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RFC 9130

YANG Data Model for the IS-IS Protocol

Abstract

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

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 7841.

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1. Introduction

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

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

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 defined in this document is designed as per the Network Management Datastore Architecture (NMDA) [RFC8342].

1.1. 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.

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 diagram below shows the overall structure of the "ietf-isis" YANG module defined in this document. NOTE: '\ ' line wrapping is per [RFC8792].

```
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 enabled?          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 enabled?          boolean
| +--rw restart-interval? rt-types:timer-value-seconds16
| +--rw helper-enabled?   boolean
+--rw nsr {nsr}?
| +--rw enabled?         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 enabled?         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 prefixes* [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
| | | 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
| | | level
| | +---w 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 two areas:

- Global parameters
- 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 the usual IS-IS parameters, e.g., "lsp-mtu", "lsp-lifetime", "lsp-refresh", "default-metric".

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, at both the global level and 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 per-level configuration. For such parameters, the parameter is modeled as a container with three configuration locations:

A top-level container:

Corresponds to "level-all", so the configuration applies to both levels.

A level-1 container:

Corresponds to parameters specific to level 1.

A level-2 container:

Corresponds to parameters specific to level 2.

```

+--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>
</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 configuration and 250 for the top-level configuration, the implementation must use 100 for the level-1 priority and 250 for the level-2 priority.

Some parameters, such as "overload bit" and "route preference", are not modeled to support per-level configuration. If an implementation supports per-level configuration for such parameters, 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 augments the IS-IS routing protocol when used.";
  }
  description
    "This augments the 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 that it does not support the configuration of level-1 and level-2 containers.

Finally, if an implementation supports per-level configuration but does not support the "level-all" 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 as defined in the "ietf-interfaces" YANG module [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 enabled?                           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 enabled? boolean
    +--rw mesh-group-enabled?                 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 enabled? boolean
| | | +---rw local-multiplier? multiplier
| | | | {client-base-cfg-parms}?
+---rw (interval-config-type)? {client-base-cfg-parms}?
| | | | +---:(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-enabled? boolean
| | | | +---rw enabled? boolean
| | | | +---rw remote-lfa {remote-lfa}?
| | | | | +---rw enabled? boolean
+---rw level-1

```

```

| | +--rw candidate-enabled? boolean
| | +--rw enabled? boolean
| | +--rw remote-lfa {remote-lfa}?
| |   +--rw enabled? boolean
+--rw level-2
|   +--rw candidate-enabled? boolean
|   +--rw enabled? boolean
|   +--rw remote-lfa {remote-lfa}?
|   +--rw enabled? 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

```

2.5. Authentication Parameters

The module defined in this document 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 PDUs), CSNPs (Complete Sequence Number PDUs), and LSPs (Link State PDUs) 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 (the Interior Gateway Protocol) needs to be synchronized with LDP (the 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 functionality 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 the "ietf-interfaces" module configuration to support selected ISO configuration parameters.

The "clns-mtu" parameter can be configured for an interface.

2.8. IP FRR

The YANG module defined in this document supports LFAs (Loop-Free Alternates) [RFC5286] and remote LFAs [RFC7490] as IP Fast Reroute (FRR) techniques. The "fast-reroute" container may be augmented by other models to support other IP FRR flavors (Maximally Redundant Trees (MRTs) as defined in [RFC7812], Topology Independent LFA (TI-LFA) FRR as defined in [SR-TI-LFA], etc.).

The current version of the model supports activation of LFAs and remote LFAs 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 LFAs are considered an extension of LFAs. Remote LFAs cannot be enabled if LFAs are not enabled.

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

2.9. Operational States

Operational states are defined in the "ietf-isis" module in various containers at various levels:

system-counters:

Provides statistical information about the global system.

interface:

Provides configuration state information for each interface.

adjacencies:

Provides state information about current IS-IS adjacencies.

spf-log:

Provides information about Shortest Path First (SPF) events for an IS-IS instance. This **SHOULD** be implemented as a wrapping buffer.

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. The implementation **MAY** optionally log LSP refreshes.

local-rib:

Provides the IS-IS internal routing table.

database:

Provides the contents of the current Link State Database (LSDB).

hostnames:

Provides the system-ID-to-hostname mappings [[RFC5301](#)].

fast-reroute:

Provides IP FRR state information.

3. RPC Operations

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

clear-database:

Resets the contents of a particular IS-IS database and restarts database synchronization with all neighbors.

clear-adjacency:

Restarts 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's 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 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 LSDB, 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 a PDU with a different value for the system ID length is received.

max-area-addresses-mismatch:

This notification is sent when a PDU with a different value for the Maximum Area Addresses is received.

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 the "up" state or the "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. Interactions with Other YANG Modules

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

The "ietf-isis" module augments "/if:interfaces/if:interface" as defined by [[RFC8343](#)] with ISO-specific parameters.

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 module defined in this document uses some groupings from "ietf-keychain" [[RFC8177](#)].

The module reuses types from [[RFC6991](#)] and [[RFC8294](#)].

To support Bidirectional Forwarding Detection (BFD) for fast detection, the module relies on [[RFC9314](#)].

6. IS-IS YANG Module

The following specifications are referenced in this module: [[ISO-10589](#)], [[RFC1195](#)], [[RFC4090](#)], [[RFC5029](#)], [[RFC5120](#)], [[RFC5130](#)], [[RFC5286](#)], [[RFC5301](#)], [[RFC5302](#)], [[RFC5305](#)], [[RFC5307](#)], [[RFC5308](#)], [[RFC5443](#)], [[RFC5880](#)], [[RFC5881](#)], [[RFC6119](#)], [[RFC6232](#)], [[RFC6241](#)], [[RFC6991](#)], [[RFC7490](#)], [[RFC7794](#)], [[RFC7917](#)], [[RFC7981](#)], [[RFC8177](#)], [[RFC8294](#)], [[RFC8342](#)], [[RFC8343](#)], [[RFC8349](#)], [[RFC8405](#)], [[RFC8570](#)], [[RFC8706](#)], and [[RFC9314](#)].

```
<CODE BEGINS> file "ietf-isis@2022-10-19.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";
  }
  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 9314: YANG Data Model for Bidirectional Forwarding
      Detection (BFD)";
  }

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

    Editor:   Stephane Litkowski
```

```

        <mailto:slitkows.ietf@gmail.com>

Author:   Derek Yeung
         <mailto:derek@arrcus.com>

Author:   Acee Lindem
         <mailto:acee@cisco.com>

Author:   Jeffrey Zhang
         <mailto:zzhang@juniper.net>

Author:   Ladislav Lhotka
         <mailto:ladislav.lhotka@nic.cz>";
description
  "This YANG module defines the generic configuration and
  operational states 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 data model conforms to the Network Management
  Datastore Architecture (NMDA) as described in RFC 8342.

  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.

  Copyright (c) 2022 IETF Trust and the persons identified as
  authors of the code. All rights reserved.

  Redistribution and use in source and binary forms, with or
  without modification, is permitted pursuant to, and subject to
  the license terms contained in, the Revised BSD License set
  forth in Section 4.c of the IETF Trust's Legal Provisions
  Relating to IETF Documents
  (https://trustee.ietf.org/license-info).

  This version of this YANG module is part of RFC 9130; see the
  RFC itself for full legal notices.";
reference
  "RFC 8342: Network Management Datastore Architecture (NMDA)";

revision 2022-10-19 {
  description
    "Initial revision.";
  reference
    "RFC 9130: YANG Data Model for the IS-IS Protocol";
}

/* Identities */

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

```

```
}

identity lsp-log-reason {
  description
    "Base identity for a Link State PDU (LSP)
    change log reason.";
}

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

identity content-change {
  base lsp-log-reason;
  description
    "Identity used when the LSP log reason is
    a change in the contents 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 RFC 5286.";
  reference
    "RFC 5286: Basic Specification for IP Fast Reroute:
    Loop-Free Alternates";
}

identity frr-protection-method-rlfa {
  base frr-protection-method;
  description
    "Remote Loop-Free Alternate as defined in RFC 7490.";
  reference
    "RFC 7490: Remote Loop-Free Alternate (LFA)
    Fast Reroute (FRR)";
}

identity frr-protection-method-rsvp-te {
  base frr-protection-method;
  description
    "RSVP-TE as defined in RFC 4090.";
  reference
    "RFC 4090: Fast Reroute Extensions to RSVP-TE for
    LSP Tunnels";
}

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
    "Shared Risk Link Group (SRLG) protection is provided by
    the alternate.";
}

identity frr-protection-available-downstream-type {
  base frr-protection-available-type;
  description
    "The alternate is downstream of the node in the path.";
}

identity frr-protection-available-other-type {
  base frr-protection-available-type;
  description
    "The level of protection is unknown.";
}

identity frr-alternate-type {
  description
    "Base identity for the IP Fast Reroute alternate type.";
}

identity frr-alternate-type-equal-cost {
  base frr-alternate-type;
  description
    "ECMP-based alternate.";
}

identity frr-alternate-type-lfa {
  base frr-alternate-type;
  description
    "LFA-based alternate.";
}

identity frr-alternate-type-remote-lfa {
  base frr-alternate-type;
  description
    "Remote-LFA-based alternate.";
}

identity frr-alternate-type-tunnel {
  base frr-alternate-type;
}
```

```
    description
      "Tunnel-based alternate (such as RSVP-TE or GRE).";
  }

  identity frr-alternate-mrt {
    base frr-alternate-type;
    description
      "MRT-based alternate.";
  }

  identity frr-alternate-tilfa {
    base frr-alternate-type;
    description
      "TI-LFA-based alternate.";
  }

  identity frr-alternate-other {
    base frr-alternate-type;
    description
      "Other type of alternate.";
  }

  identity unidirectional-link-delay-subtlv-flag {
    description
      "Base identity for the flag corresponding to the
      Unidirectional Link Delay sub-TLV as defined in RFC 8570.";
    reference
      "RFC 8570: IS-IS Traffic Engineering (TE) Metric Extensions";
  }

  identity unidirectional-link-delay-subtlv-a-flag {
    base unidirectional-link-delay-subtlv-flag;
    description
      "The 'A' bit field 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 the flag corresponding to the Min/Max
      Unidirectional Link Delay sub-TLV as defined in RFC 8570.";
    reference
      "RFC 8570: IS-IS Traffic Engineering (TE) Metric Extensions";
  }

  identity min-max-unidirectional-link-delay-subtlv-a-flag {
    base min-max-unidirectional-link-delay-subtlv-flag;
    description
      "The 'A' bit field 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 the flag corresponding to the
    Unidirectional Link Loss sub-TLV as defined in RFC 8570.";
  reference
    "RFC 8570: IS-IS Traffic Engineering (TE) Metric Extensions";
}

identity unidirectional-link-loss-subtlv-a-flag {
  base unidirectional-link-loss-subtlv-flag;
  description
    "The 'A' bit field 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 the flag corresponding to TLV 229
    (M-Topologies) as defined in RFC 5120.";
  reference
    "RFC 5120: M-ISIS: Multi Topology (MT) Routing in
    Intermediate System to Intermediate Systems (IS-ISs)";
}

identity tlv229-overload-flag {
  base tlv229-flag;
  description
    "If set, the originator is overloaded
    and must be avoided in the 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 the flag corresponding to the
    Router Capability TLV as defined in RFC 7981.";
  reference
    "RFC 7981: IS-IS Extensions for Advertising Router
    Information";
}
```

```
identity router-capability-flooding-flag {
  base router-capability-flag;
  description
    "Quote from RFC 7981:
    'If the S bit is set(1), the IS-IS Router CAPABILITY TLV
    MUST be flooded across the entire routing domain. If the
    S bit is not set(0), 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 RFC 7981:
    'When the IS-IS Router CAPABILITY TLV is leaked from
    Level 2 (L2) to Level 1 (L1), 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. This is to prevent TLV looping.'";
}

identity lsp-flag {
  description
    "Base identity for LSP attributes as defined in ISO 10589.";
  reference
    "ISO 10589: Intermediate System to Intermediate System
    intra-domain routing information exchange protocol
    for use in conjunction with the protocol for providing
    the connectionless-mode network service (ISO 8473)";
}

identity lsp-partitioned-flag {
  base lsp-flag;
  description
    "Originator partition repair supported.";
}

identity lsp-attached-error-metric-flag {
  base lsp-flag;
  description
    "Set when the originator is attached to
    another area using the error metric.";
}

identity lsp-attached-delay-metric-flag {
  base lsp-flag;
  description
    "Set when the originator is attached to
    another area using the delay metric.";
}

identity lsp-attached-expense-metric-flag {
  base lsp-flag;
  description
    "Set when the originator is attached to
    another area using the expense metric.";
```



```
}

identity lsp-attached-default-metric-flag {
  base lsp-flag;
  description
    "Set when the originator is attached to
    another area using the default metric.";
}

identity lsp-overload-flag {
  base lsp-flag;
  description
    "If set, the originator is overloaded
    and must be avoided in the path calculation.";
}

identity lsp-l1-system-flag {
  base lsp-flag;
  description
    "Set when the Intermediate System has an L1 type.";
}

identity lsp-l2-system-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 the Purge Originator Identification (POI) TLV.";
  reference
    "RFC 6232: Purge Originator Identification TLV for IS-IS";
}

feature ietf-spf-delay {
  description
    "Support for the IETF SPF delay algorithm.";
  reference
    "RFC 8405: Shortest Path First (SPF) Back-Off Delay Algorithm
    for Link-State IGPs";
}

feature bfd {
  description
    "Support for detection of IS-IS neighbor reachability
    via BFD.";
  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 key chains for authentication.";  
  reference  
    "RFC 8177: YANG Data Model for Key Chains";  
}  
  
feature node-flag {  
  description  
    "Support for node flags for IS-IS prefixes.";  
  reference  
    "RFC 7794: IS-IS Prefix Attributes for Extended IPv4 and IPv6  
    Reachability";  
}  
  
feature node-tag {  
  description  
    "Support for node administrative tags for IS-IS  
    routing instances.";  
  reference  
    "RFC 7917: Advertising Node Administrative Tags in IS-IS";  
}  
  
feature ldp-igp-sync {  
  description  
    "Support for LDP IGP synchronization.";  
  reference  
    "RFC 5443: LDP IGP Synchronization";  
}  
  
feature fast-reroute {  
  description  
    "Support for IP Fast Reroute (IP FRR).";  
}  
  
feature nsr {  
  description  
    "Support for Non-Stop-Routing (NSR). 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  
    "RFC 5286: Basic Specification for IP Fast Reroute:  
    Loop-Free Alternates";  
}  
  
feature remote-lfa {
```

```
description
  "Support for remote LFAs (R-LFAs).";
reference
  "RFC 7490: Remote Loop-Free Alternate (LFA)
  Fast Reroute (FRR)";
}

feature overload-max-metric {
  description
    "Support of overload by setting all links to the maximum
    link metric. In IS-IS, the overload bit is usually used to
    signal that a node cannot be used as a transit node. The
    'overload-max-metric' feature provides similar behavior,
    also setting all the link metrics to MAX_METRIC.";
}

feature prefix-tag {
  description
    "Support for 32-bit prefix tags.";
  reference
    "RFC 5130: A Policy Control Mechanism in IS-IS Using
    Administrative Tags";
}

feature prefix-tag64 {
  description
    "Support for 64-bit prefix tags.";
  reference
    "RFC 5130: A Policy Control Mechanism in IS-IS Using
    Administrative Tags";
}

feature auto-cost {
  description
    "Support for an IS-IS interface metric computation
    according to a reference bandwidth.";
}

feature te-rid {
  description
    "Traffic Engineering router ID.";
  reference
    "RFC 5305: IS-IS Extensions for Traffic Engineering
    RFC 6119: IPv6 Traffic Engineering in IS-IS";
}

feature max-ecmp {
  description
    "Sets the maximum number of ECMP paths.";
}

feature multi-topology {
  description
    "Support for Multi-Topology (MT) Routing.";
  reference
    "RFC 5120: M-ISIS: Multi Topology (MT) Routing in
    Intermediate System to Intermediate Systems (IS-ISs)";
}
```

```
feature nlpid-control {
  description
    "Support for the advertisement of a Network Layer
    Protocol Identifier within an IS-IS configuration.";
}

feature graceful-restart {
  description
    "Support for IS-IS graceful restart.";
  reference
    "RFC 8706: Restart Signaling for IS-IS";
}

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

feature maximum-area-addresses {
  description
    "Support for 'maximum-area-addresses' configuration.";
}

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.
    '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 the IS-IS level of an object.";
}

typedef adj-state-type {
  type enumeration {
    enum up {
      description
        "This state indicates that the adjacency is established.";
    }
    enum down {
      description
        "This state indicates that the adjacency is
        NOT established.";
    }
    enum init {
      description
        "This state indicates that the adjacency is being
        established.";
    }
    enum failed {
      description
        "This state indicates that the adjacency has failed.";
    }
  }
  description
    "This type defines the 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 Media Access Control (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 the IS-IS system ID by using a 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 the IS-IS system ID using a pattern.
        'extended-system-id' contains the pseudonode number
        in addition to the system ID.
        An example extended system ID is '0143.0438.AEF0.00'.";
    }

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

    typedef std-metric {
        type uint8 {
            range "0 .. 63";
        }
        description
            "This type defines the old-style format of the IS-IS metric.";
    }

    typedef mesh-group-state {
        type enumeration {
            enum mesh-inactive {
                description
                    "The interface is not part of a mesh group.";
            }
            enum mesh-set {
                description
                    "The interface is part of a mesh group.";
            }
            enum mesh-blocked {
                description
                    "LSPs must not be flooded over this interface.";
            }
        }
        description
            "This type describes the 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 the 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 Alternates (LFAs).
        The creation of this container has no effect on
        LFA activation.";
    }
  }
}

grouping interface-lfa-config {
  leaf candidate-enabled {
    type boolean;
    default "true";
    description
      "Enables the interface to be used as a backup.";
  }
  leaf enabled {
    type boolean;
    default "false";
  }
}
```



```
    description
      "Activates the LFA. Per-prefix LFA computation is assumed.";
  }
  container remote-lfa {
    if-feature "remote-lfa";
    leaf enabled {
      type boolean;
      default "false";
      description
        "Activates the remote LFA (R-LFA).";
    }
    description
      "Remote LFA configuration.";
  }
  description
    "Grouping for LFA interface configuration.";
}

grouping interface-fast-reroute-config {
  description
    "This group defines the 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 configuration.";
      }
      container level-2 {
        uses interface-lfa-config;
        description
          "LFA level-2 configuration.";
      }
    }
    description
      "LFA configuration.";
  }
  description
    "Interface IP FRR configuration.";
}

grouping instance-fast-reroute-state {
  description
    "IP FRR 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 identityref {
      base fr-r-alternate-type;
    }
    description
      "Type of alternate.";
  }
  leaf best {
    type boolean;
    description
      "Set when the alternate is the preferred alternate;
      clear otherwise.";
  }
  leaf non-best-reason {
    type string {
      length "1..255";
    }
    description
      "Information field that explains why the alternate
      is not the best alternate. The length should be
      limited to 255 Unicode characters. The expected format
      is a single line of text.";
  }
  container protection-available {
    leaf-list protection-types {
      type identityref {
        base fr-r-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, and one for link protection.";
  }
  description
    "Protection types provided by the alternate.";
}
leaf alternate-metric-1 {
  type uint32;
  description
    "Metric from the Point of Local Repair (PLR) to the
    destination through the alternate path.";
}
leaf alternate-metric-2 {
  type uint32;
```

```
        description
            "Metric from the PLR to the alternate node.";
    }
    leaf alternate-metric-3 {
        type uint32;
        description
            "Metric from the alternate node to the destination.";
    }
    description
        "Per-address-family protected prefix statistics.";
}
description
    "List of prefixes that are protected.";
}
container unprotected-routes {
    config false;
    list prefixes {
        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-address-family 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 yang:gauge32;
        description
            "Total prefixes.";
    }
    leaf unprotected-routes {
        type yang:gauge32;
```

```

        description
            "Total prefixes that are not protected.";
    }
    leaf protected-routes {
        type yang:gauge32;
        description
            "Total prefixes that are protected.";
    }
    leaf link-protected-routes {
        type yang:gauge32;
        description
            "Total prefixes that are link protected.";
    }
    leaf node-protected-routes {
        type yang:gauge32;
        description
            "Total prefixes that are node protected.";
    }
    description
        "Per-address-family protected prefix statistics.";
}
description
    "Global protection statistics.";
}
}

/* Routing table and local Routing Information Base (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. This list
            provides a consolidated view of both 32-bit and 64-bit
            tags (RFC 5130) available for the prefix.";
        reference
            "RFC 5130: A Policy Control Mechanism in IS-IS Using
            Administrative Tags";
    }
    leaf route-type {
        type enumeration {
            enum l2-intra-area {
                description
                    "Level-2 internal route. As per RFC 5302,
                    the prefix is directly connected to the
                    advertising router. It cannot be
                    distinguished from an L1->L2 inter-area
                    route.";
                reference
                    "RFC 5302: Domain-Wide Prefix Distribution with
                    Two-Level IS-IS";
            }
            enum l1-intra-area {

```

```

        description
            "Level-1 internal route. As per RFC 5302,
            the prefix is directly connected to the
            advertising router.";
    }
    enum l2-external {
        description
            "Level-2 external route. As per RFC 5302,
            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 RFC 5302,
            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 a level-2 external route.";
    }
    }
    description
        "IS-IS route type.";
}
}

/* Grouping definitions for configuration and operational states */

grouping adjacency-state {
    container adjacencies {
        config false;
        list adjacency {
            leaf neighbor-sys-type {
                type level;
                description
                    "Level capability of the 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
                    "The circuit ID of the neighbor.";
            }
            leaf neighbor-snpa {
                type snpa;
                description
                    "The SNPA of the neighbor.";
            }
        }
    }
}

```

```
leaf usage {
  type level;
  description
    "Defines the level(s) activated for the adjacency.
    On a point-to-point link, this might be level 1 and
    level 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
    Designated Intermediate System (DIS).";
}
leaf lastuptime {
  type yang:timestamp;
  description
    "When the adjacency most recently entered the
    'up' state, 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 the 'up' state.";
}
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 enabled {
    if-feature "admin-control";
    type boolean;
    default "true";
    description
      "Enables or disables the protocol.";
  }
}
```

```
    }
    description
      "Grouping for administrative control.";
  }

  grouping ietf-spf-delay {
    leaf initial-delay {
      type rt-types:timer-value-milliseconds;
      units "msec";
      default "50";
      description
        "Delay used while in the QUIET state (milliseconds).";
    }
    leaf short-delay {
      type rt-types:timer-value-milliseconds;
      units "msec";
      default "200";
      description
        "Delay used while in the SHORT_WAIT state (milliseconds).";
    }
    leaf long-delay {
      type rt-types:timer-value-milliseconds;
      units "msec";
      default "5000";
      description
        "Delay used while in the LONG_WAIT state (milliseconds).";
    }
    leaf hold-down {
      type rt-types:timer-value-milliseconds;
      units "msec";
      default "10000";
      description
        "This timer value defines the period without any changes
        for the IGP to be considered stable (in milliseconds).";
    }
    leaf time-to-learn {
      type rt-types:timer-value-milliseconds;
      units "msec";
      default "500";
      description
        "Duration used to learn all the IGP events
        related to a single network event (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 the time-to-learn timer fires.";
  }
  leaf remaining-hold-down {
    type rt-types:timer-value-milliseconds;
    units "msec";
    config false;
    description
      "Remaining time until the hold-down timer fires.";
  }
  leaf last-event-received {
    type yang:timestamp;
    config false;
    description
      "Time of the last IGP event received.";
  }
  leaf next-spf-time {
    type yang:timestamp;
    config false;
    description
      "Time when the next SPF has been scheduled.";
  }
  leaf last-spf-time {
    type yang:timestamp;
    config false;
    description
      "Time of the last SPF computation.";
  }
  description
    "Grouping for IETF SPF delay configuration and state.";
  reference
    "RFC 8405: Shortest Path First (SPF) Back-Off Delay Algorithm
    for Link-State IGPs";
}

grouping node-tag-config {
  description
    "IS-IS node tag configuration 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 administrative 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 a key.";
      }
    }
  }
  description
    "Choice of authentication.";
}
description
  "Grouping for global authentication configuration.";
}

grouping metric-type-global-cfg {
  leaf value {
    type enumeration {
      enum wide-only {
        description
          "Advertises the new metric style only (RFC 5305).";
        reference
          "RFC 5305: IS-IS Extensions for Traffic Engineering";
      }
      enum old-only {
        description
          "Advertises the old metric style only (RFC 1195).";
        reference
          "RFC 1195: Use of OSI IS-IS for routing in TCP/IP and
          dual environments";
      }
      enum both {
        description
          "Advertises both metric styles.";
      }
    }
  }
}
```

```
    }
    description
      "Type of metric to be generated:

      - 'wide-only' means that only a new metric style
        is generated.
      - 'old-only' means that only an old metric style
        is generated.
      - 'both' means that both are advertised.

      This leaf only affects IPv4 metrics.";
  }
  description
    "Grouping for global metric style configuration.";
}

grouping metric-type-global-cfg-with-default {
  leaf value {
    type enumeration {
      enum wide-only {
        description
          "Advertises the new metric style only (RFC 5305).";
        reference
          "RFC 5305: IS-IS Extensions for Traffic Engineering";
      }
      enum old-only {
        description
          "Advertises the old metric style only (RFC 1195).";
        reference
          "RFC 1195: Use of OSI IS-IS for routing in TCP/IP and
            dual environments";
      }
      enum both {
        description
          "Advertises both metric styles.";
      }
    }
    default "wide-only";
    description
      "Type of metric to be generated:

      - 'wide-only' means that only a new metric style
        is generated.
      - 'old-only' means that only an old metric style
        is generated.
      - 'both' means that both are advertised.

      This leaf only affects IPv4 metrics.";
  }
  description
    "Grouping for global metric style configuration.";
}

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

```
    }
    description
      "Global default metric configuration grouping.";
  }

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

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

  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 a key.";
      }
    }
  }
  description
    "Choice of authentication.";
}
description
  "Grouping for Hello authentication.";
}

grouping hello-interval-cfg {
  leaf value {
    type rt-types:timer-value-seconds16;
    units "seconds";
    description
      "Interval (in seconds) between successive Hello
        messages.";
  }
  description
    "Interval between Hello messages.";
}

grouping hello-interval-cfg-with-default {
  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;
        description
            "Number of missed Hello messages prior to
            declaring the adjacency down.";
    }
    description
        "Grouping for the number of missed Hello messages prior to
        declaring the adjacency down.";
}

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

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

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

grouping metric-cfg {
```

```
leaf value {
  type wide-metric;
  description
    "Metric value.";
}
description
  "Interface metric grouping.";
}

grouping metric-cfg-with-default {
  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-with-default;
    container level-1 {
      uses metric-type-global-cfg;
      description
        "Configuration specific to level 1.";
    }
    container level-2 {
      uses metric-type-global-cfg;
      description
        "Configuration specific to level 2.";
    }
    description
      "Metric style global configuration.";
  }
  container default-metric {
    uses default-metric-global-cfg-with-default;
    container level-1 {
      uses default-metric-global-cfg;
      description
        "Configuration specific to level 1.";
    }
    container level-2 {
      uses default-metric-global-cfg;
      description
        "Configuration specific to level 2.";
    }
    description
      "Default metric global configuration.";
  }
  container auto-cost {
    if-feature "auto-cost";
    description
      "Interface auto-cost configuration state.";
    leaf enabled {
      type boolean;
      description

```

```
        "Enables or disables interface auto-cost.";
    }
    leaf reference-bandwidth {
        when "../enabled = 'true'" {
            description
                "Only when auto-cost is enabled.";
        }
        type uint32 {
            range "1..4294967";
        }
        units "Mbits";
        description
            "Configures the reference bandwidth used to automatically
            determine the 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 enabled {
            type boolean;
            default "false";
            description
                "Enables 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-enabled {
            type boolean;
            default "true";
            description
                "Enables a local IS-IS router as a graceful restart
                helper.";
        }
    }
    description
        "Configuration of graceful restart.";
}
container nsr {
    if-feature "nsr";
    description
        "Non-Stop Routing (NSR) configuration.";
    leaf enabled {
        type boolean;
        default "false";
        description
            "Enables or disables NSR.";
    }
}
```



```
    }
    description
      "Grouping for high-availability parameters.";
  }

  grouping authentication-parameters {
    container authentication {
      uses authentication-global-cfg;
      container level-1 {
        uses authentication-global-cfg;
        description
          "Configuration specific to level 1.";
      }
      container level-2 {
        uses authentication-global-cfg;
        description
          "Configuration specific to level 2.";
      }
    }
    description
      "Authentication global configuration for
      both LSPs and Sequence Number PDUs (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 enabled {
        type boolean;
        description
          "Activates 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 IS-IS 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 LDP IGP synchronization.";
    }
    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
      "Enables the advertisement of the IS-IS Purge Originator
```

```
        Identification TLV.";
    }
    description
        "Grouping for LSP global parameters.";
}

grouping spf-parameters {
    container spf-control {
        leaf paths {
            if-feature "max-ecmp";
            type uint16 {
                range "1..65535";
            }
            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 reinitialized, then
            this node contains the time the IS-IS instance was
            reinitialized, 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
            "Configuration specific to level 1.";
    }
    container level-2 {
        uses default-metric-global-cfg;
        description
            "Configuration specific to level 2.";
    }
    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 milliseconds) 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
            is not running, but the network is advertised).";
    }
    leaf csnp-interval {
        type rt-types:timer-value-seconds16;
        units "seconds";
        default "10";
        description
            "Interval (in seconds) between Complete Sequence Number
            Packet (CSNP) messages.";
    }
    container hello-padding {
        leaf enabled {
            type boolean;
            default "true";
            description
                "IS-IS Hello padding activation. Enabled by default.";
        }
    }
}
```

```
    }
    description
      "IS-IS Hello padding configuration.";
  }
  leaf mesh-group-enabled {
    type mesh-group-state;
    description
      "IS-IS interface mesh group state.";
  }
  leaf mesh-group {
    when "../mesh-group-enabled = 'mesh-set'" {
      description
        "Only valid when 'mesh-group-enabled' 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
      "Sets the prefix as a node representative prefix.";
  }
  container hello-authentication {
    uses hello-authentication-cfg;
    container level-1 {
      uses hello-authentication-cfg;
      description
        "Configuration specific to level 1.";
    }
    container level-2 {
      uses hello-authentication-cfg;
      description
        "Configuration specific to level 2.";
    }
  }
  description
    "Authentication type to be used in Hello messages.";
```

```
}
container hello-interval {
  uses hello-interval-cfg-with-default;
  container level-1 {
    uses hello-interval-cfg;
    description
      "Configuration specific to level 1.";
  }
  container level-2 {
    uses hello-interval-cfg;
    description
      "Configuration specific to level 2.";
  }
  description
    "Interval between Hello messages.";
}
container hello-multiplier {
  uses hello-multiplier-cfg-with-default;
  container level-1 {
    uses hello-multiplier-cfg;
    description
      "Configuration specific to level 1.";
  }
  container level-2 {
    uses hello-multiplier-cfg;
    description
      "Configuration specific to level 2.";
  }
  description
    "Hello multiplier configuration.";
}
container priority {
  must '../interface-type = "broadcast"' {
    error-message "Priority only applies to broadcast "
      + "interfaces.";
  }
  description
    "Checks for a broadcast interface.";
}
uses priority-cfg-with-default;
container level-1 {
  uses priority-cfg;
  description
    "Configuration specific to level 1.";
}
container level-2 {
  uses priority-cfg;
  description
    "Configuration specific to level 2.";
}
description
  "Priority for DIS election.";
}
container metric {
  uses metric-cfg-with-default;
  container level-1 {
    uses metric-cfg;
    description
      "Configuration specific to level 1.";
  }
}
```

```

    }
    container level-2 {
      uses metric-cfg;
      description
        "Configuration specific to level 2.";
    }
    description
      "Metric configuration.";
  }
  container bfd {
    if-feature "bfd";
    description
      "BFD interface configuration.";
    uses bfd-types:client-cfg-parms;
    reference
      "RFC 5880: Bidirectional Forwarding Detection (BFD)
       RFC 5881: Bidirectional Forwarding Detection
       (BFD) for IPv4 and IPv6 (Single Hop)
       RFC 9314: YANG Data Model for Bidirectional Forwarding
       Detection (BFD)";
  }
  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 address families.";
    }
    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
        "Configuration related to LDP.";
    }
    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
            "Configuration specific to level 1.";
    }
    container level-2 {
        uses metric-cfg;
        description
            "Configuration specific to level 2.";
    }
    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 reinitialized, then
            this node contains the time the IS-IS interface was
            reinitialized, 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 RFC 5301.";
                reference
                    "RFC 5301: Dynamic Hostname Exchange Mechanism
                    for IS-IS";
            }
        }
    }
}
```

```
    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 received with errors.";
    }
    leaf spf-runs {
      type uint32;
      description
        "Number of times SPF was run at this level.";
    }
  }
  description
    "List of supported levels.";
}
description
  "List of 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 Point-to-Point
    Protocol (PPP) Network Control Protocol (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 IS-IS Hello (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 Intermediate System Hello (ISH) PDUs.";
    }
    leaf out {
      type uint32;
      description
        "Sent ISH PDUs.";
    }
    description
      "ISH PDUs received/sent.";
  }
  container esh {
    leaf in {
      type uint32;
      description
        "Received End System Hello (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 Link State PDU (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 Partial Sequence Number PDU (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 Complete Sequence Number PDU (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.";
}
description
    "List of packet counters for supported levels.";
}
description
    "Packet counters per IS-IS level.";
}
description
    "Grouping for packet counters per IS-IS level.";
}

/* Groupings for various log buffers */

grouping spf-log {
    container spf-log {
        config false;
        list event {

```

```
key "id";
leaf id {
  type yang:counter32;
  description
    "Event identifier. A purely internal value.
    The most recent events are expected to have a bigger
    ID number.";
}
leaf spf-type {
  type enumeration {
    enum full {
      description
        "Full SPF computation.";
    }
    enum route-only {
      description
        "SPF computation of route reachability
        only.";
    }
  }
  description
    "Type of SPF computation performed.";
}
leaf level {
  type level-number;
  description
    "IS-IS level number for the 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 that triggered the SPF
      computation.";
  }
  leaf sequence {
    type uint32;
    description
      "Sequence number of the LSP that triggered the 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 yang:counter32;
                description
                    "Event identifier.  A purely internal value.
                    The most recent events are expected to have a bigger
                    ID number.";
            }
            leaf level {
                type level-number;
                description
                    "IS-IS level number for the 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 for either the received
                    LSP or the locally generated LSP.";
            }
            leaf received-timestamp {
                type yang:timestamp;
                description
                    "This is the timestamp when the LSP was received.
                    In the case of a local LSP update, the timestamp refers
                    to the LSP 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 the LSP log.";
}

/* Groupings for the Link State Database (LSDB) descriptions */
/* Unknown TLV and sub-TLV descriptions */

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 RFC 7794.";
  reference
    "RFC 7794: IS-IS Prefix Attributes for Extended IPv4 and IPv6
    Reachability";
  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 RFC 1195.";
  reference
    "RFC 1195: Use of OSI IS-IS for routing in TCP/IP and
    dual environments";
  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.
      Set to 'false' to indicate an internal metric.";
  }
  container default-metric {
    leaf metric {
      type std-metric;
      description
        "Default IS-IS metric for the IPv4 prefix.";
    }
    description
      "IS-IS default metric container.";
  }
  container delay-metric {
    leaf metric {
      type std-metric;
      description
        "IS-IS delay metric for the IPv4 prefix.";
    }
    leaf supported {
      type boolean;
      default "false";
      description
        "Indicates whether the 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 the IPv4 prefix.";
    }
    leaf supported {
      type boolean;
      default "false";
      description
        "Indicates whether the IS-IS expense 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
            "Indicates whether the IS-IS error metric is supported.";
    }
    description
        "IS-IS error metric container.";
}

grouping prefix-ipv4-extended {
    description
        "Grouping for attributes of an IPv4 extended prefix
        as defined in RFC 5305.";
    reference
        "RFC 5305: IS-IS Extensions for Traffic Engineering";
    leaf up-down {
        type boolean;
        description
            "Value of the up/down bit.
            Set to 'true' when the prefix has been advertised down
            the hierarchy.";
    }
    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 64-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 RFC 5308.";
```

```
reference
  "RFC 5308: Routing IPv6 with IS-IS";
leaf up-down {
  type boolean;
  description
    "Value of the up/down bit.
     Set to 'true' when the prefix has been advertised down
     the hierarchy.";
}
leaf ip-prefix {
  type inet:ipv6-address;
  description
    "IPv6 prefix address.";
}
leaf prefix-len {
  type uint8;
  description
    "IPv6 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 IPv6 prefix.";
}
leaf-list tag64 {
  type uint64;
  description
    "List of 64-bit tags associated with the IPv6 prefix.";
}
uses prefix-attributes-extension;
}

/* TLVs and sub-TLVs for neighbors */

grouping neighbor-link-attributes {
  description
    "Grouping for link attributes as defined
     in RFC 5029.";
  reference
    "RFC 5029: Definition of an IS-IS Link Attribute Sub-TLV";
  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 RFC 5307.";
  reference
    "RFC 5307: IS-IS Extensions in Support of Generalized
```

```
Multi-Protocol Label Switching (GMPLS)";
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 maximum 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
        "Maximum LSP bandwidth.";
    }
  }
  description
    "List of maximum LSP bandwidths for different
    priorities.";
}
}
container tdm-specific {
  when '../switching-capability = 100';
  description
    "Switching-capability-specific information applicable
    when the switching type is Time-Division Multiplexing
    (TDM).";
}
```

```

    leaf minimum-lsp-bandwidth {
      type rt-types:bandwidth-ieee-float32;
      description
        "Minimum LSP bandwidth.";
    }
    leaf indication {
      type uint8;
      description
        "Indicates whether the interface supports Standard
        or Arbitrary SONET/SDH (Synchronous Optical Network /
        Synchronous Digital Hierarchy).";
    }
  }
}
container psc-specific {
  when "../switching-capability >= 1 and
        ../switching-capability <= 4";
  description
    "Switching-capability-specific information applicable
    when the switching type is PSC1, PSC2, PSC3, or PSC4
    ('PSC' stands for 'Packet Switching Capability').";
  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 RFC 8570.";
  reference
    "RFC 8570: IS-IS Traffic Engineering (TE) Metric Extensions";
  container unidirectional-link-delay {
    description
      "Container for the average delay
      from the local neighbor to the remote neighbor.";
    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 that
          are set.";
      }
      description
        "Unidirectional Link Delay sub-TLV flags.";
    }
  }
  leaf value {

```

```
    type uint32;
    units "usec";
    description
      "Delay value expressed in microseconds.";
  }
}
container min-max-unidirectional-link-delay {
  description
    "Container for the minimum and maximum delay
     from the local neighbor to the remote neighbor.";
  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 that
         are set.";
    }
    description
      "Min/Max Unidirectional Link Delay sub-TLV 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 neighbor.";
  leaf value {
    type uint32;
    units "usec";
    description
      "Delay variation value expressed in microseconds.";
  }
}
container unidirectional-link-loss {
  description
    "Container for packet loss from the local neighbor to the
     remote neighbor.";
  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 that
         are set.";
    }
  }
}
```



```
    }
    description
      "Unidirectional Link Loss sub-TLV 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 neighbor.";
  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 neighbor.";
  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 neighbor.";
  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 RFC 5305.";
  reference
    "RFC 5305: IS-IS Extensions for Traffic Engineering";
  leaf admin-group {
    type uint32;
    description
      "Administrative Group / Resource Class/Color.";
  }
}
```

```
    container local-if-ipv4-addr {
      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-addr {
      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 the 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."
      }
    }
  }
}
```

```
        Set to 'false' to indicate an internal metric.";
    }
    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 expense metric value.";
        }
        leaf supported {
            type boolean;
            default "false";
            description
                "IS-IS expense metric supported.";
        }
        description
            "IS-IS 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
```

```
        ISO 10589.";
    reference
        "ISO 10589: Intermediate System to Intermediate System
        intra-domain routing information exchange protocol
        for use in conjunction with the protocol for providing
        the connectionless-mode network service (ISO 8473)";
    }
}
}

/* 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. The IS-IS
            reference is TLV 132.";
    }
    description
        "Grouping for TLV 132.";
}

grouping tlv232-ipv6-addresses {
    leaf-list ipv6-addresses {
        type inet:ipv6-address;
        description
            "List of IPv6 addresses of the IS-IS node. The IS-IS
            reference is TLV 232.";
    }
    description
        "Grouping for TLV 232.";
}

grouping tlv134-ipv4-te-rid {
    leaf ipv4-te-routerid {
        type inet:ipv4-address;
        description
            "IPv4 Traffic Engineering router ID of the IS-IS node.
            The IS-IS reference is TLV 134.";
    }
    description
        "Grouping for TLV 134.";
}

grouping tlv140-ipv6-te-rid {
    leaf ipv6-te-routerid {
        type inet:ipv6-address;
        description
            "IPv6 Traffic Engineering router ID of the IS-IS node.
            The IS-IS reference is TLV 140.";
    }
    description
        "Grouping for TLV 140.";
}

grouping tlv129-protocols {
    leaf-list protocol-supported {
```

```
    type uint8;
    description
      "List of supported protocols of the IS-IS node.
       The IS-IS reference is TLV 129.";
  }
  description
    "Grouping for TLV 129.";
}

grouping tlv137-hostname {
  leaf dynamic-hostname {
    type string;
    description
      "Hostname of the IS-IS node. The IS-IS reference
       is TLV 137.";
  }
  description
    "Grouping for TLV 137.";
}

grouping tlv10-authentication {
  container authentication {
    leaf authentication-type {
      type identityref {
        base key-chain:crypto-algorithm;
      }
      description
        "Authentication type to be used with an 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 cleartext format in response to any request
         (e.g., via get or get-config).";
    }
    description
      "IS-IS node authentication information container. The
       IS-IS reference is TLV 10.";
  }
  description
    "Grouping for TLV 10.";
}

grouping tlv229-mt {
  container mt-entries {
    list topology {
      description
        "List of topologies supported.";
      leaf mt-id {
        type uint16 {
          range "0 .. 4095";
        }
        description
          "Multi-Topology (MT) identifier of the topology.";
      }
      container attributes {
```

```
        leaf-list flags {
            type identityref {
                base tlv229-flag;
            }
            description
                "This list contains identities for the bits that
                are set.";
        }
        description
            "TLV 229 flags.";
    }
}
description
    "IS-IS node topology information container. The
    IS-IS reference is TLV 229.";
}
description
    "Grouping for TLV 229.";
}

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 that
                    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 administrative tags.";
    }
    uses unknown-tlvs;
    description
        "IS-IS node capabilities. This list element may
        be extended with detailed information. The IS-IS
        reference is TLV 242.";
}
description
    "List of Router Capability TLVs.";
}
```

```
    description
      "Grouping for TLV 242.";
  }

  grouping tlv138-srlg {
    description
      "Grouping for TLV 138.";
    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 descriptions */

  grouping lsp-entry {
```



```
description
  "IS-IS LSP database entry grouping.";
leaf decoded-completed {
  type boolean;
  description
    "The IS-IS LSP body has been fully decoded.";
}
leaf raw-data {
  type yang:hex-string;
  description
    "The hexadecimal representation of the complete LSP
    as received or originated, in network byte order.";
}
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 that
      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. The 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. The 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.
    The 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. The
    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. The
    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 MT neighbor container. The IS-IS reference is
        TLV 223.";
    }
    container mt-extended-ipv4-reachability {
        list prefixes {
            leaf mt-id {
                type uint16 {
                    range "0 .. 4095";
                }
                description
                    "MT identifier.";
            }
            uses prefix-ipv4-extended;
            uses unknown-tlvs;
            description
                "List of extended prefixes.";
        }
        description
            "IPv4 MT extended reachability information container.
            The IS-IS reference is TLV 235.";
        reference
            "RFC 5120: M-ISIS: Multi Topology (MT) Routing in
            Intermediate System to Intermediate Systems (IS-ISs)";
    }
    container mt-ipv6-reachability {
        list prefixes {
            leaf mt-id {
                type uint16 {
                    range "0 .. 4095";
                }
                description
                    "MT identifier.";
            }
            uses prefix-ipv6-extended;
            uses unknown-tlvs;
            description
                "List of IPv6 extended prefixes.";
        }
        description
            "IPv6 MT extended reachability information container.
            The IS-IS reference is TLV 237.";
        reference
            "RFC 5120: M-ISIS: Multi Topology (MT) Routing in
            Intermediate System to Intermediate Systems (IS-ISs)";
    }
    container ipv6-reachability {
        list prefixes {
            uses prefix-ipv6-extended;
            uses unknown-tlvs;
            description

```

```

        "List of IPv6 prefixes.";
    }
    description
        "IPv6 reachability information container. The 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 the LSDB.";
            }
        }
        description
            "List of LSPs for the LSDB-level container.";
    }
    description
        "IS-IS LSDB container.";
}

/* Augmentations */

augment "/rt:routing/"
    + "rt:ribs/rt:rib/rt:routes/rt:route" {
    when "derived-from-or-self(rt:source-protocol, 'isis:isis')" {
        description
            "IS-IS-specific route attributes.";
    }
    uses route-content;
    description
        "This augments the route object in the Routing Information
        Base (RIB) with IS-IS-specific attributes.";
}

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

```

```

}

augment "/rt:routing/rt:control-plane-protocols/"
  + "rt:control-plane-protocol" {
  when "derived-from-or-self(rt:type, 'isis:isis')" {
    description
      "This augmentation is only valid when the 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
        "Enforces the configuration of at least one area.";
    }
    uses instance-config;
    uses instance-state;
    container topologies {
      if-feature "multi-topology";
      list topology {
        key "name";
        leaf enabled {
          type boolean;
          description
            "Enables the topology configuration.";
        }
        leaf name {
          type leafref {
            path "../..../rt:ribs/rt:rib/rt:name";
          }
          description
            "RIB corresponding to the topology.";
        }
        uses multi-topology-config;
        description
          "List of topologies.";
      }
      description
        "MT 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 {

```



```

        adjacencies would both be cleared.

        If the value provided is different from the value
        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.
        Additionally, all neighbor adjacencies will be forced to
        the DOWN state and self-originated LSPs will be
        reoriginated. 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 or databases 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-all', the databases for both
                level 1 and level 2 would be cleared.

                If the value provided is different from the value
                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 that the IS-IS instance has left the
          overload state.";
      }
      enum on {
        description
          "Indicates that the IS-IS instance has entered the
          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 an attempt to propagate
    an LSP that is larger than the dataLinkBlockSize (ISO 10589)
    for the circuit occurs. The generation of the notification
    must be throttled with at least 5 seconds between successive
    notifications.";
  reference
    "ISO 10589: Intermediate System to Intermediate System
    intra-domain routing information exchange protocol
    for use in conjunction with the protocol for providing
    the connectionless-mode network service (ISO 8473)";
}

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 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
            "Value for the system ID length in the received PDU.";
    }
    leaf raw-pdu {
        type binary;
        description
            "Received raw PDU.";
    }
    description
        "This notification is sent when a PDU with a different value
        for the system ID length is received. The generation of the
        notification 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 a PDU with a different value
    for the Maximum Area Addresses has been received. The
    generation of the notification 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 generation of the notification 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 on which authentication fails. The generation of the
      notification 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 generation of the notification 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 generation of the notification 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 "0..255";
    }
    description
      "The system may provide a reason to reject the
      adjacency.  If the reason is not available,
      the reason string will not be returned.
      The expected format is a single line of 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 generation of the notification
    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 generation of the notification 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 generation of the notification
  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 (RFC 5301). If the name of the neighbor
      is not available, it is not returned.";
    reference
      "RFC 5301: Dynamic Hostname Exchange Mechanism for IS-IS";
  }
  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 the 'down' state, this leaf
      provides a reason for the adjacency going down. The reason
      is provided as text. If the adjacency is going to the 'up'
      state, no reason is provided. The expected format is a
      single line of text.";
  }
  description
    "This notification is sent when an IS-IS adjacency
    moves to the 'up' state or the '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 the LSP sender.";
    }
    description
      "This notification is sent when an LSP is received.
       The generation of the notification 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 the LSP was regenerated.";
    }
    description
      "This notification is sent when an LSP is regenerated.
       The generation of the notification must be throttled with
       at least 5 seconds between successive notifications.";
  }
}

<CODE ENDS>
```

7. Security Considerations

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

The Network Configuration Access Control Model (NACM) [RFC8341] provides the means to restrict access for particular NETCONF or RESTCONF users to a preconfigured subset of all available NETCONF or RESTCONF protocol operations and content.

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

/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 DoS 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 its own set of security risks; therefore, the Security Considerations sections in the respective reference RFCs should be consulted.

Some of the readable data nodes in this 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. These are the subtrees and data nodes and their sensitivity/vulnerability:

/isis/database

/isis/local-rib

Exposure of the Link State Database (LSDB) will reveal the detailed topology of the network. Similarly, the IS-IS local RIB exposes the reachable prefixes in the IS-IS routing domain. Exposure of the LSDB and local RIB may also reveal information beyond the scope of the IS-IS router; this may be undesirable, since such exposure may facilitate other attacks. Additionally, the complete IP network topology -- and, if deployed, the TE topology of the IS-IS domain -- can be

reconstructed from the LSDB. Though not as straightforward, the IS-IS local RIB can also be exploited to discover topological information. Network operators may consider their topologies to be sensitive confidential data.

For IS-IS authentication, configuration is supported via the specification of a key chain [RFC8177] or the direct specification of a key and authentication algorithm. Hence, authentication configuration using the "key-chain" case in the "authentication-type" container inherits the security considerations of [RFC8177]. This includes 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. These are the operations and their sensitivity/vulnerability:

The IS-IS YANG module supports the "clear-adjacency" and "clear-database" RPCs. If access to either of these is compromised, they can be exploited to mount DoS attacks due to the resultant network outages.

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 entire IS-IS domain.

The model describes several notifications. Implementations must rate-limit the generation of these notifications to avoid creating significant notification load. Otherwise, this notification load may negatively affect system stability and may be exploited as an attack vector.

8. IANA Considerations

The IANA has assigned the following URI in the "IETF XML Registry" [RFC3688].

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 adds the following YANG module name in the "YANG Module Names" registry [RFC6020]:

Name: ietf-isis
Maintained by IANA? N
Namespace: urn:ietf:params:xml:ns:yang:ietf-isis
Prefix: isis
Reference: RFC 9130

9. References

9.1. Normative References

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Appendix A. Example of IS-IS Configuration in XML

This appendix gives an example of the configuration of an IS-IS instance on a device. The example is written in XML [W3C.REC-xml-20081126].

```
<?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>192.0.2.1</router-id>
    <control-plane-protocols>
      <control-plane-protocol>
        <name>IS-IS-example</name>
        <description/>
      </control-plane-protocol>
    </control-plane-protocols>
  </routing>
</data>
```

```

<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">
  <enabled>true</enabled>
  <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>
      <enabled>true</enabled>
    </address-family-list>
    <address-family-list>
      <address-family>ipv6</address-family>
      <enabled>true</enabled>
    </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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