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X. Liu
Volta Networks
P. Sarda
Ericsson
V. Choudhary
Individual
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A YANG Data Model for the Routing Information Protocol (RIP)

Abstract

This document describes a data model for the management of the Routing Information Protocol (RIP). Both RIP version 2 and RIPng are covered. The data model includes definitions for configuration, operational state, and Remote Procedure Calls (RPCs).

The YANG data model in this document conforms to the Network Management Datastore Architecture (NMDA).

Status of This Memo

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1. Introduction

This document introduces a YANG [RFC7950] data model for the Routing Information Protocol (RIP) [RFC2453][RFC2080]. RIP was designed to work as an Interior Gateway Protocol (IGP) in moderate-size Autonomous Systems (AS).

This YANG data model supports both RIP version 2 and RIPng. RIP version 2 (defined in [RFC2453]) supports IPv4. RIPng (defined in [RFC2080]) supports IPv6.

1.1. Terminology

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.

The following terms are defined in [RFC7950] and are not redefined here:

- * augment
- * data model
- * data node

1.2. Tree Diagrams

A simplified graphical representation of the data model is used in this document. The meaning of the symbols in these diagrams is defined in [RFC8340].

1.3. Prefixes in Data Node Names

In this document, names of data nodes, actions, and other data model objects are often used without a prefix, as long as it is clear from

the context in which YANG module each name is defined. Otherwise, names are prefixed using the standard prefix associated with the corresponding YANG module, as shown in Table 1.

Prefix	YANG module	Reference
yang	ietf-yang-types	[RFC6991]
inet	ietf-inet-types	[RFC6991]
if	ietf-interfaces	[RFC8343]
ip	ietf-ip	[RFC8344]
rt	ietf-routing	[RFC8349]
bfd-types	ietf-bfd-types	[YANG-BFD]
isis	ietf-isis	[YANG-ISIS]
key-chain	ietf-key-chain	[RFC8177]
ospf	ietf-ospf	[YANG-OSPF]

Table 1: Prefixes and Corresponding YANG Modules

2. Design of the Data Model

2.1. Scope of the Data Model

The data model covers RIP version 2 [RFC2453] and RIPng [RFC2080] protocols. The model is designed to be implemented on a device where RIP version 2 or RIPng is implemented, and can be used to:

- * Configure the RIP version 2 or RIPng protocol.
- * Manage the protocol operational behaviors.
- * Retrieve the protocol operational status.

The capabilities described in [RFC1724] are covered.

2.2. Relation to the Core Routing Framework

This data model augments the core routing data model "ietf-routing" specified in [RFC8349].

```

+--rw routing
  +--rw router-id?
  +--rw control-plane-protocols
    |--rw control-plane-protocol* [type name]
    |   |--rw type
    |   |--rw name

```

```
|      +--rw rip      <= Augmented by this Model
      ...
```

The "rip" container instantiates a RIP entity that supports RIP version 2 or RIPng. Depending on the implementation of "ietf-routing", a RIP instance MAY belong to a logical router or network instance.

2.3. Protocol Configuration

The data model structure for the protocol configuration is as shown below:

```
augment /rt:routing/rt:control-plane-protocols/
rt:control-plane-protocol:
  +--rw rip
    +--rw <per instance configuration>
      +--rw interface* [interface]
        +--rw interface if:interface-ref
          +--rw <per interface configuration>
            +--rw neighbors {explicit-neighbors}?
              +--rw neighbor* [address]
                +--rw address inet:ip-address
                +--rw <per neighbor configuration>
```

The data model allows the configuration of the following protocol entities:

- * Protocol instance (RIP version 2 or RIPng)
- * Interface
- * Neighbor

2.4. Protocol States

The data model structure for the protocol states is as shown below:

```
augment /rt:routing/rt:control-plane-protocols/
rt:control-plane-protocol:
  +--rw rip
    +--ro <per instance operational states>
      +--rw interface* [interface]
        +--rw interface if:interface-ref
          +--ro <per instance operational states>
            +--ro statistics {interface-statistics}?
              +--ro <per instance statistics>
      +--ro ipv4
        +--ro neighbors
          +--ro neighbor* [ipv4-address]
            +--ro <per neighbor IPv4 operational states>
        +--ro routes
          +--ro route* [ipv4-prefix]
            +--ro <IPv4 RIP route states>
      +--ro ipv6
        +--ro neighbors
```

```

|   |   |--ro neighbor* [ipv6-address]
|   |   |   |--ro <per neighbor IPv6 operational states>
|   |--ro routes
|   |   |--ro route* [ipv6-prefix]
|   |   |   |--ro ipv6-prefix                               inet:ipv6-prefix
|   |   |   |--ro <IPv4 RIP route states>
|--ro statistics {global-statistics}?
|   |--ro <per instance statistics>

```

This model conforms to the Network Management Datastore Architecture (NMDA) [RFC8342]. The operational state data is combined with the associated configuration data in the same hierarchy [RFC8407]. When protocol states are retrieved from the NMDA operational state datastore, the returned states cover all "config true" (rw) and "config false" (ro) nodes defined in the schema.

The model allows the retrieval of protocol states at the following levels:

- * Protocol instance (RIP version 2 or RIPng)
- * Interface
- * Neighbor
- * Route

2.5. RPC Operations

This model defines one RPC "clear-rip-route" that can be used to clear RIP routes from the routing table.

2.6. Notifications

This model does not define RIP-specific notifications. To enable notifications, the mechanisms defined in [RFC8639] and [RFC8641] can be used. This mechanism currently allows the user to do the following:

- * Subscribe to notifications on a per-client basis.
- * Specify subtree filters or XML Path Language (XPath) filters so that only interested contents will be sent.
- * Specify either periodic or on-demand notifications.

2.7. Optional Features

This model defines several features that are beyond the basic RIP configuration, and it is the responsibility of each vendor to decide whether to support a given feature on a device.

3. Tree Structure

This document defines the YANG module "ietf-rip", which has the following tree structure:

```

module: ietf-rip
  augment /rt:routing/rt:control-plane-protocols
  /rt:control-plane-protocol:
    +--rw rip
      +--rw originate-default-route
        |   +--rw enabled?          boolean
        |   +--rw route-policy?    route-policy-ref
      +--rw default-metric?          uint8
      +--rw distance?                uint8
      +--rw triggered-update-threshold? uint8
      +--rw maximum-paths?           uint8
      +--rw output-delay?            uint8
      +--rw distribute-list* [prefix-set-name direction]
        |   +--rw prefix-set-name    prefix-set-ref
        |   +--rw direction          enumeration
        |   +--rw if-name?           if:interface-ref
      +--rw redistribute
        |   +--rw bgp* [asn]
        |     |   +--rw asn          inet:as-number
        |     |   +--rw metric?      uint8
        |     |   +--rw route-policy? route-policy-ref
        |   +--rw cg-nat!
        |     |   +--rw metric?      uint8
        |     |   +--rw route-policy? route-policy-ref
        |   +--rw connected!
        |     |   +--rw metric?      uint8
        |     |   +--rw route-policy? route-policy-ref
        |   +--rw ipsec!
        |     |   +--rw metric?      uint8
        |     |   +--rw route-policy? route-policy-ref
        |   +--rw isis* [instance]
        |     |   +--rw instance
        |     |     |   -> ../../../../rt:control-plane-protocol/name
        |     |   +--rw level?      enumeration
        |     |   +--rw metric?      uint8
        |     |   +--rw route-policy? route-policy-ref
        |   +--rw nat!
        |     |   +--rw metric?      uint8
        |     |   +--rw route-policy? route-policy-ref
        |   +--rw ospfv2* [instance]
        |     |   +--rw instance
        |     |     |   -> ../../../../rt:control-plane-protocol/name
        |     |   +--rw route-type?  ospf:route-type
        |     |   +--rw metric?      uint8
        |     |   +--rw route-policy? route-policy-ref
        |   +--rw ospfv3* [instance]
        |     |   +--rw instance
        |     |     |   -> ../../../../rt:control-plane-protocol/name
        |     |   +--rw route-type?  ospf:route-type
        |     |   +--rw metric?      uint8
        |     |   +--rw route-policy? route-policy-ref
        |   +--rw ripv2* [instance]
        |     |   +--rw instance
        |     |     |   -> ../../../../rt:control-plane-protocol/name
        |     |   +--rw metric?      uint8

```

```

| | |--rw route-policy?    route-policy-ref
+--rw ripng* [instance]
| | |--rw instance
| | |   -> ../..../rt:control-plane-protocol/name
| | |--rw metric?         uint8
| | |--rw route-policy?    route-policy-ref
+--rw static!
| | |--rw metric?         uint8
| | |--rw route-policy?    route-policy-ref
+--rw timers
| | |--rw update-interval?  uint16
| | |--rw invalid-interval? uint16
| | |--rw holddown-interval? uint16
| | |--rw flush-interval?   uint16
+--rw interfaces
| | |--rw interface* [interface]
| | |   |--rw interface          if:interface-ref
| | |   |--rw authentication
| | |   |   |--rw (auth-type-selection)?
| | |   |   |   |--:(auth-key-chain)
| | |   |   |   |   |--rw key-chain?
| | |   |   |   |   |   key-chain:key-chain-ref
| | |   |   |   |   |   |--:(auth-key)
| | |   |   |   |   |   |--rw key?          string
| | |   |   |   |   |   |--rw crypto-algorithm? identityref
+--rw bfd {bfd}?
| | |   |--rw enable?          boolean
| | |   |--rw local-multiplier? multiplier
| | |   |--rw (interval-config-type)?
| | |   |   |--:(tx-rx-intervals)
| | |   |   |   |--rw desired-min-tx-interval? uint32
| | |   |   |   |--rw required-min-rx-interval? uint32
| | |   |   |--:(single-interval)
| | |   |   |   |--rw min-interval?          uint32
+--rw cost?          uint8
+--rw neighbors {explicit-neighbors}?
| | |   |--rw neighbor* [address]
| | |   |   |--rw address      inet:ip-address
+--rw no-listen?      empty
+--rw originate-default-route
| | |   |--rw enabled?        boolean
| | |   |--rw route-policy?    route-policy-ref
+--rw passive?        empty
+--rw split-horizon?   enumeration
+--rw summary-address
| | |   |--rw address?         inet:ip-prefix
| | |   |--rw metric?         uint8
+--rw timers
| | |   |--rw update-interval?  uint16
| | |   |--rw invalid-interval? uint16
| | |   |--rw holddown-interval? uint16
| | |   |--rw flush-interval?   uint16
+--ro oper-status?     enumeration
+--ro next-full-update? uint32
+--ro valid-address?    boolean
+--ro statistics {interface-statistics}?

```

```

|         +---ro discontinuity-time?      yang:date-and-time
|         +---ro bad-packets-rcvd?       yang:counter32
|         +---ro bad-routes-rcvd?       yang:counter32
|         +---ro updates-sent?           yang:counter32
+---ro next-triggered-update?            uint32
+---ro num-of-routes?                    uint32
+---ro ipv4
|   +---ro neighbors
|   |   +---ro neighbor* [ipv4-address]
|   |   |   +---ro ipv4-address          inet:ipv4-address
|   |   |   +---ro last-update?          yang:date-and-time
|   |   |   +---ro bad-packets-rcvd?     yang:counter32
|   |   |   +---ro bad-routes-rcvd?     yang:counter32
|   |   +---ro routes
|   |   |   +---ro route* [ipv4-prefix]
|   |   |   +---ro ipv4-prefix
inet:ipv4-prefix
|   +---ro next-hop?
inet:ipv4-address
|   +---ro interface?
if:interface-ref
|   +---ro redistributed?                 boolean
|   +---ro route-type?                   enumeration
|   +---ro metric?                       uint8
|   +---ro expire-time?                  uint16
|   +---ro deleted?                     boolean
|   +---ro holddown?                    boolean
|   +---ro need-triggered-update?        boolean
|   +---ro inactive?                    boolean
|   +---ro flush-expire-before-holddown? boolean
+---ro ipv6
|   +---ro neighbors
|   |   +---ro neighbor* [ipv6-address]
|   |   |   +---ro ipv6-address          inet:ipv6-address
|   |   |   +---ro last-update?          yang:date-and-time
|   |   |   +---ro bad-packets-rcvd?     yang:counter32
|   |   |   +---ro bad-routes-rcvd?     yang:counter32
|   |   +---ro routes
|   |   |   +---ro route* [ipv6-prefix]
|   |   |   +---ro ipv6-prefix
inet:ipv6-prefix
|   +---ro next-hop?
inet:ipv6-address
|   +---ro interface?
if:interface-ref
|   +---ro redistributed?                 boolean
|   +---ro route-type?                   enumeration
|   +---ro metric?                       uint8
|   +---ro expire-time?                  uint16
|   +---ro deleted?                     boolean
|   +---ro holddown?                    boolean
|   +---ro need-triggered-update?        boolean
|   +---ro inactive?                    boolean
|   +---ro flush-expire-before-holddown? boolean
+---ro statistics {global-statistics}?
|   +---ro discontinuity-time?           yang:date-and-time

```


+++ro requests-rcvd?	yang:counter32
+++ro requests-sent?	yang:counter32
+++ro responses-rcvd?	yang:counter32
+++ro responses-sent?	yang:counter32

```

rpcs:
  +---x clear-rip-route
    +---w input
      +---w rip-instance?  leafref

```

4. YANG Module

```

<CODE BEGINS> file "ietf-rip@2020-02-20.yang"
module ietf-rip {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-rip";
  prefix rip;

  import ietf-inet-types {
    prefix inet;
  }
  import ietf-yang-types {
    prefix yang;
  }
  import ietf-interfaces {
    prefix if;
  }
  import ietf-ip {
    prefix ip;
  }
  import ietf-routing {
    prefix rt;
  }
  import ietf-key-chain {
    prefix key-chain;
  }
  import ietf-bfd-types {
    prefix bfd-types;
  }
  import ietf-ospf {
    prefix ospf;
  }
  import ietf-isis {
    prefix isis;
  }
}

organization
  "IETF Routing Area Working Group (rtgwg)";
contact
  "WG Web:  <https://datatracker.ietf.org/wg/rtgwg/>
   WG List:  <mailto:rgtwg@ietf.org>

   Editor:   Xufeng Liu
             <mailto:xufeng.liu.ietf@gmail.com>

   Editor:   Prateek Sarda

```

<mailto:prateek.sarda@ericsson.com>

Editor: Vikram Choudhary
<mailto:vikschw@gmail.com>;

description

"This YANG module defines a model for managing Routing Information Protocol (RIP), including RIP version 2 and RIPng.

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This version of this YANG module is part of RFC 8695; see the RFC itself for full legal notices.";

revision 2020-02-20 {

description

"Initial revision.";

reference

"RFC 8695: A YANG Data Model for Routing Information Protocol (RIP).

RFC 2453: RIP Version 2.

RFC 2080: RIPng for IPv6.

RFC 1724: RIP Version 2 MIB Extension.";

}

/*

* Features

*/

feature bfd {

description

"This feature indicates that the RIP implementation on the system supports BFD (Bidirectional Forwarding Detection).";

}

feature explicit-neighbors {

description

"This feature indicates that the system supports explicit neighbor configuration on a RIP interface.";

}

feature global-statistics {

description

"This feature indicates that the system supports collecting global statistics data related to RIP.";

}

feature interface-statistics {

description

```

        "This feature indicates that the system supports collecting
        per-interface statistics data related to RIP.";
    }

/*
 * Typedefs
 */

typedef prefix-set-ref {
    type string;
    description
        "A type for a reference to a prefix set.
        The string value is the name identifier for uniquely
        identifying the referenced prefix set, which contains a list
        of prefixes that a routing policy can applied. The definition
        of such a prefix set is outside the scope of this document.";
}

typedef route-policy-ref {
    type string;
    description
        "A type for a reference to a route policy.
        The string value is the name identifier for uniquely
        identifying the referenced routing policy, which contains one
        or more policy rules that can be used for a routing decision.
        The definition of such a routing policy is outside the scope
        of this document.";
}

/*
 * Identities
 */

identity rip {
    base rt:routing-protocol;
    description
        "Identity for the Routing Information Protocol.";
}

identity ripv2 {
    base rip:rip;
    description
        "Identity for RIPv2 (RIP version 2).";
}

identity ripng {
    base rip:rip;
    description
        "Identity for RIPng.";
}

/*
 * Groupings
 */

grouping originate-default-route-container {

```

```

description
  "Container for settings on whether to originate the default
  route in RIP routing instance.";
container originate-default-route {
  description
    "Injects the default route into the RIP (RIPv2 or RIPv6)
    routing instance.";
  leaf enabled {
    type boolean;
    default "false";
    description
      "'true' if originating default route is enabled.";
  }
  leaf route-policy {
    type route-policy-ref;
    description
      "The conditions of the route policy are applied to the
      default route.";
  }
}
}

grouping redistribute-container {
  description
    "Container of redistribute attributes.";
  container redistribute {
    description
      "Redistributes routes learned from other routing protocols
      into the RIP routing instance.";
    list bgp {
      key "asn";
      description
        "Redistributes routes from the specified BGP (Border
        Gateway Protocol) autonomous system (AS) into the RIP
        routing instance.";
      leaf asn {
        type inet:as-number;
        description
          "BGP autonomous system (AS) number.";
      }
      uses redistribute-route-policy-attributes;
    }
    container cg-nat {
      presence "Present if Carrier-Grade Network Address
        Translation (CGNAT) routes are redistributed.";
      description
        "Carrier-Grade Network Address Translation (CGNAT)
        routes.";
      uses redistribute-route-policy-attributes;
    }
    container connected {
      presence "Present if directly attached network routes are
        redistributed.";
      description
        "Redistributes directly attached networks into the RIP
        routing instance.";
    }
  }
}

```

```

    uses redistribute-route-policy-attributes;
}
container ipsec {
    presence "Present if IP security routing instance routes
        are redistributed.";
    description
        "Redistributes routes from the IP security routing
        instance into the RIP routing instance.";
    uses redistribute-route-policy-attributes;
}
list isis {
    key "instance";
    description
        "Redistributes IS-IS routes.";
    leaf instance {
        type leafref {
            path "../..../rt:control-plane-protocol/rt:name";
        }
        must "derived-from-or-self("
            + "../..../rt:control-plane-protocol"
            + "[rt:name = current()]/rt:type, 'isis:isis') " {
            description
                "The type of the routing protocol must be 'isis'.";
        }
        description
            "Redistributes routes from the specified IS-IS routing
            instance into the RIP routing instance.";
    }
    leaf level {
        type enumeration {
            enum 1 {
                description
                    "IS-IS level 1 routes.";
            }
            enum 2 {
                description
                    "IS-IS level 2 routes.";
            }
            enum 1-2 {
                description
                    "IS-IS level 1-2 routes.";
            }
        }
        description
            "IS-IS level.";
    }
    uses redistribute-route-policy-attributes;
}
container nat {
    presence "Present if Network Address Translation (NAT) routes
        are redistributed.";
    description
        "Redistributes Network Address Translation (NAT)
        routes into the RIP routing instance.";
    uses redistribute-route-policy-attributes;
}

```

```

list ospfv2 {
  when "derived-from-or-self(..../rt:type, 'rip:ripv2')" {
    description
      "Applicable to RIPv2.";
  }
  key "instance";
  description
    "Redistributes routes from the specified OSPFv2 routing
    instance into the RIPv2 routing instance.";
  leaf instance {
    type leafref {
      path "..../rt:control-plane-protocol/rt:name";
    }
    must "derived-from-or-self("
      + "..../rt:control-plane-protocol"
      + "[rt:name = current()]/rt:type, 'ospf:ospfv2')\" {
      description
        "The type of the routing protocol must be 'ospfv2'.";
    }
    description
      "OSPFv2 instance ID. Redistributes routes from the
      specified OSPFv2 routing instance into the RIPv2 routing
      instance.";
  }
  leaf route-type {
    type ospf:route-type;
    description
      "Redistributes only those OSPFv2 routes matching the
      specified route type into the RIPv2 routing instance.";
  }
  uses redistribute-route-policy-attributes;
}
list ospfv3 {
  when "derived-from-or-self(..../rt:type, 'rip:ripng')\" {
    description
      "Applicable to RIPng.";
  }
  key "instance";
  description
    "Redistributes routes from the specified OSPFv3 routing
    instance into the RIPng routing instance.";
  leaf instance {
    type leafref {
      path "..../rt:control-plane-protocol/rt:name";
    }
    must "derived-from-or-self("
      + "..../rt:control-plane-protocol"
      + "[rt:name = current()]/rt:type, 'ospf:ospfv3')\" {
      description
        "The type of the routing protocol must be 'ospfv3'.";
    }
    description
      "OSPFv3 instance ID. Redistributes routes from the
      specified OSPFv3 routing instance into the RIPng routing
      instance.";
  }
}

```

```

leaf route-type {
  type ospf:route-type;
  description
    "Redistributes only those OSPFv3 routes matching the
    specified route type into the RIPng routing instance.";
}
uses redistribute-route-policy-attributes;
}
list ripv2 {
  when "derived-from-or-self(..../..../rt:type, 'rip:ripv2')" {
    description
      "Applicable to RIPv2.";
  }
  key "instance";
  description
    "Redistributes routes from another RIPv2 routing instance
    into the current RIPv2 routing instance.";
  leaf instance {
    type leafref {
      path "..../..../..../rt:control-plane-protocol/rt:name";
    }
    must "derived-from-or-self("
      + "..../..../..../rt:control-plane-protocol"
      + "[rt:name = current()]/rt:type, 'rip:ripv2')";
    description
      "The type of the routing protocol must be 'ripv2'.";
  }
  description
    "Redistributes routes from the specified RIPv2 routing
    instance into the RIPv2 routing instance.";
}
uses redistribute-route-policy-attributes;
}
list ripng {
  when "derived-from-or-self(..../..../rt:type, 'rip:ripng')" {
    description
      "Applicable to RIPng.";
  }
  key "instance";
  description
    "Redistributes routes from another RIPng routing instance
    into the current RIPng routing instance.";
  leaf instance {
    type leafref {
      path "..../..../..../rt:control-plane-protocol/rt:name";
    }
    must "derived-from-or-self("
      + "..../..../..../rt:control-plane-protocol"
      + "[rt:name = current()]/rt:type, 'rip:ripng')";
    description
      "The type of the routing protocol must be 'ripng'.";
  }
  description
    "Redistributes routes from the specified RIPng routing
    instance into the RIPng routing instance.";
}
}

```

```

        uses redistribute-route-policy-attributes;
    }
    container static {
        presence "Present if redistributing static routes.";
        description
            "Redistributes static routes into the RIP routing
            instance.";
        uses redistribute-route-policy-attributes;
    }
}
// redistribute
}
// redistribute-container

grouping redistribute-route-policy-attributes {
    description
        "Attributes for redistributing a route policy.";
    leaf metric {
        type uint8 {
            range "0..16";
        }
        description
            "Metric used for the redistributed route. If a metric is
            not specified, the metric configured with the
            default-metric attribute in RIP router configuration is
            used. If the default-metric attribute has not been
            configured, the default metric for redistributed routes
            is 1.";
    }
    leaf route-policy {
        type route-policy-ref;
        description
            "Applies the conditions of the specified route policy to
            routes that are redistributed into the RIP routing
            instance.";
    }
}
// redistribute-route-policy-attributes

grouping timers-container {
    description
        "Container for settings of basic timers";
    container timers {
        must 'invalid-interval >= (update-interval * 3)' {
            description
                "invalid-interval must be at least three times the value
                for the update-interval argument.";
        }
        must 'flush-interval > invalid-interval' {
            description
                "flush-interval must be larger than the value for the
                invalid-interval argument.";
        }
    }
    description
        "Timers for the specified RIPv2 or RIPv6 instance or
        interface.";
}

```



```

leaf update-interval {
    type uint16 {
        range "1..32767";
    }
    units "seconds";
    default "30";
    description
        "Interval at which RIPv2 or RIPv6 updates are sent.";
}
leaf invalid-interval {
    type uint16 {
        range "1..32767";
    }
    units "seconds";
    default "180";
    description
        "Interval before a route is declared invalid after no
        updates are received. This value is at least three times
        the value for the update-interval argument.";
}
leaf holddown-interval {
    type uint16 {
        range "1..32767";
    }
    units "seconds";
    default "180";
    description
        "Interval before better routes are released.";
}
leaf flush-interval {
    type uint16 {
        range "1..32767";
    }
    units "seconds";
    default "240";
    description
        "Interval before a route is flushed from the routing
        table. This value must be larger than the value for the
        invalid-interval argument.";
}
}
// timers
}
// timers-container

grouping global-attributes {
    description
        "Global configuration and state attributes.";
    uses originate-default-route-container;
    leaf default-metric {
        type uint8 {
            range "0..16";
        }
        default "1";
        description
            "Set the default metric.";
    }
}

```

```

    }
    leaf distance {
        type uint8 {
            range "1..255";
        }
        default "120";
        description
            "The administrative distance of the RIPv2 or RIPv2 for the
            current RIPv2 or RIPv2 instance.";
    }
    leaf triggered-update-threshold {
        type uint8 {
            range "1..30";
        }
        units "seconds";
        default "5";
        description
            "This attribute is used to suppress triggered updates.
            When the arrival of a regularly scheduled update matches the
            number of seconds or is less than the number seconds
            configured with this attribute, the triggered update is
            suppressed.";
    }
    leaf maximum-paths {
        type uint8 {
            range "1..16";
        }
        default "8";
        description
            "The number of multiple equal-cost RIPv2 or RIPv2 routes
            that can be used as the best paths for balancing the load
            of outgoing traffic packets.";
    }
    leaf output-delay {
        type uint8 {
            range "1..50";
        }
        units "milliseconds";
        description
            "A delay time between packets sent in multipacket
            RIPv2 or RIPv2 updates.";
    }
}
// global-attributes

grouping distribute-lists {
    description
        "Grouping for distribute lists.";
    list distribute-list {
        key "prefix-set-name direction";
        description
            "List of distribute-lists, which are used to filter incoming
            or outgoing routing updates.";
        leaf prefix-set-name {
            type prefix-set-ref;
            description

```

```

        "Reference to a prefix list to be applied to RIPv2 or
        RIPv6 packets.";
    }
    leaf direction {
        type enumeration {
            enum in {
                description
                "Apply the distribute-list to incoming routes.";
            }
            enum out {
                description
                "Apply the distribute-list to outgoing routes.";
            }
        }
        description
        "Direction of the routing updates.";
    }
    leaf if-name {
        type if:interface-ref;
        description
        "Reference to an interface to which the prefix list is
        applied.";
    }
}
// distribute-list
}
// distribute-lists

grouping route-attributes {
    description
    "Grouping for route attributes.";
    leaf redistributed {
        type boolean;
        description
        "Redistributed routes.";
    }
    leaf route-type {
        type enumeration {
            enum connected {
                description
                "Connected route.";
            }
            enum external {
                description
                "External route.";
            }
            enum external-backup {
                description
                "External backup route.";
            }
            enum rip {
                description
                "RIP route.";
            }
        }
    }
    description

```

```

        "Route type.";
    }
    leaf metric {
        type uint8 {
            range "0..16";
        }
        description
            "Route metric.";
    }
    leaf expire-time {
        type uint16;
        description
            "Expiration time.";
    }
    leaf deleted {
        type boolean;
        description
            "Deleted route.";
    }
    leaf holddown {
        type boolean;
        description
            "Holddown route.";
    }
    leaf need-triggered-update {
        type boolean;
        description
            "The route needs triggered update.";
    }
    leaf inactive {
        type boolean;
        description
            "The route is inactive.";
    }
    leaf flush-expire-before-holddown {
        type boolean;
        description
            "The flush timer expired before holddown time.";
    }
}
// route-attributes

/*
 * Configuration data and operational state data nodes
 */

augment "/rt:routing/rt:control-plane-protocols/"
    + "rt:control-plane-protocol" {
    when "derived-from(rt:type, 'rip:rip')" {
        description
            "This augment is only valid for a routing protocol instance
            of RIP (type 'ripv2' or 'ripng').";
    }
    description
        "RIP augmentation.";
    container rip {

```

```

description
  "RIP data.";
uses global-attributes;
uses distribute-lists;
uses redistribute-container;
uses timers-container;
container interfaces {
  description
    "Containing a list of RIP interfaces.";
  list interface {
    key "interface";
    description
      "List of RIP interfaces.";
    leaf interface {
      type if:interface-ref;
      must "(derived-from-or-self("
        + "../..../rt:type, 'rip:ripv2') and "
        + "/if:interfaces/if:interface[if:name=current()]/"
        + "ip:ipv4) or "
        + "(derived-from-or-self("
        + "../..../rt:type, 'rip:ripng') and "
        + "/if:interfaces/if:interface[if:name=current()]/"
        + "ip:ipv6)" {
        error-message "Invalid interface type.";
        description
          "RIPv2 can be enabled on IPv4 interface, and
            RIPng can be enabled on IPv6 interface.";
      }
    }
    description
      "Enable RIP on this interface.";
  }
  container authentication {
    when "derived-from-or-self("
      + "../..../rt:type, 'rip:ripv2')" {
      description
        "Only applicable to RIPv2.";
    }
    description
      "Enables authentication and specifies the
        authentication scheme for the RIP interface.";
    choice auth-type-selection {
      description
        "Specify the authentication scheme.";
      reference
        "RFC8177: YANG Data Model for Key Chains.";
      case auth-key-chain {
        leaf key-chain {
          type key-chain:key-chain-ref;
          description
            "key-chain name.";
        }
      }
      case auth-key {
        leaf key {
          type string;
          description

```

```

        "Key string in ASCII format.";
    }
    leaf crypto-algorithm {
        type identityref {
            base key-chain:crypto-algorithm;
        }
        description
            "Cryptographic algorithm associated with the
            key.";
    }
}
}
}
}
container bfd {
    if-feature "bfd";
    description
        "BFD configuration.";
    uses bfd-types:client-cfg-parms;
}
leaf cost {
    type uint8 {
        range "1..16";
    }
    default "1";
    description
        "Interface cost.";
}
container neighbors {
    if-feature "explicit-neighbors";
    description
        "Specifies the RIP neighbors. Useful for a
        non-broadcast multiple access (NBMA) network.";
    list neighbor {
        key "address";
        description
            "Specify a RIP neighbor on a non-broadcast network.";
        leaf address {
            type inet:ip-address;
            description
                "Neighbor IP address.";
        }
    }
}
}
leaf no-listen {
    type empty;
    description
        "Disables listening to, and processing of, RIPv2 or
        RIPng packets on the specified interface.";
}
uses originate-default-route-container;
leaf passive {
    type empty;
    description
        "Disables sending of RIPv2 or RIPng packets on the
        specified interface.";
}
}

```

```

leaf split-horizon {
    type enumeration {
        enum disabled {
            description
                "Disables split-horizon processing.";
        }
        enum simple {
            description
                "Enables simple split-horizon processing.";
        }
        enum poison-reverse {
            description
                "Enables split-horizon processing with poison
                reverse.";
        }
    }
    default "simple";
    description
        "Controls RIPv2 or RIPv6 split-horizon processing on
        the specified interface.";
}
container summary-address {
    description
        "Summarizes information about RIPv2 or RIPv6 routes
        sent over the specified interface in RIPv2 or RIPv6
        update packets.";
    leaf address {
        type inet:ip-prefix;
        description
            "Specifies the IP address and the prefix length that
            identify the routes to be summarized. The IP
            address can be specified in either IPv4 or IPv6
            format, as specified in RFC6991.";
    }
    leaf metric {
        type uint8 {
            range "0..16";
        }
        description
            "Metric used for the route. If this attribute is not
            used, the value set through the default-metric
            attribute in RIPv2 or RIPv6 router configuration is
            used for the route.";
    }
}
}
uses timers-container;

/* Operational state */
leaf oper-status {
    type enumeration {
        enum up {
            description
                "RIPv2 or RIPv6 is operational on this interface.";
        }
        enum down {
            description

```

```

        "RIPv2 or RIPv6 is not operational on this
        interface.";
    }
}
config false;
description
    "Operational state.";
}
leaf next-full-update {
    type uint32;
    config false;
    description
        "Next full update time.";
}
leaf valid-address {
    type boolean;
    config false;
    description
        "The interface has a valid address.";
}
container statistics {
    if-feature "interface-statistics";
    config false;
    description
        "Interface statistics counters.";
    leaf discontinuity-time {
        type yang:date-and-time;
        description
            "The time on the most recent occasion at which any
            one or more of the statistics counters suffered a
            discontinuity. If no such discontinuities have
            occurred since the last re-initialization of the
            local management subsystem, then this node contains
            the time the local management subsystem
            re-initialized itself.";
    }
    leaf bad-packets-rcvd {
        type yang:counter32;
        description
            "The number of RIP invalid packets received by
            the RIP process that were subsequently discarded
            for any reason (e.g., a version 0 packet, or an
            unknown command type).";
    }
    leaf bad-routes-rcvd {
        type yang:counter32;
        description
            "The number of routes, in valid RIP packets,
            which were ignored for any reason (e.g., unknown
            address family, or invalid metric).";
    }
    leaf updates-sent {
        type yang:counter32;
        description
            "The number of triggered RIP updates actually
            sent on this interface. This explicitly does

```



```

        NOT include full updates sent containing new
        information.";
    }
}
}
// interface
}
// interfaces

/* Operational state */
leaf next-triggered-update {
    type uint32;
    config false;
    description
        "Next triggered update.";
}
leaf num-of-routes {
    type uint32;
    config false;
    description
        "The number of routes.";
}
container ipv4 {
    when "derived-from-or-self ../../rt:type, 'rip:ripv2'" {
        description
            "IPv4 address family is supported by RIPv2.";
    }
    config false;
    description
        "IPv4 address family information.";
    container neighbors {
        description
            "IPv4 neighbor information.";
        list neighbor {
            key "ipv4-address";
            description
                "A RIPv2 neighbor.";
            leaf ipv4-address {
                type inet:ipv4-address;
                description
                    "IP address that a RIP neighbor is using as its
                    source address.";
            }
        }
        leaf last-update {
            type yang:date-and-time;
            description
                "The time when the most recent RIP update was
                received from this neighbor.";
        }
        leaf bad-packets-rcvd {
            type yang:counter32;
            description
                "The number of RIP invalid packets received from
                this neighbor that were subsequently discarded
                for any reason (e.g., a version 0 packet, or an
                unknown command type).";
        }
    }
}

```

```

    }
    leaf bad-routes-rcvd {
        type yang:counter32;
        description
            "The number of routes received from this neighbor,
            in valid RIP packets that were ignored for any
            reason (e.g., unknown address family, or invalid
            metric).";
    }
}
// neighbor
}
// neighbors

container routes {
    description
        "IPv4 route information.";
    list route {
        key "ipv4-prefix";
        description
            "A RIPv2 IPv4 route.";
        leaf ipv4-prefix {
            type inet:ipv4-prefix;
            description
                "IPv4 address and prefix length, in the format
                specified in RFC6991.";
        }
        leaf next-hop {
            type inet:ipv4-address;
            description
                "Next hop IPv4 address.";
        }
        leaf interface {
            type if:interface-ref;
            description
                "The interface that the route uses.";
        }
        uses route-attributes;
    }
    // route
}
// routes
}
// ipv4

container ipv6 {
    when "derived-from-or-self(..../rt:type, 'rip:ripng')" {
        description
            "IPv6 address family is supported by RIPng.";
    }
    config false;
    description
        "IPv6 address family information.";
    container neighbors {
        description
            "IPv6 neighbor information.";
    }
}

```

```

list neighbor {
  key "ipv6-address";
  description
    "A RIPng neighbor.";
  leaf ipv6-address {
    type inet:ipv6-address;
    description
      "IP address that a RIP neighbor is using as its
        source address.";
  }
  leaf last-update {
    type yang:date-and-time;
    description
      "The time when the most recent RIP update was
        received from this neighbor.";
  }
  leaf bad-packets-rcvd {
    type yang:counter32;
    description
      "The number of RIP invalid packets received from
        this neighbor that were subsequently discarded
        for any reason (e.g., a version 0 packet, or an
        unknown command type).";
  }
  leaf bad-routes-rcvd {
    type yang:counter32;
    description
      "The number of routes received from this neighbor,
        in valid RIP packets that were ignored for any
        reason (e.g., unknown address family, or invalid
        metric).";
  }
}
// neighbor
}
// neighbors

container routes {
  description
    "IPv6 route information.";
  list route {
    key "ipv6-prefix";
    description
      "A RIPng IPv6 route.";
    leaf ipv6-prefix {
      type inet:ipv6-prefix;
      description
        "IPv6 address and prefix length, in the format
          specified in RFC6991.";
    }
    leaf next-hop {
      type inet:ipv6-address;
      description
        "Next hop IPv6 address.";
    }
  }
  leaf interface {

```

```

        type if:interface-ref;
        description
            "The interface that the route uses.";
    }
    uses route-attributes;
}
// route
}
// routes
}
// ipv6

container statistics {
    if-feature "global-statistics";
    config false;
    description
        "Global statistics counters.";
    leaf discontinuity-time {
        type yang:date-and-time;
        description
            "The time on the most recent occasion at which any one
            or more of the statistics counters suffered a
            discontinuity. If no such discontinuities have occurred
            since the last re-initialization of the local
            management subsystem, then this node contains the time
            the local management subsystem re-initialized itself.";
    }
    leaf requests-rcvd {
        type yang:counter32;
        description
            "The number of requests received by RIP.";
    }
    leaf requests-sent {
        type yang:counter32;
        description
            "The number of requests sent by RIP.";
    }
    leaf responses-rcvd {
        type yang:counter32;
        description
            "The number of responses received by RIP.";
    }
    leaf responses-sent {
        type yang:counter32;
        description
            "The number of responses sent by RIP.";
    }
}
// statistics
}
// rip
}

/*
 * RPCs
 */

```

```

rpc clear-rip-route {
  description
    "Clears RIP routes from the IP routing table and routes
    redistributed into RIP for the specified RIP instance
    or for all RIP instances in the current context.";
  input {
    leaf rip-instance {
      type leafref {
        path "/rt:routing/rt:control-plane-protocols/"
          + "rt:control-plane-protocol/rt:name";
      }
      description
        "Instance name identifying a specific RIP instance.
        This leaf is optional for the RPC.
        If it is specified, the RPC will clear all routes in the
        specified RIP instance;
        if it is not specified, the RPC will clear all routes in
        all RIP instances.";
    }
  }
}
// clear-rip-route
}
<CODE ENDS>

```

5. IANA Considerations

This document registers the following namespace URIs in the "IETF XML Registry" [RFC3688]:

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

This document registers the following YANG modules in the "YANG Module Names" registry [RFC6020]:

Name: ietf-rip
 Namespace: urn:ietf:params:xml:ns:yang:ietf-rip
 Prefix: rip
 Reference: RFC 8695

6. 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 NETCONF 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:

```
/rt:routing/rt:control-plane-protocols/rt:control-plane-protocol/  
rip:rip
```

Unauthorized access to any data node of these subtrees can adversely affect the routing subsystem of both the local device and the network. This may lead to network malfunctions, delivery of packets to inappropriate destinations, and other problems.

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:

```
/rt:routing/rt:control-plane-protocols/rt:control-plane-protocol/  
rip:rip
```

Unauthorized access to any data node of these subtrees can disclose the operational state information of RIP on this device.

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:

RPC clear-rip-route:

Unauthorized access to the RPC above can adversely affect the routing subsystem of both the local device and the network. This may lead to network malfunctions, delivery of packets to inappropriate destinations, and other problems.

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- [YANG-ISIS] Litkowski, S., Yeung, D., Lindem, A., Zhang, Z., and L. Lhotka, "YANG Data Model for IS-IS Protocol", Work in Progress, Internet-Draft, draft-ietf-isis-yang-isis-cfg-42, 15 October 2019, <<https://tools.ietf.org/html/draft-ietf-isis-yang-isis-cfg-42>>.
- [YANG-OSPF]

Yeung, D., Qu, Y., Zhang, Z., Chen, I., and A. Lindem,
 "YANG Data Model for OSPF Protocol", Work in Progress,
 Internet-Draft, draft-ietf-ospf-yang-29, 17 October 2019,
 <<https://tools.ietf.org/html/draft-ietf-ospf-yang-29>>.

Appendix A. Data Tree Example

This section contains an example of an instance data tree in the JSON encoding [RFC7951], containing both configuration and state data.

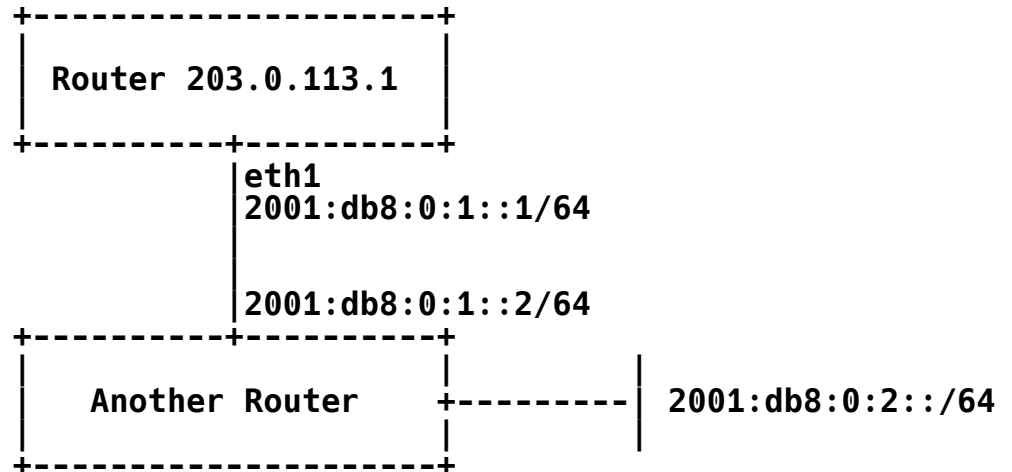


Figure 1: RIPng Example

The configuration instance data tree for Router 203.0.113.1 in Figure 1 could be as follows:

```

{
  "ietf-interfaces:interfaces": {
    "interface": [
      {
        "name": "eth1",
        "description": "An interface with RIPng enabled.",
        "type": "iana-if-type:ethernetCsmacd",
        "ietf-ip:ipv6": {
          "address": [
            {
              "ip": "2001:db8:0:1::1",
              "prefix-length": 64
            }
          ]
        },
        "forwarding": true
      }
    ]
  },
  "ietf-routing:routing": {
    "router-id": "203.0.113.1",
    "control-plane-protocols": {
      "control-plane-protocol": [
        {
          "type": "ietf-rip:ripng",

```

```

    "name": "ripng-1",
    "description": "RIPng instance ripng-1.",
    "ietf-rip:rip": {
      "redistribute": {
        "connected": {
        }
      }
    },
    "interfaces": {
      "interface": [
        {
          "interface": "eth1",
          "split-horizon": "poison-reverse"
        }
      ]
    }
  }
}

```

The corresponding operational state data for Router 203.0.113.1 could be as follows:

```

{
  "ietf-interfaces:interfaces": {
    "interface": [
      {
        "name": "eth1",
        "description": "An interface with RIPng enabled.",
        "type": "iana-if-type:ethernetCsmacd",
        "phys-address": "00:00:5e:00:53:01",
        "oper-status": "up",
        "statistics": {
          "discontinuity-time": "2016-10-24T17:11:27+02:00"
        }
      },
      {
        "ietf-ip:ipv6": {
          "forwarding": true,
          "mtu": 1500,
          "address": [
            {
              "ip": "2001:db8:0:1::1",
              "prefix-length": 64,
              "origin": "static",
              "status": "preferred"
            },
            {
              "ip": "fe80::200:5eff:fe00:5301",
              "prefix-length": 64,
              "origin": "link-layer",
              "status": "preferred"
            }
          ]
        },
        "neighbor": [
        ]
      }
    ]
  }
}

```

```

    "ip": "2001:db8:0:1::2",
    "link-layer-address": "00:00:5e:00:53:02",
    "origin": "dynamic",
    "is-router": [null],
    "state": "reachable"
  },
  {
    "ip": "fe80::200:5eff:fe00:5302",
    "link-layer-address": "00:00:5e:00:53:02",
    "origin": "dynamic",
    "is-router": [null],
    "state": "reachable"
  }
]
}
}
}
},
{
  "ietf-routing:routing": {
    "router-id": "203.0.113.1",
    "interfaces": {
      "interface": [
        "eth1"
      ]
    }
  },
  "control-plane-protocols": {
    "control-plane-protocol": [
      {
        "type": "ietf-rip:ripng",
        "name": "ripng-1",
        "description": "RIPng instance ripng-1.",
        "ietf-rip:rip": {
          "default-metric": 1,
          "next-triggered-update": 5,
          "interfaces": {
            "interface": [
              {
                "interface": "eth1",
                "oper-status": "up",
                "cost": 1,
                "split-horizon": "poison-reverse",
                "valid-address": true
              }
            ]
          }
        }
      }
    ]
  },
  "ipv6": {
    "neighbors": {
      "neighbor": [
        {
          "ipv6-address": "fe80::200:5eff:fe00:5302",
          "last-update": "2017-01-02T10:34:55+02:00"
        }
      ]
    }
  },
  "routes": {
    "route": [

```


Email: vikschw@gmail.com