;
          description
            "Actual coding/modulation in transmitting direction.";
        }
        leaf actual-snir {
          type decimal64 {
            fraction-digits 1;
            range "0..99";
          }
          units "dB";
          config false;
          description
            "Actual signal to noise plus the interference ratio
             (0.1 dB resolution).";
        }
      }
    }
    <CODE ENDS>
```

5. Security Considerations

The YANG data models specified in this document define schemas 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.

There are a number of data nodes defined in these YANG data models that are writable/creatable/deletable (i.e., config true, which is the default). These data nodes may be considered sensitive or vulnerable in some network environments. Write operations (e.g., edit-config) to these data nodes without proper protection can have a negative effect on network operations. These are the subtrees and data nodes and their sensitivity/vulnerability:

Interfaces of type microwaveRadioLinkTerminal:

```
/if:interfaces/if:interface/mode,
/if:interfaces/if:interface/carrier-terminations,
/if:interfaces/if:interface/rlp-groups,
/if:interfaces/if:interface/xpic-pairs,
/if:interfaces/if:interface/mimo-groups, and
/if:interfaces/if:interface/tdm-connections:
```

These data nodes represent the configuration of the radio link terminal, and they need to match the configuration of the radio link terminal on the other side of the radio link. Unauthorized access to these data nodes could interrupt the ability to forward traffic.

Interfaces of type microwaveCarrierTermination:

```
/if:interfaces/if:interface/carrier-id,
/if:interfaces/if:interface/tx-enabled,
/if:interfaces/if:interface/tx-frequency,
/if:interfaces/if:interface/rx-frequency,
/if:interfaces/if:interface/duplex-distance,
/if:interfaces/if:interface/channel-separation,
/if:interfaces/if:interface/rtpc/maximum-nominal-power,
/if:interfaces/if:interface/atpc/maximum-nominal-power,
/if:interfaces/if:interface/atpc/atpc-lower-threshold,
/if:interfaces/if:interface/atpc/atpc-upper-threshold,
/if:interfaces/if:interface/single/selected-cm,
/if:interfaces/if:interface/adaptive/selected-min-acm,
/if:interfaces/if:interface/adaptive/selected-max-acm,
/if:interfaces/if:interface/if-loop, and
/if:interfaces/if:interface/rf-loop:
```

These data nodes represent the configuration of the carrier termination, and they need to match the configuration of the carrier termination on the other side of the carrier. Unauthorized access to these data nodes could interrupt the ability to forward traffic.

Radio link protection:

/radio-link-protection-groups/protection-group:

This data node represents the configuration of the protection of carrier terminations. Unauthorized access to this data node could interrupt the ability to forward traffic or remove the ability to perform a necessary protection switch.

XPIC:

/xpic-pairs:

This data node represents the XPIC configuration of a pair of carriers. Unauthorized access to this data node could interrupt the ability to forward traffic.

MIMO:

/mimo-groups:

This data node represents the MIMO configuration of multiple carriers. Unauthorized access to this data node could interrupt the ability to forward traffic.

Some of the RPC operations in this YANG data model may be considered sensitive or vulnerable in some network environments. It is thus important to control access to these operations. These are the operations and their sensitivity/vulnerability:

Radio link protection:

/radio-link-protection-groups/protection-group/manual-switch-working,
/radio-link-protection-groups/protection-group/manual-switch-protection,
/radio-link-protection-groups/protection-group/forced-switch,
/radio-link-protection-groups/protection-group/lockout-of-protection,
/radio-link-protection-groups/protection-group/freeze,
/radio-link-protection-groups/protection-group/exercise, and
/radio-link-protection-groups/protection-group/clear

These data nodes represent actions that might have an impact on the configuration of the protection of carrier terminations. Unauthorized access to these data nodes could interrupt the ability to forward traffic or remove the ability to perform a necessary protection switch.

The security considerations of [RFC8343] also apply to this document.

6. IANA Considerations

No IANA Considerations in this update.

7. References

7.1. Normative References

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

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[EN302217-1] ETSI, "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 1: Overview, common characteristics and system-dependent requirements", EN 302 217-1 V3.1.0 , May 2017.

[EN302217-2] ETSI, "Fixed Radio Systems; Characteristics and requirements for point to-point equipment and antennas; Part 2: Digital systems operating in frequency bands from 1 GHz to 86 GHz; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU", EN 302 217-2 V3.1.1 , May 2017.

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[G.826] ITU-T, "SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS; Digital networks - Quality and availability targets; End-to-end error performance parameters and objectives for international, constant bit-rate digital paths and connections", ITU-T Recommendation G.826 , December 2002.

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Appendix A. Changes from RFC 8561

To be added in a future revision of this draft.

Appendix B. Example: 1+0 and 2+0 Configuration Instances

This section gives simple examples of 1+0 and 2+0 instances using the YANG data model defined in this document. The examples are not intended as a complete module for 1+0 and 2+0 configuration.

B.1. 1+0 Instance

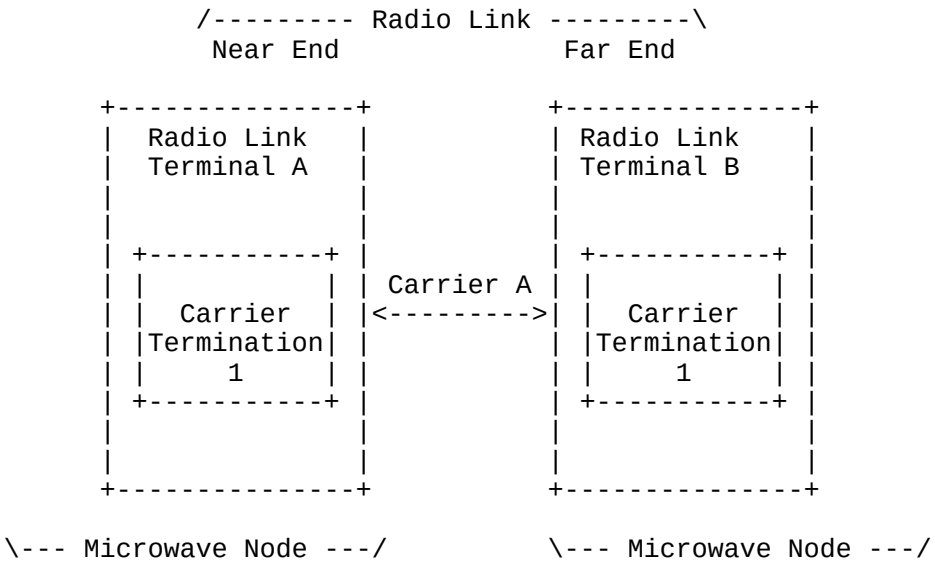

Figure 1: 1+0 Example

Figure 1 shows a 1+0 example. The following instance shows the 1+0 configuration of the Near End node.

```
{
  "ietf-interfaces:interfaces": {
    "interface": [
      {
        "name": "example:RLT-A",
        "description": "Radio Link Terminal A",
        "type": "iana-if-type:microwaveRadioLinkTerminal",
        "admin-status": "up",
        "oper-status": "up",
        "if-index": 1,
        "statistics": {
           "discontinuity-time": "2024-02-21T18:59:00-05:00"
        },
        "ietf-microwave-radio-link:mode":
           "ietf-microwave-types:one-plus-zero",
        "ietf-microwave-radio-link:carrier-terminations": [
          "example:RLT-A:CT-1"
        ]
      },
      {
        "name": "example:RLT-A:CT-1",
        "description": "Carrier Termination 1",
        "type": "iana-if-type:microwaveCarrierTermination",
        "admin-status": "up",
        "oper-status": "up",
        "if-index": 1,
        "statistics": {
           "discontinuity-time": "2024-02-21T18:59:00-05:00"
        },
        "ietf-microwave-radio-link:carrier-id": "example:A",
        "ietf-microwave-radio-link:tx-enabled": true,
        "ietf-microwave-radio-link:tx-frequency": 10728000,
        "ietf-microwave-radio-link:duplex-distance": 644000,
        "ietf-microwave-radio-link:channel-separation": 28000,
        "ietf-microwave-radio-link:polarization": "not-specified",
        "ietf-microwave-radio-link:rtpc": {
          "maximum-nominal-power": "20.0"
        },
        "ietf-microwave-radio-link:single": {
          "selected-cm": "ietf-microwave-types:qam-512"
        }
      }
    ]
  }
}
```

B.2. 2+0 Instance

Figure 2 shows a 2+0 example.

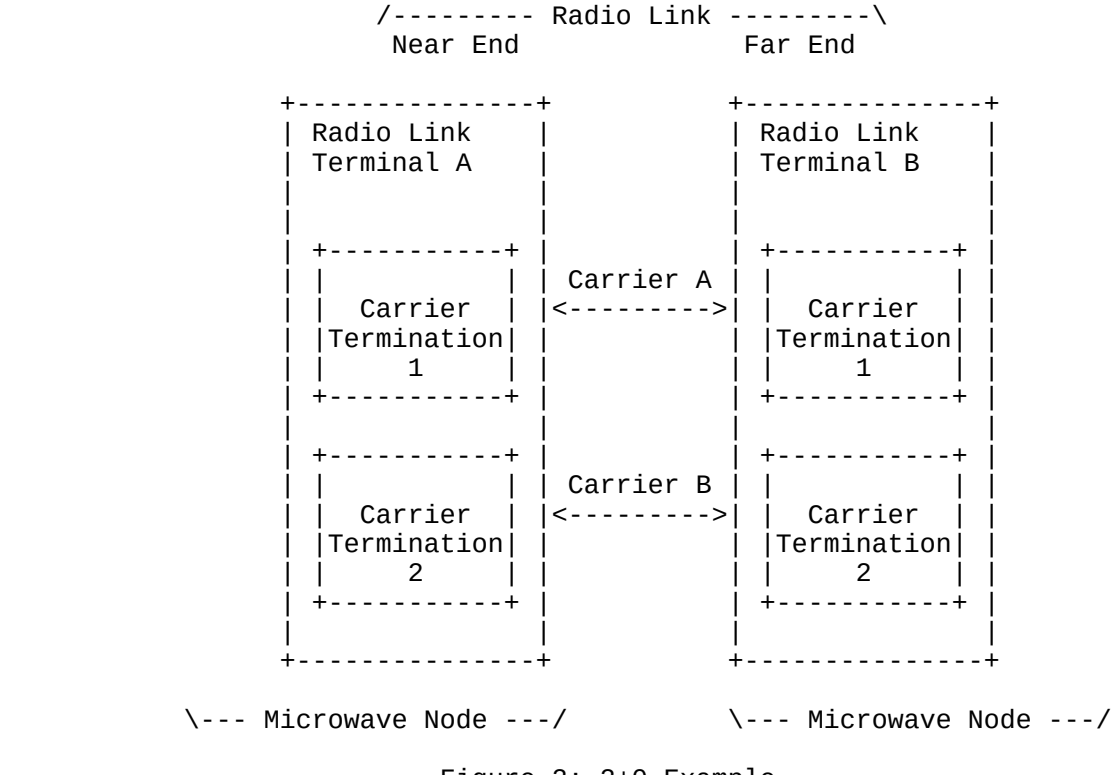

Figure 2: 2+0 Example

The following instance shows the 2+0 configuration of the Near End node.

```
{
  "ietf-interfaces:interfaces": {
    "interface": [
      {
        "name": "example:RLT-A",
        "description": "Radio Link Terminal A",
        "type": "iana-if-type:microwaveRadioLinkTerminal",
        "admin-status": "up",
        "oper-status": "up",
        "if-index": 1,
        "statistics": {
           "discontinuity-time": "2024-02-21T18:59:00-05:00"
        },
```

```
        "ietf-microwave-radio-link:mode":
          "ietf-microwave-types:two-plus-zero",
        "ietf-microwave-radio-link:carrier-terminations": [
          "example:RLT-A:CT-1",
          "example:RLT-A:CT-2"
        ]
      },
      {
        "name": "example:RLT-A:CT-1",
        "description": "Carrier Termination 1",
        "type": "iana-if-type:microwaveCarrierTermination",
        "admin-status": "up",
        "oper-status": "up",
        "if-index": 2,
        "statistics": {
           "discontinuity-time": "2024-02-21T18:59:00-05:00"
        },
        "ietf-microwave-radio-link:carrier-id": "example:A",
        "ietf-microwave-radio-link:tx-enabled": true,
        "ietf-microwave-radio-link:tx-frequency": 10728000,
        "ietf-microwave-radio-link:duplex-distance": 644000,
        "ietf-microwave-radio-link:channel-separation": 28000,
        "ietf-microwave-radio-link:polarization": "not-specified",
        "ietf-microwave-radio-link:rtpc": {
          "maximum-nominal-power": "20.0"
        },
        "ietf-microwave-radio-link:single": {
          "selected-cm": "ietf-microwave-types:qam-512"
        }
      },
      {
        "name": "example:RLT-A:CT-2",
        "description": "Carrier Termination 2",
        "type": "iana-if-type:microwaveCarrierTermination",
        "admin-status": "up",
        "oper-status": "up",
        "if-index": 3,
        "statistics": {
           "discontinuity-time": "2024-02-21T18:59:00-05:00"
        },
        "ietf-microwave-radio-link:carrier-id": "example:B",
        "ietf-microwave-radio-link:tx-enabled": true,
        "ietf-microwave-radio-link:tx-frequency": 10618000,
        "ietf-microwave-radio-link:duplex-distance": 644000,
        "ietf-microwave-radio-link:channel-separation": 28000,
        "ietf-microwave-radio-link:polarization": "not-specified",
        "ietf-microwave-radio-link:rtpc": {
          "maximum-nominal-power": "20.0"
```

```
          },
          "ietf-microwave-radio-link:single": {
            "selected-cm": "ietf-microwave-types:qam-512"
          }
        }
      ]
    }
  }
```

B.3. 2+0 XPIC Instance

The following instance shows the XPIC configuration of the Near End node.

```
{
  "ietf-interfaces:interfaces": {
    "interface": [
      {
        "name": "example:RLT-A",
        "description": "Radio Link Terminal A",
        "type": "iana-if-type:microwaveRadioLinkTerminal",
        "admin-status": "up",
        "oper-status": "up",
        "if-index": 1,
        "statistics": {
           "discontinuity-time": "2024-02-21T18:59:00-05:00"
        },
        "ietf-microwave-radio-link:mode":
           "ietf-microwave-types:two-plus-zero",
        "ietf-microwave-radio-link:carrier-terminations": [
          "example:RLT-A:CT-1",
          "example:RLT-A:CT-2"
        ],
        "ietf-microwave-radio-link:xpic-pairs": [
          "xpic-pair1"
        ]
      },
      {
        "name": "example:RLT-A:CT-1",
        "description": "Carrier Termination 1",
        "type": "iana-if-type:microwaveCarrierTermination",
        "admin-status": "up",
        "oper-status": "up",
        "if-index": 2,
        "statistics": {
           "discontinuity-time": "2024-02-21T18:59:00-05:00"
        },
        "ietf-microwave-radio-link:carrier-id": "example:A",
```

```
          "ietf-microwave-radio-link:tx-enabled": true,
          "ietf-microwave-radio-link:tx-frequency": 10728000,
          "ietf-microwave-radio-link:duplex-distance": 644000,
          "ietf-microwave-radio-link:channel-separation": 28000,
          "ietf-microwave-radio-link:polarization": "not-specified",
          "ietf-microwave-radio-link:rtpc": {
            "maximum-nominal-power": "20.0"
          },
          "ietf-microwave-radio-link:single": {
            "selected-cm": "ietf-microwave-types:qam-512"
          }
        },
        {
          "name": "example:RLT-A:CT-2",
          "description": "Carrier Termination 2",
          "type": "iana-if-type:microwaveCarrierTermination",
          "admin-status": "up",
          "oper-status": "up",
          "if-index": 3,
          "statistics": {
             "discontinuity-time": "2024-02-21T18:59:00-05:00"
          },
          "ietf-microwave-radio-link:carrier-id": "example:B",
          "ietf-microwave-radio-link:tx-enabled": true,
          "ietf-microwave-radio-link:tx-frequency": 10618000,
          "ietf-microwave-radio-link:duplex-distance": 644000,
          "ietf-microwave-radio-link:channel-separation": 28000,
          "ietf-microwave-radio-link:polarization": "not-specified",
          "ietf-microwave-radio-link:rtpc": {
            "maximum-nominal-power": "20.0"
          },
          "ietf-microwave-radio-link:single": {
            "selected-cm": "ietf-microwave-types:qam-512"
          }
        }
      ]
    },
    "ietf-microwave-radio-link:xpic-pairs": {
      "xpic-pair": [
        {
          "name": "xpic-pair1",
          "members": [
            "example:RLT-A:CT-1",
            "example:RLT-A:CT-2"
          ]
        }
      ]
    }
```

```
}
```

~~~~

Appendix C. Acknowledgments

This document was prepared using the kramdown RFC tool written and maintained by Carsten Bormann. Thanks to Martin Thomson for the github integration of the kramdown RFC tool and for the aasvg tool which is used for the ascii to SVG conversion.

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