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YANG Data Model for IS-IS Protocol
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Abstract

This document defines a YANG data model that can be used to configure and manage the IS-IS protocol on network elements.

Requirements Language

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

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1. Introduction

This document defines a YANG [RFC7950] data model for IS-IS routing protocol.

The data model covers configuration of an IS-IS routing protocol instance, as well as, the retrieval of IS-IS operational state.

A simplified tree representation of the data model is presented in Section 2. Tree diagrams used in this document follow the notation defined in [RFC8340].

The module is designed as per the NMDA (Network Management Datastore Architecture) [RFC8342].

2. Design of the Data Model

The IS-IS YANG module augments the "control-plane-protocol" list in the ietf-routing module [RFC8349] with specific IS-IS parameters.

The figure below describes the overall structure of the ietf-isis YANG module:

```
module: ietf-isis
  augment /rt:routing/rt:ribs/rt:rib/rt:routes/rt:route:
    +--ro metric?       uint32
    +--ro tag*          uint64
    +--ro route-type?   enumeration
  augment /if:interfaces/if:interface:
    +--rw clns-mtu?   uint16 {osi-interface}?
  augment
    | /rt:routing/rt:control-plane-protocols/rt:control-plane-protocol:
    +--rw isis
       +--rw enable?                   boolean {admin-control}?
       +--rw level-type?               level
       +--rw system-id?                system-id
       +--rw maximum-area-addresses?   uint8 {maximum-area-addresses}?
       +--rw area-address*             area-address
       +--rw lsp-mtu?                  uint16
       +--rw lsp-lifetime?             uint16
       +--rw lsp-refresh?
       |                   rt-types:timer-value-seconds16 {lsp-refresh}?
       +--rw poi-tlv?                  boolean {poi-tlv}?
       +--rw graceful-restart {graceful-restart}?
       |  +--rw enable?             boolean
       |  +--rw restart-interval?   rt-types:timer-value-seconds16
       |  +--rw helper-enable?      boolean
       +--rw nsr {nsr}?
       |  +--rw enable?   boolean
       +--rw node-tags {node-tag}?
       |  +--rw node-tag* [tag]
       |        ...
       +--rw metric-type
```

```
       |  +--rw value?     enumeration
       |  +--rw level-1
       |  |     ...
       |  +--rw level-2
       |        ...
       +--rw default-metric
       |  +--rw value?     wide-metric
       |  +--rw level-1
       |  |     ...
       |  +--rw level-2
       |        ...
       +--rw auto-cost {auto-cost}?
       |  +--rw enable?                boolean
       |  +--rw reference-bandwidth?   uint32
       +--rw authentication
       |  +--rw (authentication-type)?
       |  |     ...
       |  +--rw level-1
       |  |     ...
       |  +--rw level-2
       |        ...
       +--rw address-families {nlpid-control}?
       |  +--rw address-family-list* [address-family]
       |        ...
       +--rw mpls
       |  +--rw te-rid {te-rid}?
       |  |     ...
       |  +--rw ldp
       |        ...
       +--rw spf-control
       |  +--rw paths?            uint16 {max-ecmp}?
       |  +--rw ietf-spf-delay {ietf-spf-delay}?
       |        ...
       +--rw fast-reroute {fast-reroute}?
       |  +--rw lfa {lfa}?
       +--rw preference
       |  +--rw (granularity)?
       |        ...
       +--rw overload
       |  +--rw status?   boolean
       +--rw overload-max-metric {overload-max-metric}?
       |  +--rw timeout?   rt-types:timer-value-seconds16
       +--ro spf-log
       |  +--ro event* [id]
       |        ...
       +--ro lsp-log
       |  +--ro event* [id]
       |        ...
```

```
      +--ro hostnames
      |  +--ro hostname* [system-id]
      |        ...
      +--ro database
      |  +--ro levels* [level]
      |        ...
      +--ro local-rib
      |  +--ro route* [prefix]
      |        ...
      +--ro system-counters
      |  +--ro level* [level]
      |        ...
      +--ro protected-routes
      |  +--ro address-family-stats* [address-family prefix alternate]
      |        ...
      +--ro unprotected-routes
      |  +--ro address-family-stats* [address-family prefix]
      |        ...
      +--ro protection-statistics* [frr-protection-method]
      |  +--ro frr-protection-method    identityref
      |  +--ro address-family-stats* [address-family]
      |        ...
      +--rw discontinuity-time?       yang:date-and-time
      +--rw topologies {multi-topology}?
      |  +--rw topology* [name]
      |        ...
      +--rw interfaces
         +--rw interface* [name]
               ...

  rpcs:
    +---x clear-adjacency
    |  +---w input
    |     +---w routing-protocol-instance-name
    |  ->/rt:routing/control-plane-protocols/control-plane-protocol/name
    |     +---w level?                           level
    |     +---w interface?                       if:interface-ref
    +---x clear-database
       +---w input
          +---w routing-protocol-instance-name
      -> /rt:routing/control-plane-protocols/control-plane-protocol/name
          +---w level?                           level

  notifications:
    +---n database-overload
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
```

```
    |  +--ro overload?                enumeration
    +---n lsp-too-large
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro pdu-size?                uint32
    |  +--ro lsp-id?                  lsp-id
    +---n if-state-change
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro state?                   if-state-type
    +---n corrupted-lsp-detected
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro lsp-id?                  lsp-id
    +---n attempt-to-exceed-max-sequence
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro lsp-id?                  lsp-id
    +---n id-len-mismatch
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro pdu-field-len?           uint8
    |  +--ro raw-pdu?                 binary
    +---n max-area-addresses-mismatch
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro max-area-addresses?      uint8
    |  +--ro raw-pdu?                 binary
    +---n own-lsp-purge
    |  +--ro routing-protocol-name?
```

```
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro lsp-id?                  lsp-id
    +---n sequence-number-skipped
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro lsp-id?                  lsp-id
    +---n authentication-type-failure
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro raw-pdu?                 binary
    +---n authentication-failure
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro raw-pdu?                 binary
    +---n version-skew
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro protocol-version?        uint8
    |  +--ro raw-pdu?                 binary
    +---n area-mismatch
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro raw-pdu?                 binary
    +---n rejected-adjacency
```

```
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro raw-pdu?                 binary
    |  +--ro reason?                  string
    +---n protocols-supported-mismatch
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro raw-pdu?                 binary
    |  +--ro protocols*               uint8
    +---n lsp-error-detected
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro lsp-id?                  lsp-id
    |  +--ro raw-pdu?                 binary
    |  +--ro error-offset?            uint32
    |  +--ro tlv-type?                uint8
    +---n adjacency-state-change
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro neighbor?                string
    |  +--ro neighbor-system-id?      system-id
    |  +--ro state?                   adj-state-type
    |  +--ro reason?                  string
    +---n lsp-received
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro lsp-id?                  lsp-id
    |  +--ro sequence?                uint32
```

```
    |  +--ro received-timestamp?      yang:timestamp
    |  +--ro neighbor-system-id?      system-id
    +---n lsp-generation
       +--ro routing-protocol-name?
      -> /rt:routing/control-plane-protocols/control-plane-protocol/name
       +--ro isis-level?              level
       +--ro lsp-id?                  lsp-id
       +--ro sequence?                uint32
       +--ro send-timestamp?          yang:timestamp
```

2.1. IS-IS Configuration

The IS-IS configuration is divided into:

o Global parameters.

o Per-interface configuration (see Section 2.4).

Additional modules may be created to support additional parameters. These additional modules MUST augment the ietf-isis module.

The model includes optional features, for which the corresponding configuration data nodes are also optional. As an example, the ability to control the administrative state of a particular IS-IS instance is optional. By advertising the feature "admin-control", a device communicates to the client that it supports the ability to shut down a particular IS-IS instance.

The global configuration contains usual IS-IS parameters, such as, lsp-mtu, lsp-lifetime, lsp-refresh, default-metric, etc.

2.2. Multi-topology Parameters

The model supports multi-topology (MT) IS-IS as defined in [RFC5120].

The "topologies" container is used to enable support of the MT extensions.

The "name" used in the topology list should refer to an existing Routing Information Base (RIB) defined for the device [RFC8349].

Some specific parameters can be defined on a per-topology basis, both at the global level and at the interface level: for example, an interface metric can be defined per-topology.

Multiple address families (such as, IPv4 or IPv6) can also be enabled within the default topology. This can be achieved using the address-

families container (requiring the "nlpid-control" feature to be supported).

2.3. Per-Level Parameters

Some parameters allow a per-level configuration. For such parameters, the parameter is modeled as a container with three configuration locations:

- o a Top-level container: Corresponds to level-1-2, so the configuration applies to both levels.
- o a Level-1 container: Corresponds to level-1 specific parameters.
- o a Level-2 container: Corresponds to level-2 specific parameters.

```
+--rw priority
|  +--rw value?     uint8
|  +--rw level-1
|  |  +--rw value?   uint8
|  +--rw level-2
|     +--rw value?   uint8
```

Example:

```
<priority>
    <value>250</value>
    <level-1>
        <value>100</value>
    </level-1>
    <level-2>
        <value>200</value>
    </level-2>
</priority>
```

An implementation MUST prefer a level-specific parameter over a top-level parameter. For example, if the priority is 100 for the level-1, 200 for the level-2 and 250 for the top-level configuration, the implementation must use 100 for the level-1 priority and 200 for the level-2 priority.

Some parameters, such as, "overload bit" and "route preference", are not modeled to support a per-level configuration. If an implementation supports per-level configuration for such parameter, this implementation MUST augment the current model by adding both level-1 and level-2 containers and MUST reuse existing configuration groupings.

Example of augmentation:

```
augment "/rt:routing/" +
        "rt:control-plane-protocols/rt:control-plane-protocol"+
        "/isis:isis/isis:overload" {
        when "rt:type = 'isis:isis'" {
          description
           "This augment IS-IS routing protocol when used";
        }
        description
          "This augments IS-IS overload configuration
           with per-level configuration.";

        container level-1 {
          uses isis:overload-global-cfg;
          description
            "Level 1 configuration.";
        }
        container level-2 {
          uses isis:overload-global-cfg;
          description
            "Level 2 configuration.";
        }
}
```

If an implementation does not support per-level configuration for a parameter modeled with per-level configuration, the implementation SHOULD advertise a deviation to announce the non-support of the level-1 and level-2 containers.

Finally, if an implementation supports per-level configuration but does not support the level-1-2 configuration, it SHOULD also advertise a deviation.

2.4. Per-Interface Parameters

The per-interface section of the IS-IS instance describes the interface-specific parameters.

The interface is modeled as a reference to an existing interface defined in the "ietf-interfaces" YANG model ([RFC8343].

Each interface has some interface-specific parameters that may have a different per-level value as described in the previous section. An interface-specific parameter MUST be preferred over an IS-IS global parameter.

Some parameters, such as, hello-padding are defined as containers to allow easy extension by vendor-specific modules.

```
+--rw interfaces
   +--rw interface* [name]
      +--rw name                      if:interface-ref
      +--rw enable?                   boolean {admin-control}?
      +--rw level-type?               level
      +--rw lsp-pacing-interval?
      |                       rt-types:timer-value-milliseconds
      +--rw lsp-retransmit-interval?
      |                       rt-types:timer-value-seconds16
      +--rw passive?                  boolean
      +--rw csnp-interval?
      |                       rt-types:timer-value-seconds16
      +--rw hello-padding
      |  +--rw enable?   boolean
      +--rw mesh-group-enable?        mesh-group-state
      +--rw mesh-group?               uint8
      +--rw interface-type?           interface-type
      +--rw tag*                      uint32 {prefix-tag}?
      +--rw tag64*                    uint64 {prefix-tag64}?
      +--rw node-flag?                boolean {node-flag}?
      +--rw hello-authentication
      |  +--rw (authentication-type)?
      |  |  +--:(key-chain) {key-chain}?
      |  |  |  +--rw key-chain?         key-chain:key-chain-ref
      |  |  +--:(password)
      |  |     +--rw key?               string
      |  |     +--rw crypto-algorithm?  identityref
      |  +--rw level-1
      |  |  +--rw (authentication-type)?
      |  |     +--:(key-chain) {key-chain}?
      |  |     |  +--rw key-chain?      key-chain:key-chain-ref
      |  |     +--:(password)
      |  |        +--rw key?               string
      |  |        +--rw crypto-algorithm?  identityref
      |  +--rw level-2
      |     +--rw (authentication-type)?
      |        +--:(key-chain) {key-chain}?
      |        |  +--rw key-chain?      key-chain:key-chain-ref
      |        +--:(password)
      |           +--rw key?               string
      |           +--rw crypto-algorithm?  identityref
      +--rw hello-interval
      |  +--rw value?     rt-types:timer-value-seconds16
      |  +--rw level-1
      |  |  +--rw value?   rt-types:timer-value-seconds16
```

```
             |  +--rw level-2
             |     +--rw value?   rt-types:timer-value-seconds16
             +--rw hello-multiplier
             |  +--rw value?     uint16
             |  +--rw level-1
             |  |  +--rw value?   uint16
             |  +--rw level-2
             |     +--rw value?   uint16
             +--rw priority
             |  +--rw value?     uint8
             |  +--rw level-1
             |  |  +--rw value?   uint8
             |  +--rw level-2
             |     +--rw value?   uint8
             +--rw metric
             |  +--rw value?     wide-metric
             |  +--rw level-1
             |  |  +--rw value?   wide-metric
             |  +--rw level-2
             |     +--rw value?   wide-metric
             +--rw bfd {bfd}?
             |  +--rw enable?                          boolean
             |  +--rw local-multiplier?                multiplier
             |  +--rw (interval-config-type)?
             |     +--:(tx-rx-intervals)
             |     |  +--rw desired-min-tx-interval?    uint32
             |     |  +--rw required-min-rx-interval?   uint32
             |     +--:(single-interval) {single-minimum-interval}?
             |        +--rw min-interval?               uint32
             +--rw address-families {nlpid-control}?
             |  +--rw address-family-list* [address-family]
             |     +--rw address-family    iana-rt-types:address-family
             +--rw mpls
             |  +--rw ldp
             |     +--rw igp-sync?   boolean {ldp-igp-sync}?
             +--rw fast-reroute {fast-reroute}?
             |  +--rw lfa {lfa}?
             |     +--rw candidate-enable?   boolean
             |     +--rw enable?             boolean
             |     +--rw remote-lfa {remote-lfa}?
             |     |  +--rw enable?   boolean
             |     +--rw level-1
             |     |  +--rw candidate-enable?   boolean
             |     |  +--rw enable?             boolean
             |     |  +--rw remote-lfa {remote-lfa}?
             |     |     +--rw enable?   boolean
             |     +--rw level-2
             |        +--rw candidate-enable?   boolean
```

```
             |        +--rw enable?             boolean
             |        +--rw remote-lfa {remote-lfa}?
             |           +--rw enable?   boolean
             +--ro adjacencies
             |  +--ro adjacency* []
             |     +--ro neighbor-sys-type?            level
             |     +--ro neighbor-sysid?               system-id
             |     +--ro neighbor-extended-circuit-id?
             |     |                         extended-circuit-id
             |     +--ro neighbor-snpa?                snpa
             |     +--ro usage?                        level
             |     +--ro hold-timer?
             |                        rt-types:timer-value-seconds16
             |     +--ro neighbor-priority?              uint8
             |     +--ro lastuptime?                     yang:timestamp
             |     +--ro state?                          adj-state-type
             +--ro event-counters
             |  +--ro adjacency-changes?             uint32
             |  +--ro adjacency-number?              uint32
             |  +--ro init-fails?                    uint32
             |  +--ro adjacency-rejects?             uint32
             |  +--ro id-len-mismatch?               uint32
             |  +--ro max-area-addresses-mismatch?   uint32
             |  +--ro authentication-type-fails?     uint32
             |  +--ro authentication-fails?          uint32
             |  +--ro lan-dis-changes?               uint32
             +--ro packet-counters
             |  +--ro level* [level]
             |     +--ro level      level-number
             |     +--ro iih
             |     |  +--ro in?    uint32
             |     |  +--ro out?   uint32
             |     +--ro ish
             |     |  +--ro in?    uint32
             |     |  +--ro out?   uint32
             |     +--ro esh
             |     |  +--ro in?    uint32
             |     |  +--ro out?   uint32
             |     +--ro lsp
             |     |  +--ro in?    uint32
             |     |  +--ro out?   uint32
             |     +--ro psnp
             |     |  +--ro in?    uint32
             |     |  +--ro out?   uint32
             |     +--ro csnp
             |     |  +--ro in?    uint32
             |     |  +--ro out?   uint32
             |     +--ro unknown
```

```
             |        +--ro in?   uint32
             +--rw discontinuity-time?       yang:date-and-time
             +--rw topologies {multi-topology}?
                +--rw topology* [name]
                   +--rw name
                   |    -> ../../../../../../../../rt:ribs/rib/name
                   +--rw metric
                      +--rw value?     wide-metric
                      +--rw level-1
                      |  +--rw value?   wide-metric
                      +--rw level-2
                         +--rw value?   wide-metric

   rpcs:
    +---x clear-adjacency
    |  +---w input
    |     +---w routing-protocol-instance-name
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |     +---w level?                            level
    |     +---w interface?                        if:interface-ref
    +---x clear-database
       +---w input
          +---w routing-protocol-instance-name
      -> /rt:routing/control-plane-protocols/control-plane-protocol/name
          +---w level?                            level

   notifications:
    +---n database-overload
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro overload?                enumeration
    +---n lsp-too-large
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro pdu-size?                uint32
    |  +--ro lsp-id?                  lsp-id
    +---n if-state-change
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
```

```
    |  +--ro state?                   if-state-type
    +---n corrupted-lsp-detected
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro lsp-id?                  lsp-id
    +---n attempt-to-exceed-max-sequence
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro lsp-id?                  lsp-id
    +---n id-len-mismatch
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro pdu-field-len?           uint8
    |  +--ro raw-pdu?                 binary
    +---n max-area-addresses-mismatch
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro max-area-addresses?      uint8
    |  +--ro raw-pdu?                 binary
    +---n own-lsp-purge
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro lsp-id?                  lsp-id
    +---n sequence-number-skipped
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro lsp-id?                  lsp-id
    +---n authentication-type-failure
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
```

```
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro raw-pdu?                 binary
    +---n authentication-failure
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro raw-pdu?                 binary
    +---n version-skew
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro protocol-version?        uint8
    |  +--ro raw-pdu?                 binary
    +---n area-mismatch
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro raw-pdu?                 binary
    +---n rejected-adjacency
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro raw-pdu?                 binary
    |  +--ro reason?                  string
    +---n protocols-supported-mismatch
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro raw-pdu?                 binary
    |  +--ro protocols*               uint8
```

```
    +---n lsp-error-detected
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro lsp-id?                  lsp-id
    |  +--ro raw-pdu?                 binary
    |  +--ro error-offset?            uint32
    |  +--ro tlv-type?                uint8
    +---n adjacency-state-change
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro neighbor?                string
    |  +--ro neighbor-system-id?      system-id
    |  +--ro state?                   adj-state-type
    |  +--ro reason?                  string
    +---n lsp-received
    |  +--ro routing-protocol-name?
    | -> /rt:routing/control-plane-protocols/control-plane-protocol/name
    |  +--ro isis-level?              level
    |  +--ro interface-name?          if:interface-ref
    |  +--ro interface-level?         level
    |  +--ro extended-circuit-id?     extended-circuit-id
    |  +--ro lsp-id?                  lsp-id
    |  +--ro sequence?                uint32
    |  +--ro received-timestamp?      yang:timestamp
    |  +--ro neighbor-system-id?      system-id
    +---n lsp-generation
       +--ro routing-protocol-name?
      -> /rt:routing/control-plane-protocols/control-plane-protocol/name
       +--ro isis-level?              level
       +--ro lsp-id?                  lsp-id
       +--ro sequence?                uint32
       +--ro send-timestamp?          yang:timestamp
```

2.5. Authentication Parameters

The module enables authentication configuration through the IETF key-chain module [RFC8177]. The IS-IS module imports the "ietf-key-chain" module and reuses some groupings to allow global and per-interface configuration of authentication. If global authentication is configured, an implementation SHOULD authenticate PSNPs (Partial

Sequence Number Packets), CSNPs (Complete Sequence Number Packets) and LSPs (Link State Packets) with the authentication parameters supplied. The authentication of HELLO PDUs (Protocol Data Units) can be activated on a per-interface basis.

2.6. IGP/LDP synchronization

[RFC5443] defines a mechanism where IGP (Interior Gateway Protocol) needs to be synchronized with LDP (Label Distribution Protocol). An "ldp-igp-sync" feature has been defined in the model to support this functionality. The "mpls/ldp/igp-sync" leaf under "interface" allows activation of the mechanism on a per-interface basis. The "mpls/ldp/igp-sync" container in the global configuration is intentionally empty and is not required for feature activation. The goal of this empty container is to facilitate augmentation with additional parameters, e.g., timers.

2.7. ISO parameters

As the IS-IS protocol is based on the ISO protocol suite, some ISO parameters may be required.

This module augments interface configuration model to support selected ISO configuration parameters.

The clns-mtu can be configured for an interface.

2.8. IP FRR

This YANG module supports LFA (Loop Free Alternates) [RFC5286] and remote LFA [RFC7490] as IP Fast Re-Route (FRR) techniques. The "fast-reroute" container may be augmented by other models to support other IP FRR flavors (MRT, TI-LFA, etc.).

The current version of the model supports activation of LFA and remote LFA at the interface-level only. The global "lfa" container is present but kept empty to allow augmentation with vendor-specific properties, e.g., policies.

Remote LFA is considered as an extension of LFA. Remote LFA cannot be enabled if LFA is not enabled.

The "candidate-enable" data leaf designates that an interface can be used as a backup.

2.9. Operational States

Operational state is defined in module in various containers at various levels:

- o system-counters: Provides statistical information about the global system.

- o interface: Provides configuration state information for each interface.

- o adjacencies: Provides state information about current IS-IS adjacencies.

- o spf-log: Provides information about SPF events for an IS-IS instance. This SHOULD be implemented as a wrapping buffer.

- o lsp-log: Provides information about LSP events for an IS-IS instance (reception of an LSP or modification of a local LSP). This SHOULD be implemented as a wrapping buffer and the implementation MAY optionally log LSP refreshes.

- o local-rib: Provides the IS-IS internal routing table.

- o database: Provides contents of the current Link State Database.

- o hostnames: Provides the system-id to hostname mappings [RFC5301].

- o fast-reroute: Provides IP FRR state information.

3. RPC Operations

The "ietf-isis" module defines two RPC operations:

- o clear-database: Reset the content of a particular IS-IS database and restart database synchronization with all neighbors.

- o clear-adjacency: Restart a particular set of IS-IS adjacencies.

4. Notifications

The "ietf-isis" module defines the following notifications :

database-overload: This notification is sent when the IS-IS Node overload condition changes.

lsp-too-large: This notification is sent when the system tries to propagate a PDU that is too large.

if-state-change: This notification is sent when the state of an interface's state changes.

corrupted-lsp-detected: This notification is sent when the IS-IS node discovers that an LSP that was previously stored in the Link State Database, i.e., local memory, has become corrupted.

attempt-to-exceed-max-sequence: This notification is sent when the system wraps the 32-bit sequence counter of an LSP.

id-len-mismatch: This notification is sent when we receive a PDU with a different value for the System ID length.

max-area-addresses-mismatch: This notification is sent when we receive a PDU with a different value for the Maximum Area Addresses.

own-lsp-purge: This notification is sent when the system receives a PDU with its own system ID and zero age.

sequence-number-skipped: This notification is sent when the system receives a PDU with its own system ID and different contents. The system has to reissue the LSP with a higher sequence number.

authentication-type-failure: This notification is sent when the system receives a PDU with the wrong authentication type field.

authentication-failure: This notification is sent when the system receives a PDU with the wrong authentication information.

version-skew: This notification is sent when the system receives a PDU with a different protocol version number.

area-mismatch: This notification is sent when the system receives a Hello PDU from an IS that does not share any area address.

rejected-adjacency: This notification is sent when the system receives a Hello PDU from an IS but does not establish an adjacency for some reason.

protocols-supported-mismatch: This notification is sent when the system receives a non-pseudonode LSP that has no matching protocol supported.

lsp-error-detected: This notification is sent when the system receives an LSP with a parse error.

adjacency-state-change: This notification is sent when an IS-IS adjacency moves to Up state or to Down state.

lsp-received: This notification is sent when an LSP is received.

lsp-generation: This notification is sent when an LSP is regenerated.

5. Interaction with Other YANG Modules

The "isis" container augments the "/rt:routing/rt:control-plane-protocols/control-plane-protocol" container of the ietf-routing [RFC8349] module by with IS-IS-specific parameters.

The "isis" module augments "/if:interfaces/if:interface" defined by [RFC8343] with ISO specific parameters.

The "isis" operational state container augments the "/rt:routing-state/rt:control-plane-protocols/control-plane-protocol" container of the ietf-routing module with IS-IS-specific operational states.

Some IS-IS-specific route attributes are added to route objects in the ietf-routing module by augmenting "/rt:routing-state/rt:ribs/rt:rib/rt:routes/rt:route".

The modules defined in this document uses some groupings from ietf-keychain [RFC8177].

The module reuses types from [RFC6991] and [RFC8294].

To support BFD for fast detection, the module relies on [I-D.ietf-bfd-yang].

6. IS-IS YANG Module

The following RFCs, drafts and external standards are not referenced in the document text but are referenced in the ietf-isis.yang module: [ISO-10589], [RFC1195], [RFC4090],[RFC5029], [RFC5130], [RFC5302], [RFC5305], [RFC5306], [RFC5307], [RFC5308], [RFC5880], [RFC5881], [RFC6119], [RFC6232], [RFC7794], [RFC7981], [RFC8570], [RFC7917], [RFC8405].

```
<CODE BEGINS> file "ietf-isis@2019-09-26.yang"
module ietf-isis {
```

```
yang-version 1.1;
namespace "urn:ietf:params:xml:ns:yang:ietf-isis";

prefix isis;

import ietf-routing {
  prefix "rt";
  reference "RFC 8349 - A YANG Data Model for Routing
             Management (NMDA Version)";
}

import ietf-inet-types {
  prefix inet;
  reference "RFC 6991 - Common YANG Data Types";
}

import ietf-yang-types {
  prefix yang;
  reference "RFC 6991 - Common YANG Data Types";
}

import ietf-interfaces {
  prefix "if";
  reference "RFC 8343 - A YANG Data Model for Interface
             Management (NDMA Version)";
}

import ietf-key-chain {
  prefix "key-chain";
  reference "RFC 8177 - YANG Data Model for Key Chains";
}

import ietf-routing-types {
  prefix "rt-types";
  reference "RFC 8294 - Common YANG Data Types for the
             Routing Area";
}

import iana-routing-types {
  prefix "iana-rt-types";
  reference "RFC 8294 - Common YANG Data Types for the
             Routing Area";
}

import ietf-bfd-types {
  prefix "bfd-types";
  reference "RFC YYYY - YANG Data Model for Bidirectional
             Forwarding Detection (BFD).
```

```
   -- Note to RFC Editor Please replace YYYY with published RFC
     number for draft-ietf-bfd-yang.";

     }

     organization
       "IETF LSR Working Group";

     contact
       "WG List:  <mailto:lsr@ietf.org>

       Editor:    Stephane Litkowski
             <mailto:stephane.litkowski@orange.com>

           Derek Yeung
             <mailto:derek@arrcus.com>
           Acee Lindem
             <mailto:acee@cisco.com>
           Jeffrey Zhang
             <mailto:zzhang@juniper.net>
           Ladislav Lhotka
             <mailto:llhotka@nic.cz>

       ";

     description
      "This YANG module defines the generic configuration and
       operational state for the IS-IS protocol common to all
       vendor implementations. It is intended that the module
       will be extended by vendors to define vendor-specific
       IS-IS configuration parameters and policies,
       for example, route maps or route policies.

       This YANG model conforms to the Network Management
       Datastore Architecture (NMDA) as described in RFC 8242.

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       authors of the code.  All rights reserved.

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       Relating to IETF Documents
       (https://trustee.ietf.org/license-info).

       This version of this YANG module is part of RFC XXXX
       (https://www.rfc-editor.org/info/rfcXXXX); see the RFC itself
```

```
       for full legal notices.

       The key words 'MUST', 'MUST NOT', 'REQUIRED', 'SHALL', 'SHALL
       NOT', 'SHOULD', 'SHOULD NOT', 'RECOMMENDED', 'NOT RECOMMENDED',
       'MAY', and 'OPTIONAL' in this document are to be interpreted as
       described in BCP 14 (RFC 2119) (RFC 8174) when, and only when,
       they appear in all capitals, as shown here.

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

     revision 2019-09-26 {
       description
         "Initial revision.";
       reference "RFC XXXX";
     }

     /* Identities */

     identity isis {
       base rt:routing-protocol;
       description "Identity for the IS-IS routing protocol.";
     }

     identity lsp-log-reason {
       description "Base identity for an LSP change log reason.";
     }

     identity refresh {
       base lsp-log-reason;
       description
         "Identity used when the LSP log reason is
          a refresh LSP received.";
     }

     identity content-change {
       base lsp-log-reason;
       description
         "Identity used when the LSP log reason is
          a change in the content of the LSP.";
     }

     identity frr-protection-method {
       description
         "Base identity for a Fast Reroute protection method.";
     }
     identity frr-protection-method-lfa {
       base frr-protection-method;
```

```
        description "Loop Free Alternate as defined in RFC5286.";
      }
      identity frr-protection-method-rlfa {
        base frr-protection-method;
        description "Remote Loop Free Alternate as defined in RFC7490.";
      }
      identity frr-protection-method-rsvpte {
        base frr-protection-method;
        description "RSVP-TE as defined in RFC4090.";
      }

      identity frr-protection-available-type {
        description "Base identity for Fast Reroute protection types
                     provided by an alternate path.";
      }
      identity frr-protection-available-node-type {
        base frr-protection-available-type;
        description "Node protection is provided by the alternate.";
      }
      identity frr-protection-available-link-type {
        base frr-protection-available-type;
        description "Link protection is provided by the alternate.";
      }
      identity frr-protection-available-srlg-type {
        base frr-protection-available-type;
        description "SRLG protection is provided by the alternate.";
      }
      identity frr-protection-available-downstream-type {
        base frr-protection-available-type;
        description "The alternate is downstream of node in the path.";
      }
      identity frr-protection-available-other-type {
        base frr-protection-available-type;
        description "The level of protection is unknown.";
      }


      identity unidirectional-link-delay-subtlv-flag {
          description "Base identity for unidirectional-link-delay
                       subTLV flags. Flags are defined in RFC8570.";
      }
      identity unidirectional-link-delay-subtlv-a-flag {
          base unidirectional-link-delay-subtlv-flag;
          description
              "The A bit represents the Anomalous (A) bit.
                The A bit is set when the measured value of
                this parameter exceeds its configured
                maximum threshold.
```

```
                The A bit is cleared when the measured value
                falls below its configured reuse threshold.
                If the A bit is clear,
                the value represents steady-state link performance.";
      }
      identity min-max-unidirectional-link-delay-subtlv-flag {
          description
            "Base identity for min-max-unidirectional-link-delay
             subTLV flags. Flags are defined in RFC8570.";
      }
      identity min-max-unidirectional-link-delay-subtlv-a-flag {
          base min-max-unidirectional-link-delay-subtlv-flag;
          description
              "The A bit represents the Anomalous (A) bit.
                The A bit is set when the measured value of
                this parameter exceeds its configured
                maximum threshold.
                The A bit is cleared when the measured value
                falls below its configured reuse threshold.
                If the A bit is clear,
                the value represents steady-state link performance.";
      }
      identity unidirectional-link-loss-subtlv-flag {
          description "Base identity for unidirectional-link-loss
                       subTLV flags. Flags are defined in RFC8570.";
      }

      identity unidirectional-link-loss-subtlv-a-flag {
          base unidirectional-link-loss-subtlv-flag;
          description
              "The A bit represents the Anomalous (A) bit.
                The A bit is set when the measured value of
                this parameter exceeds its configured
                maximum threshold.
                The A bit is cleared when the measured value
                falls below its configured reuse threshold.
                If the A bit is clear,
                the value represents steady-state link performance.";
      }
      identity tlv229-flag {
          description "Base identity for TLV229 flags. Flags are defined
                       in RFC5120.";
      }
      identity tlv229-overload-flag {
          base tlv229-flag;
          description
              "If set, the originator is overloaded,
              and must be avoided in path calculation.";
```

```
     }
     identity tlv229-attached-flag {
         base tlv229-flag;
         description
             "If set, the originator is attached to
             another area using the referred metric.";
     }
     identity router-capability-flag {
         description "Base identity for router capability flags.
           Flags are defined in RFC7981.";
     }
     identity router-capability-flooding-flag {
         base router-capability-flag;
         description
             "Quote from RFC7981: 'If the S bit is set,
              the IS-IS Router CAPABILITY
              TLV MUST be flooded across the entire routing
              domain. If the S bit is clear, the TLV MUST NOT
              be leaked between levels. This bit MUST NOT
              be altered during the TLV leaking'.";
     }
     identity router-capability-down-flag {
         base router-capability-flag;
         description
             "Quote from RFC7981: 'When the IS-IS Router CAPABILITY TLV
              is leaked from level-2 to level-1, the D bit MUST be set.
              Otherwise, this bit MUST be clear.  IS-IS Router
              capability TLVs with the D bit set MUST NOT be
              leaked from level-1 to level-2 in to prevent
              TLV looping'.";
     }

     identity lsp-flag {
         description "Base identity for LSP attributes.
                      Attributes are defined in ISO 10589";
     }
     identity lsp-partitioned-flag {
         base lsp-flag;
         description "Originator partition repair supported";
     }
     identity lsp-attached-error-metric-flag {
         base lsp-flag;
         description "Set when originator is attached to
              another area using the referred metric.";
     }
     identity lsp-attached-delay-metric-flag {
         base lsp-flag;
         description "Set when originator is attached to
```

```
             another area using the referred metric.";
     }
     identity lsp-attached-expense-metric-flag {
         base lsp-flag;
         description "Set when originator is attached to
              another area using the referred metric.";
     }
     identity lsp-attached-default-metric-flag {
         base lsp-flag;
         description "Set when originator is attached to
              another area using the referred metric.";
     }
     identity lsp-overload-flag {
         base lsp-flag;
         description
             "If set, the originator is overloaded,
              and must be avoided in path calculation.";
     }
     identity lsp-l1system-flag {
         base lsp-flag;
         description
             "Set when the Intermediate System has an L1 type.";
     }
     identity lsp-l2system-flag {
         base lsp-flag;
         description
             "Set when the Intermediate System has an L2 type.";
     }


     /* Feature definitions */

     feature osi-interface {
       description "Support of OSI specific parameters on an
                    interface.";
     }
     feature poi-tlv {
       description "Support of Purge Originator Identification.";
       reference "RFC 6232 - Purge Originator Identification TLV
                  for IS-IS";
     }
     feature ietf-spf-delay {
       description
         "Support for IETF SPF delay algorithm.";
       reference "RFC 8405 - SPF Back-off algorithm for link
                  state IGPs";
     }
     feature bfd {
```

```
      description
        "Support for BFD detection of IS-IS neighbor reachability.";
      reference "RFC 5880 - Bidirectional Forwarding Detection (BFD)
                 RFC 5881 - Bidirectional Forwarding Detection
                 (BFD) for IPv4 and IPv6 (Single Hop)";
    }
    feature key-chain {
      description
        "Support of keychain for authentication.";
      reference "RFC8177 - YANG Data Model for Key Chains";
    }
    feature node-flag {
      description
        "Support for node-flag for IS-IS prefixes.";
      reference "RFC7794 - IS-IS Prefix Attributes for
                 Extended IP and IPv6 Reachability";
    }
    feature node-tag {
      description
        "Support for node admin tag for IS-IS routing instances.";
      reference "RFC7917 - Advertising Node Administrative Tags
                 in IS-IS";
    }
    feature ldp-igp-sync {
      description
        "LDP IGP synchronization.";
      reference "RFC5443 - LDP IGP Synchronization.";
    }
    feature fast-reroute {
      description
        "Support for IP Fast Reroute (IP-FRR).";
    }
    feature nsr {
      description
        "Non-Stop-Routing (NSR) support. The IS-IS NSR feature
            allows  a router with redundant control-plane capability
            (e.g., dual Route-Processor (RP) cards) to maintain its
            state and adjacencies during planned and unplanned
            IS-IS instance restarts. It differs from graceful-restart
            or Non-Stop Forwarding (NSF) in that no protocol signaling
            or assistance from adjacent IS-IS neighbors is required to
            recover control-plane state.";
    }
    feature lfa {
      description
        "Support for Loop-Free Alternates (LFAs).";
      reference "RFC5286 - Basic Specification of IP Fast-Reroute:
                 Loop-free Alternates";
```

```
     }
     feature remote-lfa {
       description
         "Support for Remote Loop-Free Alternates (R-LFAs).";
       reference "RFC7490 - Remote Loop-Free Alternate Fast Reroute";
     }

     feature overload-max-metric {
       description
         "Support of overload by setting all links to max metric.
           In IS-IS, the overload bit is usually used to signal that
           a node cannot be used as a transit. The overload-max-metric
           feature brings a similar behavior leveraging on setting all
           the link metrics to MAX_METRIC.";
     }
     feature prefix-tag {
       description
         "Support for 32-bit prefix tags";
       reference "RFC5130 - A Policy Control Mechanism in
                  IS-IS Using Administrative Tags";
     }
     feature prefix-tag64 {
       description
         "Support for 64-bit prefix tags";
       reference "RFC5130 - A Policy Control Mechanism in
                  IS-IS Using Administrative Tags";
     }
     feature auto-cost {
       description
         "Calculate IS-IS interface metric according to
          reference bandwidth.";
     }

     feature te-rid {
       description
         "Traffic-Engineering Router-ID.";
       reference "RFC5305 - IS-IS Extensions for Traffic Engineering
                  RFC6119 - IPv6 Traffic Engineering in IS-IS";
     }
     feature max-ecmp {
       description
         "Setting maximum number of ECMP paths.";
     }
     feature multi-topology {
       description
         "Support for Multiple-Topology Routing (MTR).";
       reference "RFC5120 - M-IS-IS: Multi Topology Routing in IS-IS";
     }
```

```
     feature nlpid-control {
       description
         "This feature controls the advertisement
          of support NLPID within IS-IS configuration.";
     }
     feature graceful-restart {
       description
         "IS-IS Graceful restart support.";
       reference "RFC5306 - Restart Signaling in IS-IS";
     }

     feature lsp-refresh {
       description
         "Configuration of LSP refresh interval.";
     }

     feature maximum-area-addresses {
       description
         "Support of maximum-area-addresses config.";
     }

     feature admin-control {
       description
         "Administrative control of the protocol state.";
     }

     /* Type definitions */

     typedef circuit-id {
       type uint8;
       description
         "This type defines the circuit ID
          associated with an interface.";
     }

     typedef extended-circuit-id {
       type uint32;
       description
         "This type defines the extended circuit ID
          associated with an interface.";
     }

     typedef interface-type {
       type enumeration {
         enum broadcast {
           description
             "Broadcast interface type.";
         }
```

```
        enum point-to-point {
          description
            "Point-to-point interface type.";
        }
      }
      description
        "This type defines the type of adjacency
         to be established for the interface.
         The interface-type determines the type
         of hello message that is used.";

    }

    typedef level {
      type enumeration {
        enum "level-1" {
          description
            "This enum indicates L1-only capability.";
        }
        enum "level-2" {
          description
            "This enum indicates L2-only capability.";
        }
        enum "level-all" {
          description
            "This enum indicates capability for both levels.";
        }
      }
      default "level-all";
      description
        "This type defines IS-IS level of an object.";

    }

    typedef adj-state-type {
      type enumeration {
        enum "up" {
          description
            "State indicates the adjacency is established.";
        }
        enum "down" {
          description
            "State indicates the adjacency is NOT established.";
        }
        enum "init" {
          description
            "State indicates the adjacency is establishing.";
        }
```

```
        enum "failed" {
          description
            "State indicates the adjacency is failed.";
        }
      }
      description
        "This type defines states of an adjacency";
    }

    typedef if-state-type {
      type enumeration {
        enum "up" {
          description "Up state.";

        }
        enum "down" {
          description "Down state";
        }
      }
      description
        "This type defines the state of an interface";
    }

    typedef level-number {
      type uint8 {
        range "1 .. 2";
      }
      description
        "This type defines the current IS-IS level.";
    }

    typedef lsp-id {
      type string {
        pattern
          '[0-9A-Fa-f]{4}\.[0-9A-Fa-f]{4}\.[0-9A-Fa-f]'
          +'{4}\.[0-9][0-9]-[0-9][0-9]';
      }
      description
        "This type defines the IS-IS LSP ID format using a
         pattern. An example LSP ID is 0143.0438.AEF0.02-01";
    }

    typedef area-address {
      type string {
        pattern '[0-9A-Fa-f]{2}(\.[0-9A-Fa-f]{4}){0,6}';
      }
      description
        "This type defines the area address format.";
```

```
     }

     typedef snpa {
       type string {
         length "0 .. 20";
       }
       description
         "This type defines the Subnetwork Point
          of Attachment (SNPA) format.
          The SNPA should be encoded according to the rules
          specified for the particular type of subnetwork
          being used. As an example, for an ethernet subnetwork,
          the SNPA is encoded as a MAC address, such as,
          '00aa.bbcc.ddee'.";
     }

     typedef system-id {
       type string {
         pattern
           '[0-9A-Fa-f]{4}\.[0-9A-Fa-f]{4}\.[0-9A-Fa-f]{4}';
       }
       description
         "This type defines IS-IS system-id using pattern,
          An example system-id is 0143.0438.AEF0";
     }
     typedef extended-system-id {
       type string {
         pattern
           '[0-9A-Fa-f]{4}\.[0-9A-Fa-f]{4}\.[0-9A-Fa-f]{4}\.'
           +'[0-9][0-9]';
       }
       description
         "This type defines IS-IS system-id using pattern. The extended
          system-id contains the pseudonode number in addition to the
          system-id.
          An example system-id is 0143.0438.AEF0.00";
     }

     typedef wide-metric {
       type uint32 {
         range "0 .. 16777215";
       }
       description
         "This type defines wide style format of IS-IS metric.";
     }

     typedef std-metric {
       type uint8 {
```

```
        range "0 .. 63";
      }
      description
        "This type defines old style format of IS-IS metric.";
    }

    typedef mesh-group-state {
      type enumeration {
        enum "mesh-inactive" {
          description
            "Interface is not part of a mesh group.";
        }
        enum "mesh-set" {
          description
            "Interface is part of a mesh group.";
        }
        enum "mesh-blocked" {
          description
            "LSPs must not be flooded over this interface.";
        }
      }
      description
        "This type describes mesh group state of an interface";
    }

    /* Grouping for notifications */

    grouping notification-instance-hdr {
      description
        "Instance specific IS-IS notification data grouping";
      leaf routing-protocol-name {
        type leafref {
          path "/rt:routing/rt:control-plane-protocols/"
             + "rt:control-plane-protocol/rt:name";
        }
        description "Name of the IS-IS instance.";
      }
      leaf isis-level {
        type level;
        description "IS-IS level of the instance.";
      }
    }

    grouping notification-interface-hdr {
      description
        "Interface specific IS-IS notification data grouping";
      leaf interface-name {
        type if:interface-ref;
```

```
        description "IS-IS interface name";
      }
      leaf interface-level {
        type level;
        description "IS-IS level of the interface.";
      }
      leaf extended-circuit-id {
        type extended-circuit-id;
        description "Extended circuit-id of the interface.";
      }
    }


   /* Groupings for IP Fast Reroute */

   grouping instance-fast-reroute-config {
      description
        "This group defines global configuration of IP
         Fast ReRoute (FRR).";
      container fast-reroute {
        if-feature fast-reroute;
        description
          "This container may be augmented with global
           parameters for IP-FRR.";
        container lfa {
          if-feature lfa;
          description
            "This container may be augmented with
             global parameters for Loop-Free Alternatives (LFA).
             Container creation has no effect on LFA activation.";
        }
      }
    }

   grouping interface-lfa-config {
      leaf candidate-enable {
        type boolean;
        default "true";
        description
          "Enable the interface to be used as backup.";
      }
      leaf enable {
        type boolean;
        default false;
        description
          "Activates LFA - Per-prefix LFA computation
           is assumed.";
      }
```

```
        container remote-lfa {
          if-feature remote-lfa;
          leaf enable {
            type boolean;
            default false;
            description
              "Activates Remote LFA (R-LFA).";
          }
          description
            "Remote LFA configuration.";
        }
        description "Grouping for LFA interface configuration";
      }
      grouping interface-fast-reroute-config {
        description
          "This group defines interface configuration of IP-FRR.";
        container fast-reroute {
          if-feature fast-reroute;
          container lfa {
            if-feature lfa;
            uses interface-lfa-config;
            container level-1 {
              uses interface-lfa-config;
              description
                "LFA level 1 config";
            }
            container level-2 {
            uses interface-lfa-config;
             description
              "LFA level 2 config";
            }
            description
              "LFA configuration.";
          }
          description
            "Interface IP Fast-reroute configuration.";
        }
      }
      grouping instance-fast-reroute-state {
        description "IPFRR state data grouping";
        container protected-routes {
          config false;
          list address-family-stats {
            key "address-family prefix alternate";

            leaf address-family {
              type iana-rt-types:address-family;
              description
```

```
                "Address-family";
            }
            leaf prefix {
              type inet:ip-prefix;
              description
                "Protected prefix.";
            }
            leaf alternate {
              type inet:ip-address;
              description
                "Alternate next hop for the prefix.";
            }
            leaf alternate-type {
              type enumeration {
                enum equal-cost {
                  description
                    "ECMP alternate.";
                }
                enum lfa {
                  description
                    "LFA alternate.";
                }
                enum remote-lfa {
                  description
                    "Remote LFA alternate.";
                }
                enum tunnel {
                  description
                    "Tunnel based alternate (such as,
                     RSVP-TE or GRE).";
                }
                enum ti-lfa {
                  description
                    "TI-LFA alternate.";
                }
                enum mrt {
                  description
                    "MRT alternate.";
                }
                enum other {
                  description
                    "Unknown alternate type.";
                }
              }
              description
                "Type of alternate.";
            }
            leaf best {
```

```
              type boolean;
              description
                "Is set when the alternate is the preferred one,
                 is unset otherwise.";
            }
            leaf non-best-reason {
              type string {
                length "1..255";
              }
              description
                "Information field to describe why the alternate
                 is not best. The length should be limited to 255
                 unicode characters. The expected format is a single
                 line text.";
            }
            container protection-available {
              leaf-list protection-types {
                type identityref {
                  base frr-protection-available-type;
                }
                description "This list contains a set of protection
                            types defined as identities.
                            An identity must be added for each type of
                            protection provided by the alternate.
                            As an example, if an alternate provides
                            SRLG, node and link protection, three
                            identities must be added in this list:
                            one for SRLG protection, one for node
                            protection, one for link protection.";
              }
              description "Protection types provided by the alternate.";
            }
            leaf alternate-metric1 {
              type uint32;
              description
                "Metric from Point of Local Repair (PLR) to
                 destination through the alternate path.";
            }
            leaf alternate-metric2 {
              type uint32;
              description
                "Metric from PLR to the alternate node";
            }
            leaf alternate-metric3 {
              type uint32;
              description
                "Metric from alternate node to the destination";
            }
```

```
            description
              "Per-AF protected prefix statistics.";
          }
          description
            "List of prefixes that are protected.";
        }

        container unprotected-routes {
          config false;
          list address-family-stats {
            key "address-family prefix";

            leaf address-family {
              type iana-rt-types:address-family;

              description "Address-family";
            }
            leaf prefix {
              type inet:ip-prefix;
              description "Unprotected prefix.";
            }
            description
              "Per-AF unprotected prefix statistics.";
          }
          description
            "List of prefixes that are not protected.";
        }

        list protection-statistics {
          key frr-protection-method;
          config false;
          leaf frr-protection-method {
            type identityref {
              base frr-protection-method;
            }
            description "Protection method used.";
          }
          list address-family-stats {
            key address-family;

            leaf address-family {
              type iana-rt-types:address-family;

              description "Address-family";
            }
            leaf total-routes {
              type uint32;
              description "Total prefixes.";
```

```
          }
          leaf unprotected-routes {
            type uint32;
            description
              "Total prefixes that are not protected.";
          }
          leaf protected-routes {
            type uint32;
            description
              "Total prefixes that are protected.";
          }
          leaf link-protected-routes {
            type uint32;
            description
              "Total prefixes that are link protected.";
          }
          leaf node-protected-routes {
            type uint32;
            description
              "Total prefixes that are node protected.";
          }
          description
            "Per-AF protected prefix statistics.";
        }

        description "Global protection statistics.";
      }
    }

          /* Route table and local RIB groupings */

    grouping local-rib {
      description "Local-rib - RIB for Routes computed by the local
                   IS-IS routing instance.";
      container local-rib {
        config false;
        description "Local-rib.";
        list route {
          key "prefix";
          description "Routes";
          leaf prefix {
            type inet:ip-prefix;
            description "Destination prefix.";
          }
          container next-hops {
            description "Next hops for the route.";
            list next-hop {
              key "next-hop";
```

```
                description "List of next hops for the route";
                leaf outgoing-interface {
                  type if:interface-ref;
                  description
                    "Name of the outgoing interface.";
                }
                leaf next-hop {
                 type inet:ip-address;
                 description "Next hop address.";
                }
              }
            }
            leaf metric {
              type uint32;
              description "Metric for this route.";
            }
            leaf level {
              type level-number;
              description "Level number for this route.";
            }
            leaf route-tag {
              type uint32;
              description "Route tag for this route.";
            }
          }
        }
      }

      grouping route-content {
        description
          "IS-IS protocol-specific route properties grouping.";
        leaf metric {
          type uint32;
          description "IS-IS metric of a route.";
        }
        leaf-list tag {
          type uint64;
          description
            "List of tags associated with the route. The leaf
             describes both 32-bit and 64-bit tags.";
        }
        leaf route-type {
          type enumeration {
            enum l2-intra-area {
              description "Level 2 internal route. As per RFC5302,
                           the prefix is directly connected to the
                           advertising router. It cannot be
                           distinguished from an L1->L2 inter-area
```

```
                          route.";
          }
          enum l1-intra-area {
            description "Level 1 internal route. As per RFC5302,
                         the prefix is directly connected to the
                         advertising router.";
          }
          enum l2-external {
            description "Level 2 external route. As per RFC5302,
                         such a route is learned from other IGPs.
                         It cannot be distinguished from an L1->L2
                         inter-area external route.";
          }
          enum l1-external {
            description "Level 1 external route. As per RFC5302,
                         such a route is learned from other IGPs.";
          }
          enum l1-inter-area {
            description "These prefixes are learned via L2 routing.";
          }
          enum l1-inter-area-external {
            description "These prefixes are learned via L2 routing
                         towards an l2-external route.";
          }
        }
        description "IS-IS route type.";
      }
    }


          /* Grouping definitions for configuration and ops state */


    grouping adjacency-state {
      container adjacencies {
        config false;
        list adjacency {
          leaf neighbor-sys-type {
            type level;
            description
              "Level capability of neighboring system";
          }
          leaf neighbor-sysid {
            type system-id;
            description
              "The system-id of the neighbor";
          }
          leaf neighbor-extended-circuit-id {
```

```
              type extended-circuit-id;
              description
                "Circuit ID of the neighbor";
            }
            leaf neighbor-snpa {
              type snpa;
              description
                "SNPA of the neighbor";
            }
            leaf usage {
              type level;
              description
                "Define the level(s) activated for the adjacency.
                 On a p2p link this might be level 1 and 2,
                 but on a LAN, the usage will be level 1
                 between neighbors at level 1 or level 2 between
                 neighbors at level 2.";
            }
            leaf hold-timer {
              type rt-types:timer-value-seconds16;
              units seconds;
              description
                "The holding time in seconds for this
                 adjacency. This value is based on
                 received hello PDUs and the elapsed
                 time since receipt.";
            }
            leaf neighbor-priority {
              type uint8 {
                range "0 .. 127";
              }
              description
                "Priority of the neighboring IS for becoming
                 the DIS.";
            }
            leaf lastuptime {
              type yang:timestamp;
              description
                "When the adjacency most recently entered
                 state 'up', measured in hundredths of a
                 second since the last reinitialization of
                 the network management subsystem.
                 The value is 0 if the adjacency has never
                 been in state 'up'.";
            }
            leaf state {
              type adj-state-type;
              description
```

```
                "This leaf describes the state of the interface.";
            }

            description
              "List of operational adjacencies.";
          }
          description
            "This container lists the adjacencies of
             the local node.";
        }
        description
          "Adjacency state";
      }

      grouping admin-control {
        leaf enable {
          if-feature admin-control;
          type boolean;
          default "true";
          description
            "Enable/Disable the protocol.";
        }
        description
          "Grouping for admin control.";
      }

      grouping ietf-spf-delay {
        leaf initial-delay {
          type rt-types:timer-value-milliseconds;
          units msec;
          description
            "Delay used while in QUIET state (milliseconds).";
        }
        leaf short-delay {
          type rt-types:timer-value-milliseconds;
          units msec;
          description
            "Delay used while in SHORT_WAIT state (milliseconds).";
        }
        leaf long-delay {
          type rt-types:timer-value-milliseconds;
          units msec;
          description
            "Delay used while in LONG_WAIT state (milliseconds).";
        }

        leaf hold-down {
          type rt-types:timer-value-milliseconds;
```

```
          units msec;
          description
            "Timer used to consider an IGP stability period
                                    (milliseconds).";
        }
        leaf time-to-learn {
          type rt-types:timer-value-milliseconds;
          units msec;
          description
            "Duration used to learn all the IGP events
             related to a single component failure (milliseconds).";
        }
        leaf current-state {
          type enumeration {
            enum "quiet" {
              description "QUIET state";
            }
            enum "short-wait" {
              description "SHORT_WAIT state";
            }
            enum "long-wait" {
              description "LONG_WAIT state";
            }
          }
          config false;
          description
            "Current SPF back-off algorithm state.";
        }
        leaf remaining-time-to-learn {
          type rt-types:timer-value-milliseconds;
          units "msec";
          config false;
          description
            "Remaining time until time-to-learn timer fires.";
        }
        leaf remaining-hold-down {
          type rt-types:timer-value-milliseconds;
          units "msec";
          config false;
          description
            "Remaining time until hold-down timer fires.";
        }
        leaf last-event-received {
          type yang:timestamp;
          config false;
          description
            "Time of last IGP event received";
        }
```

```
        leaf next-spf-time {
          type yang:timestamp;
          config false;
          description
            "Time when next SPF has been scheduled.";
        }
        leaf last-spf-time {
          type yang:timestamp;
          config false;
          description
            "Time of last SPF computation.";
        }
        description
          "Grouping for IETF SPF delay configuration and state.";
      }



      grouping node-tag-config {
        description
          "IS-IS node tag config state.";
        container node-tags {
          if-feature node-tag;
          list node-tag {
            key tag;
            leaf tag {
              type uint32;
                description
                  "Node tag value.";
            }
            description
              "List of tags.";
          }
          description
            "Container for node admin tags.";
        }
      }

      grouping authentication-global-cfg {
        choice authentication-type {
          case key-chain {
            if-feature key-chain;
            leaf key-chain {
              type key-chain:key-chain-ref;
              description
                "Reference to a key-chain.";
            }
          }
```

```
        case password {
          leaf key {
            type string;
            description
              "This leaf specifies the authentication key. The
               length of the key may be dependent on the
               cryptographic algorithm.";
          }
          leaf crypto-algorithm {
            type identityref {
              base key-chain:crypto-algorithm;
            }
            description
              "Cryptographic algorithm associated with key.";
          }
        }
        description "Choice of authentication.";
      }
      description "Grouping for global authentication config.";
    }

    grouping metric-type-global-cfg {
      leaf value {
        type enumeration {
          enum wide-only {
            description
              "Advertise new metric style only (RFC5305)";
          }
          enum old-only {
            description
              "Advertise old metric style only (RFC1195)";
          }
          enum both {
            description "Advertise both metric styles";
          }
        }
        default wide-only;
        description
          "Type of metric to be generated:
           - wide-only means only new metric style
              is generated,
           - old-only means that only old-style metric
             is generated,
           - both means that both are advertised.
           This leaf is only affecting IPv4 metrics.";
      }
      description
        "Grouping for global metric style config.";
```

```
     }

     grouping default-metric-global-cfg {
       leaf value {
         type wide-metric;
         default "10";
         description  "Value of the metric";
       }
       description
         "Global default metric config grouping.";
     }


     grouping overload-global-cfg {
       leaf status {
         type boolean;
         default false;
         description
           "This leaf specifies the overload status.";
       }
       description "Grouping for overload bit config.";
     }

     grouping overload-max-metric-global-cfg {
       leaf timeout {
         type rt-types:timer-value-seconds16;
         units "seconds";
         description
           "Timeout (in seconds) of the overload condition.";
       }
       description
         "Overload maximum metric configuration grouping";
     }

     grouping route-preference-global-cfg {
       choice granularity {
         case detail {
           leaf internal {
             type uint8;
             description
               "Protocol preference for internal routes.";
           }
           leaf external {
             type uint8;
             description
               "Protocol preference for external routes.";
           }
         }
```

```
        case coarse {
          leaf default {
            type uint8;
            description
              "Protocol preference for all IS-IS routes.";
          }
        }
        description
          "Choice for implementation of route preference.";
      }
      description
        "Global route preference grouping";
    }

    grouping hello-authentication-cfg {
      choice authentication-type {
        case key-chain {
          if-feature key-chain;
          leaf key-chain {
            type key-chain:key-chain-ref;
            description "Reference to a key-chain.";
          }
        }
        case password {
          leaf key {
            type string;
            description "Authentication key specification - The
                         length of the key may be dependent on the
                         cryptographic algorithm.";
          }
          leaf crypto-algorithm {
            type identityref {
              base key-chain:crypto-algorithm;
            }
            description
              "Cryptographic algorithm associated with key.";
          }
        }
        description "Choice of authentication.";
      }
      description "Grouping for hello authentication.";
    }

    grouping hello-interval-cfg {
      leaf value {
        type rt-types:timer-value-seconds16;
        units "seconds";
        default 10;
```

```
        description
          "Interval (in seconds) between successive hello
           messages.";
      }

      description "Interval between hello messages.";
    }

    grouping hello-multiplier-cfg {
      leaf value {
        type uint16;
        default 3;
        description
          "Number of missed hello messages prior to
           declaring the adjacency down.";
      }
      description
          "Number of missed hello messages prior to
           adjacency down grouping.";
    }

    grouping priority-cfg {
      leaf value {
        type uint8 {
          range "0 .. 127";
        }
        default 64;
        description
          "Priority of interface for DIS election.";
      }

      description "Interface DIS election priority grouping";
    }

    grouping metric-cfg {
      leaf value {
        type wide-metric;
        default "10";
        description "Metric value.";
      }
      description "Interface metric grouping";
    }


    grouping metric-parameters {
      container metric-type {
        uses metric-type-global-cfg;
        container level-1 {
```

```
          uses metric-type-global-cfg;
          description "level-1 specific configuration";
        }
        container level-2 {
          uses metric-type-global-cfg;
          description "level-2 specific configuration";
        }
        description "Metric style global configuration";
      }

      container default-metric {
        uses default-metric-global-cfg;
        container level-1 {
          uses default-metric-global-cfg;
          description "level-1 specific configuration";
        }
        container level-2 {
          uses default-metric-global-cfg;
          description "level-2 specific configuration";
        }
        description "Default metric global configuration";
      }
      container auto-cost {
        if-feature auto-cost;
        description
          "Interface Auto-cost configuration state.";
        leaf enable {
          type boolean;
          description
            "Enable/Disable interface auto-cost.";
        }
        leaf reference-bandwidth {
          when "../enable = 'true'" {
            description "Only when auto cost is enabled";
          }
          type uint32 {
            range "1..4294967";
          }
          units Mbits;
          description
            "Configure reference bandwidth used to automatically
             determine interface cost (Mbits). The cost is the
             reference bandwidth divided by the interface speed
             with 1 being the minimum cost.";
        }
      }

      description "Grouping for global metric parameters.";
```

```
     }

     grouping high-availability-parameters {
       container graceful-restart {
         if-feature graceful-restart;
         leaf enable {
           type boolean;
           default false;
           description "Enable graceful restart.";
         }
         leaf restart-interval {
           type rt-types:timer-value-seconds16;
           units "seconds";
           description
             "Interval (in seconds) to attempt graceful restart prior
              to failure.";
         }
         leaf helper-enable {
           type boolean;
           default "true";
           description
             "Enable local IS-IS router as graceful restart helper.";
         }
         description "Graceful-Restart Configuration.";
       }
       container nsr {
         if-feature nsr;
         description "Non-Stop Routing (NSR) configuration.";
         leaf enable {
           type boolean;
           default false;
           description "Enable/Disable Non-Stop Routing (NSR).";
         }
       }
       description "Grouping for High Availability parameters.";
     }

     grouping authentication-parameters {
       container authentication {
         uses authentication-global-cfg;

         container level-1 {
           uses authentication-global-cfg;
           description "level-1 specific configuration";
         }
         container level-2 {
           uses authentication-global-cfg;
           description "level-2 specific configuration";
```

```
        }
        description "Authentication global configuration for
                     both LSPs and SNPs.";
      }
      description "Grouping for authentication parameters";
    }
    grouping address-family-parameters {
      container address-families {
        if-feature nlpid-control;
        list address-family-list {
          key address-family;
          leaf address-family {
            type iana-rt-types:address-family;
            description "Address-family";
          }
          leaf enable {
            type boolean;
            description "Activate the address family.";
          }
          description
            "List of address families and whether or not they
             are activated.";
        }
        description "Address Family configuration";
      }
      description "Grouping for address family parameters.";
    }

    grouping mpls-parameters {
      container mpls {
        container te-rid {
          if-feature te-rid;
          description
            "Stable ISIS Router IP Address used for Traffic
             Engineering";
          leaf ipv4-router-id {
            type inet:ipv4-address;
            description
              "Router ID value that would be used in TLV 134.";
          }
          leaf ipv6-router-id {
            type inet:ipv6-address;
            description
              "Router ID value that would be used in TLV 140.";
          }
        }
        container ldp {
          container igp-sync {
```

```
            if-feature ldp-igp-sync;
            description
              "This container may be augmented with global
               parameters for igp-ldp-sync.";
          }
          description "LDP configuration.";
        }
        description "MPLS configuration";
      }
      description "Grouping for MPLS global parameters.";
    }

    grouping lsp-parameters {
      leaf lsp-mtu {
        type uint16;
        units "bytes";
        default 1492;
        description
          "Maximum size of an LSP PDU in bytes.";
      }
      leaf lsp-lifetime {
        type uint16 {
          range "1..65535";
        }
        units "seconds";
        description
          "Lifetime of the router's LSPs in seconds.";
      }
      leaf lsp-refresh {
        if-feature lsp-refresh;
        type rt-types:timer-value-seconds16;
        units "seconds";
        description
          "Refresh interval of the router's LSPs in seconds.";
      }
      leaf poi-tlv {
        if-feature poi-tlv;
        type boolean;
        default false;
        description
          "Enable advertisement of IS-IS purge TLV.";
      }
      description "Grouping for LSP global parameters.";
    }
    grouping spf-parameters {
      container spf-control {
          leaf paths {
            if-feature max-ecmp;
```

```
            type uint16 {
              range "1..32";
            }
            description
              "Maximum number of Equal-Cost Multi-Path (ECMP) paths.";
          }
          container ietf-spf-delay {
            if-feature ietf-spf-delay;
            uses ietf-spf-delay;
            description "IETF SPF delay algorithm configuration.";
          }
          description
            "SPF calculation control.";
      }
      description "Grouping for SPF global parameters.";
    }
    grouping instance-config {
      description "IS-IS global configuration grouping";

      uses admin-control;

      leaf level-type {
        type level;
        default "level-all";
        description
          "Level of an IS-IS node - can be level-1,
           level-2 or level-all.";
      }

      leaf system-id {
        type system-id;
        description "system-id of the node.";
      }

      leaf maximum-area-addresses {
        if-feature maximum-area-addresses;
        type uint8;
        default 3;
        description "Maximum areas supported.";
      }

      leaf-list area-address {
        type area-address;
        description
          "List of areas supported by the protocol instance.";
      }

      uses lsp-parameters;
```

```
        uses high-availability-parameters;
        uses node-tag-config;
        uses metric-parameters;
        uses authentication-parameters;
        uses address-family-parameters;
        uses mpls-parameters;
        uses spf-parameters;
        uses instance-fast-reroute-config;

        container preference {
          uses route-preference-global-cfg;
          description "Router preference configuration for IS-IS
                       protocol instance route installation";
        }

        container overload {
          uses overload-global-cfg;
          description "Router protocol instance overload state
                       configuration";
        }

        container overload-max-metric {
          if-feature overload-max-metric;
          uses overload-max-metric-global-cfg;
          description
            "Router protocol instance overload maximum
             metric advertisement configuration.";
        }
      }

      grouping instance-state {
        description
          "IS-IS instance operational state.";
        uses spf-log;
        uses lsp-log;
        uses hostname-db;
        uses lsdb;
        uses local-rib;
        uses system-counters;
        uses instance-fast-reroute-state;
        leaf discontinuity-time {
          type yang:date-and-time;
          description
            "The time of the most recent occasion at which any one
             or more of this IS-IS instance's counters suffered a
             discontinuity.  If no such discontinuities have occurred
             since the IS-IS instance was last re-initialized, then
             this node contains the time the IS-IS instance was
```

```
            re-initialized which normally occurs when it was
            created.";
      }
    }

    grouping multi-topology-config {
      description "Per-topology configuration";
      container default-metric {
        uses default-metric-global-cfg;
        container level-1 {
          uses default-metric-global-cfg;
          description "level-1 specific configuration";
        }
        container level-2 {
          uses default-metric-global-cfg;
          description "level-2 specific configuration";
        }
        description "Default metric per-topology configuration";
      }
      uses node-tag-config;
    }

    grouping interface-config {
      description "Interface configuration grouping";

      uses admin-control;

      leaf level-type {
        type level;
        default "level-all";
        description "IS-IS level of the interface.";
      }
      leaf lsp-pacing-interval {
        type rt-types:timer-value-milliseconds;
        units "milliseconds";
        default 33;
        description
          "Interval (in milli-seconds) between LSP
           transmissions.";
      }
      leaf lsp-retransmit-interval {
        type rt-types:timer-value-seconds16;
        units "seconds";
        description
          "Interval (in seconds) between LSP
           retransmissions.";
      }
      leaf passive {
```

```
          type boolean;
          default "false";
          description
            "Indicates whether the interface is in passive mode (IS-IS
             not running but network is advertised).";
        }
        leaf csnp-interval {
          type rt-types:timer-value-seconds16;
          units "seconds";
          default 10;
          description
             "Interval (in seconds) between CSNP messages.";
        }
        container hello-padding {
          leaf enable {
            type boolean;
            default "true";
            description
              "IS-IS Hello-padding activation - enabled by default.";
          }
          description "IS-IS hello padding configuration.";
        }
        leaf mesh-group-enable {
          type mesh-group-state;
          description "IS-IS interface mesh-group state";
        }
        leaf mesh-group {
          when "../mesh-group-enable = 'mesh-set'" {
            description
              "Only valid when mesh-group-enable equals mesh-set";
          }
          type uint8;
          description "IS-IS interface mesh-group ID.";
        }
        leaf interface-type {
          type interface-type;
          default "broadcast";
          description
            "Type of adjacency to be established for the interface. This
             dictates the type of hello messages that are used.";
        }

        leaf-list tag {
          if-feature prefix-tag;
          type uint32;
          description
            "List of tags associated with the interface.";
        }
```

```
        leaf-list tag64 {
          if-feature prefix-tag64;
          type uint64;
          description
            "List of 64-bit tags associated with the interface.";
        }
        leaf node-flag {
          if-feature node-flag;
          type boolean;
          default false;
          description
            "Set prefix as a node representative prefix.";
        }
        container hello-authentication {
          uses hello-authentication-cfg;
          container level-1 {
            uses hello-authentication-cfg;
            description "level-1 specific configuration";
          }
          container level-2 {
            uses hello-authentication-cfg;
            description "level-2 specific configuration";
          }
          description
            "Authentication type to be used in hello messages.";
        }
        container hello-interval {
          uses hello-interval-cfg;
          container level-1 {
            uses hello-interval-cfg;
            description "level-1 specific configuration";
          }
          container level-2 {
            uses hello-interval-cfg;
            description "level-2 specific configuration";
          }
          description "Interval between hello messages.";
        }
        container hello-multiplier {
          uses hello-multiplier-cfg;
          container level-1 {
            uses hello-multiplier-cfg;
            description "level-1 specific configuration";
          }
          container level-2 {
            uses hello-multiplier-cfg;
            description "level-2 specific configuration";
          }
```

```
        description "Hello multiplier configuration.";
      }
      container priority {
        must '../interface-type = "broadcast"' {
          error-message
            "Priority only applies to broadcast interfaces.";
          description "Check for broadcast interface.";
        }
        uses priority-cfg;
        container level-1 {
          uses priority-cfg;
          description "level-1 specific configuration";
        }
        container level-2 {
          uses priority-cfg;
          description "level-2 specific configuration";
        }
        description "Priority for DIS election.";
      }
      container metric {
        uses metric-cfg;
        container level-1 {
          uses metric-cfg;
          description "level-1 specific configuration";
        }
        container level-2 {
          uses metric-cfg;
          description "level-2 specific configuration";
        }
        description "Metric configuration.";
      }
      container bfd {
        if-feature bfd;
        description "BFD Client Configuration.";
        uses bfd-types:client-cfg-parms;

        reference "RFC YYYY - YANG Data Model for Bidirectional
                 Forwarding Detection (BFD).

   -- Note to RFC Editor Please replace YYYY with published FC
      number for draft-ietf-bfd-yang.";

      }
      container address-families {
        if-feature nlpid-control;
        list address-family-list {
          key address-family;
          leaf address-family {
```

```
              type iana-rt-types:address-family;
              description  "Address-family";
            }
            description "List of AFs.";
          }
          description "Interface address-families";
        }
        container mpls {
          container ldp {
            leaf igp-sync {
              if-feature ldp-igp-sync;
              type boolean;
              default false;
              description "Enables IGP/LDP synchronization";
            }
            description "LDP protocol related configuration.";
          }
          description "MPLS configuration for IS-IS interfaces";
        }
        uses interface-fast-reroute-config;
      }

      grouping multi-topology-interface-config {
        description "IS-IS interface topology configuration.";
        container metric {
          uses metric-cfg;
          container level-1 {
            uses metric-cfg;
            description "level-1 specific configuration";
          }
          container level-2 {
            uses metric-cfg;
            description "level-2 specific configuration";
          }
          description "Metric IS-IS interface configuration.";
        }
      }
      grouping interface-state {
        description
          "IS-IS interface operational state.";
        uses adjacency-state;
        uses event-counters;
        uses packet-counters;
        leaf discontinuity-time {
          type yang:date-and-time;
          description
            "The time of the most recent occasion at which any one
             or more of this IS-IS interface's counters suffered a
```

```
            discontinuity.  If no such discontinuities have occurred
            since the IS-IS interface was last re-initialized, then
            this node contains the time the IS-IS interface was
            re-initialized which normally occurs when it was
            created.";
        }
    }

   /* Grouping for the hostname database */

    grouping hostname-db {
      container hostnames {
        config false;
        list hostname {
          key system-id;
          leaf system-id {
            type system-id;
            description
              "system-id associated with the hostname.";
          }
          leaf hostname {
            type string {
              length "1..255";
            }
            description
              "Hostname associated with the system-id
               as defined in RFC5301.";
          }
          description
            "List of system-id/hostname associations.";
        }
        description
          "Hostname to system-id mapping database.";
      }
      description
        "Grouping for hostname to system-id mapping database.";
    }

    /* Groupings for counters */

    grouping system-counters {
      container system-counters {
        config false;
        list level {
          key level;

          leaf level {
            type level-number;
```

```
            description "IS-IS level.";
          }
          leaf corrupted-lsps {
            type uint32;
            description
              "Number of corrupted in-memory LSPs detected.
               LSPs received from the wire with a bad
               checksum are silently dropped and not counted.
               LSPs received from the wire with parse errors
               are counted by lsp-errors.";
          }
          leaf authentication-type-fails {
            type uint32;
            description
               "Number of authentication type mismatches.";
          }
          leaf authentication-fails {
            type uint32;
            description
              "Number of authentication key failures.";
          }
          leaf database-overload {
            type uint32;
            description
              "Number of times the database has become
               overloaded.";
          }
          leaf own-lsp-purge {
            type uint32;
            description
              "Number of times a zero-aged copy of the system's
               own LSP is received from some other IS-IS node.";
          }
          leaf manual-address-drop-from-area {
            type uint32;
            description
              "Number of times a manual address
               has been dropped from the area.";
          }
          leaf max-sequence {
            type uint32;
            description
              "Number of times the system has attempted
               to exceed the maximum sequence number.";
          }
          leaf sequence-number-skipped {
            type uint32;
            description
```

```
               "Number of times a sequence number skip has
                occurred.";
           }
           leaf id-len-mismatch {
             type uint32;
             description
               "Number of times a PDU is received with a
                different value for the ID field length
                than that of the receiving system.";
           }
           leaf partition-changes {
             type uint32;
             description
               "Number of partition changes detected.";
           }
           leaf lsp-errors {
             type uint32;
             description
               "Number of LSPs with errors we have received.";
           }
           leaf spf-runs {
             type uint32;
             description
               "Number of times we ran SPF at this level.";
           }
           description
             "List of supported levels.";
         }
         description
           "List counters for the IS-IS protocol instance";
       }
       description
         "Grouping for IS-IS system counters";
     }

     grouping event-counters {
       container event-counters {
         config false;
         leaf adjacency-changes {
           type uint32;
           description
             "The number of times an adjacency state change has
              occurred on this interface.";
         }
         leaf adjacency-number {
           type uint32;
           description
             "The number of adjacencies on this interface.";
```

```
        }
        leaf init-fails {
          type uint32;
          description
            "The number of times initialization of this
             interface has failed. This counts events such
             as PPP NCP failures. Failures to form an
             adjacency are counted by adjacency-rejects.";
        }
        leaf adjacency-rejects {
          type uint32;
          description
            "The number of times an adjacency has been
             rejected on this interface.";
        }
        leaf id-len-mismatch {
          type uint32;
          description
            "The number of times an IS-IS PDU with an ID
             field length different from that for this
             system has been received on this interface.";
        }
        leaf max-area-addresses-mismatch {
          type uint32;
          description
            "The number of times an IS-IS PDU has been
             received on this interface with the
             max area address field differing from that of
             this system.";
        }
        leaf authentication-type-fails {
          type uint32;
          description
            "Number of authentication type mismatches.";
        }
        leaf authentication-fails {
          type uint32;
          description
            "Number of authentication key failures.";
        }
        leaf lan-dis-changes {
          type uint32;
          description
            "The number of times the DIS has changed on this
             interface at this level. If the interface type is
             point-to-point, the count is zero.";
        }
        description "IS-IS interface event counters.";
```

```
      }
      description
        "Grouping for IS-IS interface event counters";
    }

    grouping packet-counters {
      container packet-counters {
        config false;
        list level {
          key level;

          leaf level {
            type level-number;
            description "IS-IS level.";
          }
          container iih {
            leaf in {
              type uint32;
              description "Received IIH PDUs.";
            }
            leaf out {
              type uint32;
              description "Sent IIH PDUs.";
            }
            description "Number of IIH PDUs received/sent.";
          }
          container ish {
            leaf in {
              type uint32;
              description "Received ISH PDUs.";
            }
            leaf out {
              type uint32;
              description "Sent ISH PDUs.";
            }
            description
              "ISH PDUs received/sent.";
          }
          container esh {
            leaf in {
              type uint32;
              description "Received ESH PDUs.";
            }
            leaf out {
              type uint32;
              description "Sent ESH PDUs.";
            }
            description "Number of ESH PDUs received/sent.";
```

```
            }
            container lsp {
              leaf in {
                type uint32;
                description "Received LSP PDUs.";
              }
              leaf out {
                type uint32;
                description "Sent LSP PDUs.";
              }
              description "Number of LSP PDUs received/sent.";
            }
            container psnp {
              leaf in {
                type uint32;
                description "Received PSNP PDUs.";
              }
              leaf out {
                type uint32;
                description "Sent PSNP PDUs.";
              }
              description "Number of PSNP PDUs received/sent.";
            }
            container csnp {
              leaf in {
                type uint32;
                description "Received CSNP PDUs.";
              }
              leaf out {
                type uint32;
                description "Sent CSNP PDUs.";
              }
              description "Number of CSNP PDUs received/sent.";
            }
            container unknown {
              leaf in {
                type uint32;
                description "Received unknown PDUs.";
              }
              description "Number of unknown PDUs received/sent.";
            }
            description
              "List of packet counter for supported levels.";
          }
          description "Packet counters per IS-IS level.";
        }
        description
          "Grouping for per IS-IS Level packet counters.";
```

```
     }

           /* Groupings for various log buffers */
     grouping spf-log {
       container spf-log {
         config false;
         list event {
           key id;

           leaf id {
             type uint32;
             description
               "Event identifier -  purely internal value.";
           }
           leaf spf-type {
             type enumeration {
               enum full {
                 description "Full SPF computation.";
               }
               enum route-only {
                 description
                   "Route reachability only SPF computation";
               }
             }
             description "Type of SPF computation performed.";
           }
           leaf level {
             type level-number;
             description
               "IS-IS level number for SPF computation";
           }
           leaf schedule-timestamp {
             type yang:timestamp;
             description
               "Timestamp of when the SPF computation was
                scheduled.";
           }
           leaf start-timestamp {
             type yang:timestamp;
             description
               "Timestamp of when the SPF computation started.";
           }
           leaf end-timestamp {
             type yang:timestamp;
             description
               "Timestamp of when the SPF computation ended.";
           }
           list trigger-lsp {
```

```
            key "lsp";
            leaf lsp {
              type lsp-id;
              description
                "LSP ID of the LSP triggering SPF computation.";
            }
            leaf sequence {
              type uint32;
              description
                "Sequence number of the LSP triggering SPF
                 computation";
            }
            description
              "This list includes the LSPs that triggered the
               SPF computation.";
          }
          description
            "List of computation events - implemented as a
             wrapping buffer.";
        }

        description
          "This container lists the SPF computation events.";
      }
      description "Grouping for spf-log events.";
    }

    grouping lsp-log {
      container lsp-log {
        config false;
        list event {
          key id;

          leaf id {
            type uint32;
            description
              "Event identifier -  purely internal value.";
          }
          leaf level {
            type level-number;
            description
              "IS-IS level number for LSP";
          }
          container lsp {
            leaf lsp {
              type lsp-id;
              description
                "LSP ID of the LSP.";
```

```
            }
            leaf sequence {
              type uint32;
              description
                "Sequence number of the LSP.";
            }
            description
              "LSP identification container - either the received
               LSP or the locally generated LSP.";
          }

          leaf received-timestamp {
            type yang:timestamp;
            description
              "This is the timestamp when the LSA was received.
               In case of local LSA update, the timestamp refers
               to the LSA origination time.";
          }

          leaf reason {
            type identityref {
              base lsp-log-reason;
            }
            description "Type of LSP change.";
          }

          description
            "List of LSP events - implemented as a
             wrapping buffer.";
        }

        description
          "This container lists the LSP log.
           Local LSP modifications are also included
           in the list.";

      } description "Grouping for LSP log.";
    }



    /* Groupings for the LSDB description */

    /* Unknown TLV and sub-TLV description */
    grouping tlv {
      description
        "Type-Length-Value (TLV)";
      leaf type {
```

```
        type uint16;
        description "TLV type.";
      }
      leaf length {
        type uint16;
        description "TLV length (octets).";
      }
      leaf value {
        type yang:hex-string;
        description "TLV value.";
      }
    }

    grouping unknown-tlvs {
      description
        "Unknown TLVs grouping - Used for unknown TLVs or
         unknown sub-TLVs.";
      container unknown-tlvs {
        description "All unknown TLVs.";
        list unknown-tlv {
          description "Unknown TLV.";
          uses tlv;
        }
      }
    }

    /* TLVs and sub-TLVs for prefixes */

    grouping prefix-reachability-attributes {
      description
        "Grouping for extended reachability attributes of an
         IPv4 or IPv6 prefix.";

      leaf external-prefix-flag {
        type boolean;
        description "External prefix flag.";
      }
      leaf readvertisement-flag {
        type boolean;
        description "Re-advertisement flag.";
      }
      leaf node-flag {
        type boolean;
        description "Node flag.";
      }
    }

    grouping prefix-ipv4-source-router-id {
```

```
      description
        "Grouping for the IPv4 source router ID of a prefix
         advertisement.";

      leaf ipv4-source-router-id {
        type inet:ipv4-address;
        description "IPv4 Source router ID address.";
      }
    }

    grouping prefix-ipv6-source-router-id {
      description
        "Grouping for the IPv6 source router ID of a prefix
         advertisement.";

      leaf ipv6-source-router-id {
        type inet:ipv6-address;
        description "IPv6 Source router ID address.";
      }
    }

    grouping prefix-attributes-extension {
      description "Prefix extended attributes
                   as defined in RFC7794.";

      uses prefix-reachability-attributes;
      uses prefix-ipv4-source-router-id;
      uses prefix-ipv6-source-router-id;
    }

    grouping prefix-ipv4-std {
      description
        "Grouping for attributes of an IPv4 standard prefix
         as defined in RFC1195.";
      leaf ip-prefix {
        type inet:ipv4-address;
        description "IPv4 prefix address";
      }
      leaf prefix-len {
        type uint8;
        description "IPv4 prefix length (in bits)";
      }
      leaf i-e {
        type boolean;
        description "Internal or External (I/E) Metric bit value.";
      }
      container default-metric {
        leaf metric {
```

```
          type std-metric;
          description "Default IS-IS metric for IPv4 prefix";
        }
        description "IS-IS default metric container.";
      }
      container delay-metric {
        leaf metric {
          type std-metric;
          description "IS-IS delay metric for IPv4 prefix";
        }
        leaf supported {
          type boolean;
          default "false";
          description
            "Indicates whether IS-IS delay metric is supported.";
        }
        description "IS-IS delay metric container.";
      }
      container expense-metric {
        leaf metric {
          type std-metric;
          description "IS-IS expense metric for IPv4 prefix";
        }
        leaf supported {
          type boolean;
          default "false";
          description
            "Indicates whether IS-IS delay metric is supported.";
        }
        description "IS-IS expense metric container.";
      }
      container error-metric {
        leaf metric {
          type std-metric;
          description
            "This leaf describes the IS-IS error metric value";
        }
        leaf supported {
          type boolean;
          default "false";
          description "IS-IS error metric for IPv4 prefix";
        }
        description "IS-IS error metric container.";
      }
    }

    grouping prefix-ipv4-extended {
      description
```

```
         "Grouping for attributes of an IPv4 extended prefix
          as defined in RFC5305.";
       leaf up-down {
         type boolean;
         description  "Value of up/down bit.";
       }
       leaf ip-prefix {
         type inet:ipv4-address;
         description "IPv4 prefix address";
       }
       leaf prefix-len {
         type uint8;
         description "IPv4 prefix length (in bits)";
       }
       leaf metric {
         type wide-metric;
         description "IS-IS wide metric value";
       }
       leaf-list tag {
         type uint32;
         description
           "List of 32-bit tags associated with the IPv4 prefix.";
       }
       leaf-list tag64 {
         type uint64;
         description
           "List of 32-bit tags associated with the IPv4 prefix.";
       }
       uses prefix-attributes-extension;
     }

     grouping prefix-ipv6-extended {
       description "Grouping for attributes of an IPv6 prefix
                    as defined in RFC5308.";
       leaf up-down {
         type boolean;
         description "Value of up/down bit.";
       }
       leaf ip-prefix {
         type inet:ipv6-address;
         description "IPv6 prefix address";
       }
       leaf prefix-len {
         type uint8;
         description  "IPv4 prefix length (in bits)";
       }
       leaf metric {
         type wide-metric;
```

```
        description  "IS-IS wide metric value";
      }
      leaf-list tag {
        type uint32;
        description
          "List of 32-bit tags associated with the IPv4 prefix.";
      }
      leaf-list tag64 {
        type uint64;
        description
          "List of 32-bit tags associated with the IPv4 prefix.";
      }
      uses prefix-attributes-extension;
    }

    /* TLVs and sub-TLVs for neighbors */

    grouping neighbor-link-attributes {
      description
        "Grouping for link attributes as defined
        in RFC5029";
      leaf link-attributes-flags {
        type uint16;
        description
          "Flags for the link attributes";
      }
    }
    grouping neighbor-gmpls-extensions {
      description
        "Grouping for GMPLS attributes of a neighbor as defined
        in RFC5307";
      leaf link-local-id {
        type uint32;
        description
          "Local identifier of the link.";
      }
      leaf remote-local-id {
        type uint32;
        description
          "Remote identifier of the link.";
      }
      leaf protection-capability {
        type uint8;
        description
          "Describes the protection capabilities
          of the link. This is the value of the
          first octet of the sub-TLV type 20 value.";
      }
```

```
        container interface-switching-capability {
          description
            "Interface switching capabilities of the link.";
          leaf switching-capability {
            type uint8;
            description
              "Switching capability of the link.";
          }
          leaf encoding {
            type uint8;
            description
              "Type of encoding of the LSP being used.";
          }
          container max-lsp-bandwidths {
            description "Per-priority max LSP bandwidths.";
            list max-lsp-bandwidth {
              leaf priority {
                type uint8 {
                  range "0 .. 7";
                }
                description "Priority from 0 to 7.";
              }
              leaf bandwidth {
                type rt-types:bandwidth-ieee-float32;
                description "max LSP bandwidth.";
              }
              description
                "List of max LSP bandwidths for different
                 priorities.";
            }
          }
          container tdm-specific {
            when "../switching-capability = 100";
            description
              "Switching Capability-specific information applicable
              when switching type is TDM.";

            leaf minimum-lsp-bandwidth {
              type rt-types:bandwidth-ieee-float32;
              description "minimum LSP bandwidth.";
            }
            leaf indication {
              type uint8;
              description
                "The indication whether the interface supports Standard
                or Arbitrary SONET/SDH.";
            }
          }
```

```
        container psc-specific {
          when "../switching-capability >= 1 and
                ../switching-capability <= 4";
          description
            "Switching Capability-specific information applicable
            when switching type is PSC1,PSC2,PSC3 or PSC4.";

          leaf minimum-lsp-bandwidth {
            type rt-types:bandwidth-ieee-float32;
            description "minimum LSP bandwidth.";
          }
          leaf mtu {
            type uint16;
            units bytes;
            description
              "Interface MTU";
          }
        }
      }
    }

    grouping neighbor-extended-te-extensions {
      description
        "Grouping for TE attributes of a neighbor as defined
        in RFC8570";

      container unidirectional-link-delay {
        description
          "Container for the average delay
          from the local neighbor to the remote one.";
        container flags {
          leaf-list unidirectional-link-delay-subtlv-flags {
              type identityref {
                  base unidirectional-link-delay-subtlv-flag;
              }
             description
                   "This list contains identities for the bits
                    which are set.";
          }
          description
            "unidirectional-link-delay subTLV flags.";
        }
        leaf value {
          type uint32;
          units usec;
          description
            "Delay value expressed in microseconds.";
        }
```

```
        }
        container min-max-unidirectional-link-delay {
          description
            "Container for the min and max delay
            from the local neighbor to the remote one.";
          container flags {
            leaf-list min-max-unidirectional-link-delay-subtlv-flags {
                type identityref {
                    base min-max-unidirectional-link-delay-subtlv-flag;
                }
                description
                    "This list contains identities for the bits which are
                    set.";
            }
            description
              "min-max-unidirectional-link-delay subTLV flags.";
          }
          leaf min-value {
            type uint32;
            units usec;
            description
              "Minimum delay value expressed in microseconds.";
          }
          leaf max-value {
            type uint32;
            units usec;
            description
              "Maximum delay value expressed in microseconds.";
          }
        }
        container unidirectional-link-delay-variation {
          description
            "Container for the average delay variation
            from the local neighbor to the remote one.";
          leaf value {
            type uint32;
            units usec;
            description
              "Delay variation value expressed in microseconds.";
          }
        }
        container unidirectional-link-loss {
          description
            "Container for the packet loss
            from the local neighbor to the remote one.";
          container flags {
            leaf-list unidirectional-link-loss-subtlv-flags {
                type identityref {
```

```
                    base unidirectional-link-loss-subtlv-flag;
                }
                description
                    "This list contains identities for the bits which are
                    set.";
            }
            description
              "unidirectional-link-loss subTLV flags.";
          }
          leaf value {
            type uint32;
            units percent;
            description
              "Link packet loss expressed as a percentage
              of the total traffic sent over a configurable interval.";
          }
        }
        container unidirectional-link-residual-bandwidth {
          description
            "Container for the residual bandwidth
            from the local neighbor to the remote one.";
          leaf value {
            type rt-types:bandwidth-ieee-float32;
            units Bps;
            description
              "Residual bandwidth.";
          }
        }
        container unidirectional-link-available-bandwidth {
          description
            "Container for the available bandwidth
            from the local neighbor to the remote one.";
          leaf value {
            type rt-types:bandwidth-ieee-float32;
            units Bps;
            description
              "Available bandwidth.";
          }
        }
        container unidirectional-link-utilized-bandwidth {
          description
            "Container for the utilized bandwidth
            from the local neighbor to the remote one.";
          leaf value {
            type rt-types:bandwidth-ieee-float32;
            units Bps;
            description
              "Utilized bandwidth.";
```

```
        }
      }
    }

    grouping neighbor-te-extensions {
      description
        "Grouping for TE attributes of a neighbor as defined
        in RFC5305";
      leaf admin-group {
        type uint32;
        description
          "Administrative group/Resource Class/Color.";
      }
      container local-if-ipv4-addrs {
        description "All local interface IPv4 addresses.";
        leaf-list local-if-ipv4-addr {
          type inet:ipv4-address;
          description
            "List of local interface IPv4 addresses.";
        }
      }
      container remote-if-ipv4-addrs {
        description "All remote interface IPv4 addresses.";
        leaf-list remote-if-ipv4-addr {
          type inet:ipv4-address;
          description
            "List of remote interface IPv4 addresses.";
        }
      }
      leaf te-metric {
        type uint32;
        description "TE metric.";
      }
      leaf max-bandwidth {
        type rt-types:bandwidth-ieee-float32;
        description "Maximum bandwidth.";
      }
      leaf max-reservable-bandwidth {
        type rt-types:bandwidth-ieee-float32;
        description "Maximum reservable bandwidth.";
      }
      container unreserved-bandwidths {
        description "All unreserved bandwidths.";
        list unreserved-bandwidth {
          leaf priority {
            type uint8 {
              range "0 .. 7";
            }
```

```
            description "Priority from 0 to 7.";
          }
          leaf unreserved-bandwidth {
            type rt-types:bandwidth-ieee-float32;
            description "Unreserved bandwidth.";
          }
          description
            "List of unreserved bandwidths for different
             priorities.";
        }
      }
    }

    grouping neighbor-extended {
      description
       "Grouping for attributes of an IS-IS extended neighbor.";
      leaf neighbor-id {
        type extended-system-id;
        description "system-id of the extended neighbor.";
      }
     container instances {
        description "List of all adjacencies between the local
                     system and the neighbor system-id.";
        list instance {
          key id;

          leaf id {
            type uint32;
            description "Unique identifier of an instance of a
                         particular neighbor.";
          }
          leaf metric {
            type wide-metric;
            description "IS-IS wide metric for extended neighbor";
          }
          uses neighbor-gmpls-extensions;
          uses neighbor-te-extensions;
          uses neighbor-extended-te-extensions;
          uses neighbor-link-attributes;
          uses unknown-tlvs;
          description "Instance of a particular adjacency.";
        }
      }
    }

    grouping neighbor {
      description  "IS-IS standard neighbor grouping.";
      leaf neighbor-id {
```

```
         type extended-system-id;
         description "IS-IS neighbor system-id";
       }
      container instances {
         description "List of all adjacencies between the local
                      system and the neighbor system-id.";
         list instance {
           key id;

           leaf id {
             type uint32;
             description "Unique identifier of an instance of a
                          particular neighbor.";
           }
           leaf i-e {
             type boolean;
             description
               "Internal or External (I/E) Metric bit value";
           }
           container default-metric {
             leaf metric {
               type std-metric;
               description "IS-IS default metric value";
             }
            description "IS-IS default metric container";
           }
           container delay-metric {
             leaf metric {
               type std-metric;
               description "IS-IS delay metric value";
             }
             leaf supported {
               type boolean;
               default "false";
               description "IS-IS delay metric supported";
             }
             description "IS-IS delay metric container";
           }
           container expense-metric {
             leaf metric {
               type std-metric;
               description "IS-IS delay expense metric value";
             }
             leaf supported {
               type boolean;
               default "false";
               description "IS-IS delay expense metric supported";
             }
```

```
            description "IS-IS delay expense metric container";
          }
          container error-metric {
            leaf metric {
              type std-metric;
              description "IS-IS error metric value";
            }
            leaf supported {
              type boolean;
              default "false";
              description "IS-IS error metric supported";
            }
            description "IS-IS error metric container";
          }
          description "Instance of a particular adjacency
                       as defined in ISO10589.";
        }
      }
    }

    /* Top-level TLVs */

    grouping tlv132-ipv4-addresses {
      leaf-list ipv4-addresses {
        type inet:ipv4-address;
        description
          "List of IPv4 addresses of the IS-IS node - IS-IS
           reference is TLV 132.";
      }
      description "Grouping for TLV132.";
    }
    grouping tlv232-ipv6-addresses {
      leaf-list ipv6-addresses {
        type inet:ipv6-address;
        description
          "List of IPv6 addresses of the IS-IS node - IS-IS
           reference is TLV 232.";
      }
      description "Grouping for TLV232.";
    }
    grouping tlv134-ipv4-te-rid {
      leaf ipv4-te-routerid {
        type inet:ipv4-address;
        description
          "IPv4 Traffic Engineering router ID of the IS-IS node -
           IS-IS reference is TLV 134.";
      }
      description "Grouping for TLV134.";
```

```
     }
     grouping tlv140-ipv6-te-rid {
       leaf ipv6-te-routerid {
         type inet:ipv6-address;
         description
           "IPv6 Traffic Engineering router ID of the IS-IS node -
            IS-IS reference is TLV 140.";
       }
       description "Grouping for TLV140.";
     }
     grouping tlv129-protocols {
       leaf-list protocol-supported {
         type uint8;
         description
         "List of supported protocols of the IS-IS node -
          IS-IS reference is TLV 129.";
       }
       description "Grouping for TLV129.";
     }
     grouping tlv137-hostname {
       leaf dynamic-hostname {
         type string;
         description
           "Host Name of the IS-IS node - IS-IS reference
            is TLV 137.";
       }
       description "Grouping for TLV137.";
     }
     grouping tlv10-authentication {
       container authentication {
         leaf authentication-type {
           type identityref {
               base key-chain:crypto-algorithm;
           }
           description
             "Authentication type to be used with IS-IS node.";
         }
         leaf authentication-key {
           type string;
           description
             "Authentication key to be used. For security reasons,
              the authentication key MUST NOT be presented in
              a clear text format in response to any request
             (e.g., via get, get-config).";
         }
         description
           "IS-IS node authentication information container -
            IS-IS reference is TLV 10.";
```

```
      }
      description "Grouping for TLV10.";
    }
    grouping tlv229-mt {
      container mt-entries {
        list topology {
          description
            "List of topologies supported";

          leaf mt-id {
            type uint16 {
              range "0 .. 4095";
            }
            description
              "Multi-Topology identifier of topology.";
          }
          container attributes {
              leaf-list flags {
                  type identityref {
                      base tlv229-flag;
                  }
                  description
                  "This list contains identities for the bits which are
                  set.";
              }
              description
                  "TLV 229 flags.";
          }
        }
        description
          "IS-IS node topology information container -
           IS-IS reference is TLV 229.";
      }
      description "Grouping for TLV229.";
    }

    grouping tlv242-router-capabilities {
      container router-capabilities {
        list router-capability {
            container flags {
              leaf-list router-capability-flags {
                  type identityref {
                      base router-capability-flag;
                  }
                  description
                  "This list contains identities for the bits which are
                  set.";
              }
```

```
              description
                  "Router capability flags.";
            }
            container node-tags {
              if-feature node-tag;
              list node-tag {
                leaf tag {
                  type uint32;
                  description "Node tag value.";
                }
                description "List of tags.";
              }
              description "Container for node admin tags";
            }

            uses unknown-tlvs;

            description
              "IS-IS node capabilities. This list element may
               be extended with detailed information -  IS-IS
               reference is TLV 242.";
          }
          description "List of router capability TLVs.";
        }
        description "Grouping for TLV242.";
      }

      grouping tlv138-srlg {
        description
          "Grouping for TLV138.";
        container links-srlgs {
          list links {
            leaf neighbor-id {
              type extended-system-id;
              description "system-id of the extended neighbor.";
            }
            leaf flags {
              type uint8;
              description
                "Flags associated with the link.";
            }
            leaf link-local-id {
              type union {
                type inet:ip-address;
                type uint32;
              }
              description
                "Local identifier of the link.
```

```
              It could be an IPv4 address or a local identifier.";
          }
          leaf link-remote-id {
            type union {
              type inet:ip-address;
              type uint32;
            }
            description
              "Remote identifier of the link.
              It could be an IPv4 address or a remotely learned
              identifier.";
          }
          container srlgs {
            description "List of SRLGs.";
            leaf-list srlg {
              type uint32;
              description
                "SRLG value of the link.";
            }
          }
          description
            "SRLG attribute of a link.";
        }
        description
          "List of links with SRLGs";
      }
    }

    /* Grouping for LSDB description */

    grouping lsp-entry {
      description "IS-IS LSP database entry grouping";

      leaf decoded-completed {
        type boolean;
        description "IS-IS LSP body fully decoded.";
      }
      leaf raw-data {
        type yang:hex-string;
        description
          "The hexadecimal representation of the complete LSP in
           network-byte order (NBO) as received or originated.";
      }
      leaf lsp-id {
        type lsp-id;
        description "LSP ID of the LSP";
      }
      leaf checksum {
```

```
          type uint16;
          description "LSP checksum";
        }
        leaf remaining-lifetime {
          type uint16;
          units "seconds";
          description
            "Remaining lifetime (in seconds) until LSP expiration.";
        }
        leaf sequence {
          type uint32;
          description
            "This leaf describes the sequence number of the LSP.";
        }
        container attributes {
            leaf-list lsp-flags {
                type identityref {
                    base lsp-flag;
                }
                description
                    "This list contains identities for the bits which are
                    set.";
            }
            description "LSP attributes.";
        }

        uses tlv132-ipv4-addresses;
        uses tlv232-ipv6-addresses;
        uses tlv134-ipv4-te-rid;
        uses tlv140-ipv6-te-rid;
        uses tlv129-protocols;
        uses tlv137-hostname;
        uses tlv10-authentication;
        uses tlv229-mt;
        uses tlv242-router-capabilities;
        uses tlv138-srlg;
        uses unknown-tlvs;

        container is-neighbor {
          list neighbor {
            key neighbor-id;

            uses neighbor;
            description "List of neighbors.";
          }
          description
            "Standard IS neighbors container - IS-IS reference is
             TLV 2.";
```

```
        }

        container extended-is-neighbor {
          list neighbor {
            key neighbor-id;

            uses neighbor-extended;
            description
              "List of extended IS neighbors";
          }
          description
            "Standard IS extended neighbors container - IS-IS
             reference is TLV 22";
        }

        container ipv4-internal-reachability {
          list prefixes {
            uses prefix-ipv4-std;
            description "List of prefixes.";
          }
          description
          "IPv4 internal reachability information container - IS-IS
           reference is TLV 128.";
        }

        container ipv4-external-reachability {
          list prefixes {
            uses prefix-ipv4-std;
            description "List of prefixes.";
          }
          description
            "IPv4 external reachability information container -
             IS-IS reference is TLV 130.";
        }

        container extended-ipv4-reachability {
          list prefixes {
            uses prefix-ipv4-extended;
            uses unknown-tlvs;
            description "List of prefixes.";
          }
          description
            "IPv4 extended reachability information container -
             IS-IS reference is TLV 135.";
        }

        container mt-is-neighbor {
          list neighbor {
```

```
            leaf mt-id {
              type uint16 {
                range "0 .. 4095";
              }
              description "Multi-topology (MT) identifier";
            }
            uses neighbor-extended;
            description "List of neighbors.";
          }
          description
            "IS-IS multi-topology neighbor container - IS-IS
             reference is TLV 223.";
        }

        container mt-extended-ipv4-reachability {
          list prefixes {
            leaf mt-id {
              type uint16 {
                range "0 .. 4095";
              }
              description  "Multi-topology (MT) identifier";
            }
            uses prefix-ipv4-extended;
            uses unknown-tlvs;
            description "List of extended prefixes.";
          }
          description
            "IPv4 multi-topology (MT) extended reachability
             information container - IS-IS reference is TLV 235.";
        }

        container mt-ipv6-reachability {
          list prefixes {
            leaf MT-ID {
              type uint16 {
                range "0 .. 4095";
              }
              description "Multi-topology (MT) identifier";
            }
            uses prefix-ipv6-extended;
            uses unknown-tlvs;
            description "List of IPv6 extended prefixes.";
          }
          description
            "IPv6 multi-topology (MT) extended reachability
             information container - IS-IS reference is TLV 237.";
        }
```

```
      container ipv6-reachability {
        list prefixes {
          uses prefix-ipv6-extended;
          uses unknown-tlvs;
          description "List of IPv6 prefixes.";
        }
        description
          "IPv6 reachability information container - IS-IS
           reference is TLV 236.";
      }
    }

    grouping lsdb {
      description "Link State Database (LSDB) grouping";
      container database {
        config false;
        list levels {
          key level;

          leaf level {
            type level-number;
            description "LSDB level number (1 or 2)";
          }
          list lsp {
            key lsp-id;
            uses lsp-entry;
            description "List of LSPs in LSDB";
          }
          description "List of LSPs for the LSDB level container";
        }
        description "IS-IS Link State database container";
      }
    }




    /* Augmentations */

    augment "/rt:routing/"
      +"rt:ribs/rt:rib/rt:routes/rt:route" {
      when "rt:source-protocol = 'isis:isis'" {
        description "IS-IS-specific route attributes.";
      }
      uses route-content;
      description
        "This augments route object in RIB with IS-IS-specific
         attributes.";
```

```
     }


     augment "/if:interfaces/if:interface" {
       leaf clns-mtu {
         if-feature osi-interface;
         type uint16;
         description "CLNS MTU of the interface";
       }
       description "ISO specific interface parameters.";
     }

     augment "/rt:routing/rt:control-plane-protocols/"
       +"rt:control-plane-protocol" {
       when "rt:type = 'isis:isis'" {
         description
           "This augment is only valid when routing protocol
            instance type is 'isis'";
       }
       description
         "This augments a routing protocol instance with IS-IS
          specific parameters.";
       container isis {
         must "count(area-address) > 0" {
           error-message
             "At least one area-address must be configured.";
           description
             "Enforce configuration of at least one area.";
         }

         uses instance-config;
         uses instance-state;

         container topologies {
           if-feature multi-topology;
           list topology {
             key "name";
             leaf enable {
               type boolean;
               description "Topology enable configuration";
             }
             leaf name {
               type leafref {
                 path "../../../../../../rt:ribs/rt:rib/rt:name";
               }
               description
                 "Routing Information Base (RIB) corresponding
                  to topology.";
```

```
            }

            uses multi-topology-config;

            description "List of topologies";
          }
          description "Multi-topology container";
        }
        container interfaces {
          list interface {
            key "name";
            leaf name {
              type if:interface-ref;

              description
                "Reference to the interface within
                 the routing-instance.";
            }
            uses interface-config;
            uses interface-state;
            container topologies {
              if-feature multi-topology;
              list topology {
                key name;

                leaf name {
                  type leafref {
                    path "../../../../../../../../"+
                      "rt:ribs/rt:rib/rt:name";
                  }

                  description
                    "Routing Information Base (RIB) corresponding
                     to topology.";
                }
                uses multi-topology-interface-config;
                description "List of interface topologies";
              }
              description "Multi-topology container";
            }
            description "List of IS-IS interfaces.";
          }
          description
            "IS-IS interface specific configuration container";
        }

        description
          "IS-IS configuration/state top-level container";
```

```
      }
    }


    /* RPC methods */

    rpc clear-adjacency {
      description
        "This RPC request clears a particular set of IS-IS
         adjacencies. If the operation fails due to an internal
         reason, then the error-tag and error-app-tag should be
         set indicating the reason for the failure.";
      input {

        leaf routing-protocol-instance-name {
          type leafref {
            path "/rt:routing/rt:control-plane-protocols/"
               + "rt:control-plane-protocol/rt:name";
          }
          mandatory "true";
          description
            "Name of the IS-IS protocol instance whose IS-IS
             adjacency is being cleared.

             If the corresponding IS-IS instance doesn't exist,
             then the operation will fail with an error-tag of
             'data-missing' and an error-app-tag of
             'routing-protocol-instance-not-found'.";
        }
        leaf level {
          type level;
          description
            "IS-IS level of the adjacency to be cleared. If the
             IS-IS level is level-1-2, both level 1 and level 2
             adjacencies would be cleared.

             If the value provided is different from the one
             authorized in the enum type, then the operation
             SHALL fail with an error-tag of 'data-missing' and
             an error-app-tag of 'bad-isis-level'.";
        }
        leaf interface {
          type if:interface-ref;
          description
            "IS-IS interface name.

             If the corresponding IS-IS interface doesn't exist,
             then the operation SHALL fail with an error-tag of
```

```
              'data-missing' and an error-app-tag of
              'isis-interface-not-found'.";
          }
        }
      }

      rpc clear-database {
        description
          "This RPC request clears a particular  IS-IS database. If
           the operation fails for an IS-IS internal reason, then
           the error-tag and error-app-tag should be set
           indicating the reason for the failure.";
        input {
          leaf routing-protocol-instance-name {
            type leafref {
              path "/rt:routing/rt:control-plane-protocols/"
                 + "rt:control-plane-protocol/rt:name";
            }
            mandatory "true";
            description
              "Name of the IS-IS protocol instance whose IS-IS
               database(s) is/are being cleared.

               If the corresponding IS-IS instance doesn't exist,
               then the operation will fail with an error-tag of
               'data-missing' and an error-app-tag of
               'routing-protocol-instance-not-found'.";
          }
          leaf level {
            type level;
            description
              "IS-IS level of the adjacency to be cleared. If the
               IS-IS level is level-1-2, both level 1 and level 2
               databases would be cleared.

               If the value provided is different from the one
               authorized in the enum type, then the operation
               SHALL fail with an error-tag of 'data-missing' and
               an error-app-tag of 'bad-isis-level'.";
          }
        }
      }


      /* Notifications */

      notification database-overload {
        uses notification-instance-hdr;
```

```
        leaf overload {
          type enumeration {
            enum off {
              description
                "Indicates IS-IS instance has left overload state";
            }
            enum on {
              description
                "Indicates IS-IS instance has entered overload state";
            }

          }
          description "New overload state of the IS-IS instance";
        }
        description
          "This notification is sent when an IS-IS instance
           overload state changes.";
      }

      notification lsp-too-large {
        uses notification-instance-hdr;
        uses notification-interface-hdr;

        leaf pdu-size {
          type uint32;
          description "Size of the LSP PDU";
        }
        leaf lsp-id {
          type lsp-id;
          description "LSP ID";
        }
        description
          "This notification is sent when we attempt to propagate
           an LSP that is larger than the dataLinkBlockSize (ISO10589)
           for the circuit.  The notification generation must be
           throttled with at least 5 seconds between successive
           notifications.";
      }

      notification if-state-change {
        uses notification-instance-hdr;
        uses notification-interface-hdr;

        leaf state {
          type if-state-type;
          description "Interface state.";
        }
        description
```

```
         "This notification is sent when an interface
          state change is detected.";
     }

     notification corrupted-lsp-detected {
       uses notification-instance-hdr;
       leaf lsp-id {
         type lsp-id;
         description "LSP ID";
       }
       description
         "This notification is sent when we find that
          an LSP that was stored in memory has become
          corrupted.";
     }

     notification attempt-to-exceed-max-sequence {
       uses notification-instance-hdr;
       leaf lsp-id {
         type lsp-id;
         description "LSP ID";
       }
       description
         "This notification is sent when the system
          wraps the 32-bit sequence counter of an LSP.";
     }

     notification id-len-mismatch {
       uses notification-instance-hdr;
       uses notification-interface-hdr;

       leaf pdu-field-len {
         type uint8;
         description "Size of the ID length in the received PDU";
       }
       leaf raw-pdu {
         type binary;
         description "Received raw PDU.";
       }
       description
         "This notification is sent when we receive a PDU
          with a different value for the system-id length.
          The notification generation must be throttled
          with at least 5 seconds between successive
          notifications.";
     }

     notification max-area-addresses-mismatch {
```

```
        uses notification-instance-hdr;
        uses notification-interface-hdr;

        leaf max-area-addresses {
          type uint8;
          description "Received number of supported areas";
        }
        leaf raw-pdu {
          type binary;
          description "Received raw PDU.";
        }
        description
          "This notification is sent when we receive a PDU
           with a different value for the Maximum Area Addresses.
           The notification generation must be throttled
           with at least 5 seconds between successive
           notifications.";
      }

      notification own-lsp-purge {
        uses notification-instance-hdr;
        uses notification-interface-hdr;
        leaf lsp-id {
          type lsp-id;
          description "LSP ID";
        }
        description
          "This notification is sent when the system receives
           a PDU with its own system-id and zero age.";
      }

      notification sequence-number-skipped {
        uses notification-instance-hdr;
        uses notification-interface-hdr;
        leaf lsp-id {
          type lsp-id;
          description "LSP ID";
        }
        description
          "This notification is sent when the system receives a
           PDU with its own system-id and different contents. The
           system has to originate the LSP with a higher sequence
           number.";
      }

      notification authentication-type-failure {
        uses notification-instance-hdr;
        uses notification-interface-hdr;
```

```
        leaf raw-pdu {
          type binary;
          description "Received raw PDU.";
        }
        description
          "This notification is sent when the system receives a
           PDU with the wrong authentication type field.
           The notification generation must be throttled
           with at least 5 seconds between successive
           notifications.";
      }

      notification authentication-failure {
        uses notification-instance-hdr;
        uses notification-interface-hdr;
        leaf raw-pdu {
          type binary;
          description "Received raw PDU.";
        }
        description
          "This notification is sent when the system receives
           a PDU with the wrong authentication information.
           The notification generation must be throttled
           with at least 5 seconds between successive
           notifications.";
      }

      notification version-skew {
        uses notification-instance-hdr;
        uses notification-interface-hdr;
        leaf protocol-version {
          type uint8;
          description "Protocol version received in the PDU.";
        }
        leaf raw-pdu {
          type binary;
          description "Received raw PDU.";
        }
        description
          "This notification is sent when the system receives a
           PDU with a different protocol version number.
           The notification generation must be throttled
           with at least 5 seconds between successive
           notifications.";
      }

      notification area-mismatch {
        uses notification-instance-hdr;
```

```
        uses notification-interface-hdr;
        leaf raw-pdu {
          type binary;
          description "Received raw PDU.";
        }
        description
          "This notification is sent when the system receives a
           Hello PDU from an IS that does not share any area
           address. The notification generation must be throttled
           with at least 5 seconds between successive
           notifications.";
      }

      notification rejected-adjacency {
        uses notification-instance-hdr;
        uses notification-interface-hdr;
        leaf raw-pdu {
          type binary;
          description
            "Received raw PDU.";
        }
        leaf reason {
          type string {
            length "1..255";
          }
          description
            "The system may provide a reason to reject the
             adjacency. If the reason is not available,
             an empty string will be returned.
             The expected format is a single line text.";
        }
        description
          "This notification is sent when the system receives a
           Hello PDU from an IS but does not establish an adjacency
           for some reason. The notification generation must be
           throttled with at least 5 seconds between successive
           notifications.";
      }


      notification protocols-supported-mismatch {
        uses notification-instance-hdr;
        uses notification-interface-hdr;
        leaf raw-pdu {
          type binary;
          description "Received raw PDU.";
        }
        leaf-list protocols {
```

```
        type uint8;
        description
          "List of protocols supported by the remote system.";
      }
      description
        "This notification is sent when the system receives a
         non-pseudonode LSP that has no matching protocols
         supported. The notification generation must be throttled
         with at least 5 seconds between successive
         notifications.";
    }

    notification lsp-error-detected {
      uses notification-instance-hdr;
      uses notification-interface-hdr;
      leaf lsp-id {
        type lsp-id;
        description "LSP ID.";
      }
      leaf raw-pdu {
        type binary;
        description "Received raw PDU.";
      }
      leaf error-offset {
        type uint32;
        description
          "If the problem is a malformed TLV, the error-offset
           points to the start of the TLV. If the problem is with
           the LSP header, the error-offset points to the errant
           byte";
      }
      leaf tlv-type {
        type uint8;
        description
          "If the problem is a malformed TLV, the tlv-type is set
           to the type value of the suspicious TLV. Otherwise,
           this leaf is not present.";
      }
      description
        "This notification is sent when the system receives an
         LSP with a parse error. The notification generation must
         be throttled with at least 5 seconds between successive
         notifications.";
    }

    notification adjacency-state-change {
      uses notification-instance-hdr;
      uses notification-interface-hdr;
```

```
        leaf neighbor {
          type string {
            length "1..255";
          }
          description
            "Name of the neighbor.
             It corresponds to the hostname associated
             with the system-id of the neighbor in the
             mapping database (RFC5301).
             If the name of the neighbor is
             not available, it is not returned.";
        }
        leaf neighbor-system-id {
          type system-id;
          description "Neighbor system-id";
        }
        leaf state {
          type adj-state-type;

          description "New state of the IS-IS adjacency.";
        }
        leaf reason {
          type string {
            length "1..255";
          }
          description
            "If the adjacency is going to DOWN,  this leaf provides
             a reason for the adjacency going down. The reason is
             provided as a text. If the adjacency is going to UP, no
             reason is provided. The expected format is a single line
             text.";
        }
        description
          "This notification is sent when an IS-IS adjacency
           moves to Up state or to Down state.";
      }

      notification lsp-received {
        uses notification-instance-hdr;
        uses notification-interface-hdr;

        leaf lsp-id {
          type lsp-id;
          description "LSP ID";
        }
        leaf sequence {
          type uint32;
          description "Sequence number of the received LSP.";
```

```
      }
      leaf received-timestamp {
        type yang:timestamp;

        description "Timestamp when the LSP was received.";
      }
      leaf neighbor-system-id {
        type system-id;
        description "Neighbor system-id of LSP sender";
      }
      description
        "This notification is sent when an LSP is received.
         The notification generation must be throttled with at
         least 5 seconds between successive notifications.";
     }

    notification lsp-generation {
      uses notification-instance-hdr;

      leaf lsp-id {
        type lsp-id;
        description "LSP ID";
      }
      leaf sequence {
        type uint32;
        description "Sequence number of the received LSP.";
      }
      leaf send-timestamp {
        type yang:timestamp;

        description "Timestamp when our LSP was regenerated.";
      }
      description
        "This notification is sent when an LSP is regenerated.
         The notification generation must be throttled with at
         least 5 seconds between successive notifications.";
    }
  }
  <CODE ENDS>
```

7. Security Considerations

The YANG modules specified in this document define 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 NETCONF Access Control Model (NACM) [RFC8341] provides the means to restrict access for particular NETCONF or RESTCONF users to a pre-configured subset of all available NETCONF or RESTCONF protocol operations and content.

There are a number of data nodes defined in ietf-isis.yang module 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. Writable data node represent configuration of each instance and interface. These correspond to the following schema nodes:

```
/isis

/isis/interfaces/interface[name]
```

For IS-IS, the ability to modify IS-IS configuration will allow the entire IS-IS domain to be compromised including forming adjacencies with unauthorized routers to misroute traffic or mount a massive Denial-of-Service (DoS) attack. For example, adding IS-IS on any unprotected interface could allow an IS-IS adjacency to be formed with an unauthorized and malicious neighbor. Once an adjacency is formed, traffic could be hijacked. As a simpler example, a Denial-of-Service attack could be mounted by changing the cost of an IS-IS interface to be asymmetric such that a hard routing loop ensues. In general, unauthorized modification of most IS-IS features will pose their own set of security risks and the "Security Considerations" in the respective reference RFCs should be consulted.

Some of the readable data nodes in the ietf-isi.yang module may be considered sensitive or vulnerable in some network environments. It is thus important to control read access (e.g., via get, get-config, or notification) to these data nodes. The exposure of the Link State Database (LSDB) will expose the detailed topology of the network. The Link State Database (LSDB) is represented by the following schema node:

```
/isis/database
```

Exposure of the Link State Database includes information beyond the scope of the IS-IS router and this may be undesirable since exposure may facilitate other attacks. Additionally, the complete IP network topology and, if deployed, the traffic engineering topology of the

IS-IS domain can be reconstructed. Network operators may consider their topologies to be sensitive confidential data.

For IS-IS authentication, configuration is supported via the specification of key-chain [RFC8177] or the direction specification of key and authentication algorithm. Hence, authentication configuration using the "auth-table-trailer" case in the "authentication" container inherits the security considerations of [RFC8177]. This includes the considerations with respect to the local storage and handling of authentication keys.

Some of the RPC operations in this YANG module may be considered sensitive or vulnerable in some network environments. It is thus important to control access to these operations. The IS-IS YANG module support the "clear-adjacency" and "clear-database" RPCs. If access to either of these is compromised, they can result in temporary network outages be employed to mount DoS attacks.

The actual authentication key data (whether locally specified or part of a key-chain) is sensitive and needs to be kept secret from unauthorized parties; compromise of the key data would allow an attacker to forge IS-IS traffic that would be accepted as authentic, potentially compromising the entirety IS-IS domain.

8. Contributors

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10. IANA Considerations

The IANA is requested to assign two new URIs from the IETF XML registry [RFC3688]. Authors are suggesting the following URI:

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

This document also requests one new YANG module name in the YANG Module Names registry [RFC6020] with the following suggestion:

```
name: ietf-isis
namespace: urn:ietf:params:xml:ns:yang:ietf-isis
prefix: isis
reference: RFC XXXX
```

11. References

11.1. Normative References

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11.2. Informative References

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Appendix A. Example of IS-IS configuration in XML

This section gives an example of configuration of an IS-IS instance on a device. The example is written in XML.

```
<?xml version="1.0" encoding="utf-8"?>
<data xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <routing xmlns="urn:ietf:params:xml:ns:yang:ietf-routing">
      <name>SLI</name>
      <router-id>1.1.1.1</router-id>
      <control-plane-protocols>
        <control-plane-protocol>
          <name>ISIS-example</name>
          <description/>
          <type>
            <type xmlns:isis="urn:ietf:params:xml:ns:yang:ietf-isis">
            isis:isis
            </type>
          </type>
          <isis xmlns="urn:ietf:params:xml:ns:yang:ietf-isis">
              <enable>true</enable>
              <level-type>level-2</level-type>
```

```
                <system-id>87FC.FCDF.4432</system-id>
                <area-address>49.0001</area-address>
                <mpls>
                  <te-rid>
                    <ipv4-router-id>192.0.2.1</ipv4-router-id>
                  </te-rid>
                </mpls>
                <lsp-lifetime>65535</lsp-lifetime>
                <lsp-refresh>65000</lsp-refresh>
                <metric-type>
                  <value>wide-only</value>
                </metric-type>
                <default-metric>
                  <value>111111</value>
                </default-metric>
                <address-families>
                  <address-family-list>
                    <address-family>ipv4</address-family>
                    <enable>true</enable>
                  </address-family-list>
                  <address-family-list>
                    <address-family>ipv6</address-family>
                    <enable>true</enable>
                  </address-family-list>
                </address-families>
                <interfaces>
                  <interface>
                    <name>Loopback0</name>
                    <tag>200</tag>
                    <metric>
                      <value>0</value>
                    </metric>
                    <passive>true</passive>
                  </interface>
                  <interface>
                    <name>Eth1</name>
                    <level-type>level-2</level-type>
                    <interface-type>point-to-point</interface-type>
                    <metric>
                      <value>167890</value>
                    </metric>
                  </interface>
                </interfaces>
            </isis>
          </control-plane-protocol>
        </control-plane-protocols>
      </routing>
      <interfaces xmlns="urn:ietf:params:xml:ns:yang:ietf-interfaces">
```

```
      <interface>
        <name>Loopback0</name>
        <description/>
        <type xmlns:ianaift="urn:ietf:params:xml:ns:yang:iana-if-type">
        ianaift:softwareLoopback
        </type>
        <link-up-down-trap-enable>enabled</link-up-down-trap-enable>
        <ipv4 xmlns="urn:ietf:params:xml:ns:yang:ietf-ip">
          <address>
            <ip>192.0.2.1</ip>
            <prefix-length>32</prefix-length>
          </address>
        </ipv4>
        <ipv6 xmlns="urn:ietf:params:xml:ns:yang:ietf-ip">
          <address>
            <ip>2001:DB8::1</ip>
            <prefix-length>128</prefix-length>
          </address>
        </ipv6>
      </interface>
      <interface>
        <name>Eth1</name>
        <description/>
        <type xmlns:ianaift="urn:ietf:params:xml:ns:yang:iana-if-type">
        ianaift:ethernetCsmacd
        </type>
        <link-up-down-trap-enable>enabled</link-up-down-trap-enable>
        <ipv4 xmlns="urn:ietf:params:xml:ns:yang:ietf-ip">
          <address>
            <ip>198.51.100.1</ip>
            <prefix-length>30</prefix-length>
          </address>
        </ipv4>
        <ipv6 xmlns="urn:ietf:params:xml:ns:yang:ietf-ip">
          <address>
            <ip>2001:DB8:0:0:FF::1</ip>
            <prefix-length>64</prefix-length>
          </address>
        </ipv6>
      </interface>
    </interfaces>
  </data>
```


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