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YANG Data Model for RIB Extensions
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Abstract

The Routing Information Base (RIB) is a list of routes and their corresponding administrative data and operational state.

The document [[ROUTING-CFG](#)] defines the basic building blocks for RIB, and this model augments it to support multiple next-hops (aka, paths) for each route as well as additional attributes.

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Table of Contents

1.	Introduction	2
1.1.	Requirements Notation	2
2.	Design of the Model	2
2.1.	RIB next-hop dampening	3
2.2.	Multiple next-hops	3
2.3.	Repair path	3
3.	RIB Extensions Model Tree	3
4.	RIB Extensions YANG Model	5
5.	Security Considerations	10
6.	IANA Considerations	10
7.	References	10
7.1.	Normative References	11
7.2.	Informative References	11
Appendix A.	Acknowledgments	11
	Authors' Addresses	11

[1.](#) Introduction

This document defines a YANG, [[YANG](#)], data model which extends the generic data model for RIB by augmenting the [ietf-routing](#) model as defined in [[ROUTING-CFG](#)].

RIB is a collection of best routes from all routing protocols. Within a protocol routes are selected based on the metrics in use by that protocol, and the protocol install its best routes to RIB. RIB selects the best route by comparing the route preference (aka, administrative distance) of the associated protocol.

The augmentations described herein extend the RIB to support multiple paths per route, route metrics, and administrative tags.

[1.1.](#) Requirements Notation

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [[RFC-KEYWORDS](#)].

[2.](#) Design of the Model

The YANG definitions in this document augment the [ietf-routing](#) model defined in [[ROUTING-CFG](#)], which provides a basis for routing system data model development. Together with modules defined in

[[ROUTING-CFG](#)], a generic RIB Yang model is defined to implement and monitor RIB.

The models in [[ROUTING-CFG](#)] also define the basic configuration and operational state for both IPv4 and IPv6 static routes and this document also provides augmentations for static routes to support multiple next-hop and more next-hop attributes.

[2.1.](#) RIB next-hop dampening

A feature "next-hop-dampen" is defined. Implementations that support this feature can enable/disable RIB dampening.

[2.2.](#) Multiple next-hops

Both Ipv4 and IPv6 static route configuration defined in [[ROUTING-CFG](#)] have been augmented with a multi-next-hop option.

A static route/prefix can be configured to have multiple next-hops, each with their own tag and route preference.

In RIB, a route may have multiple next-hops. They can be either equal cost multiple paths (ECMP), or they may have different metrics.

[2.3.](#) Repair path

The loop-free alternate (LFA) Fast Reroute (FRR) pre-computes repair paths by routing protocols, and RIB stores the best repair path.

A repair path is augmented in RIB operation state for each path.

[3.](#) RIB Extensions Model Tree

A simplified graphical representation of the augmentations described herein is included below.

The meaning of the symbols in this diagrams is as follows:

- o Brackets "[" and "]" enclose list keys.
- o Curly braces "{" and "}" contain names of optional features that make the corresponding node conditional.
- o Abbreviations before data node names: "rw" means configuration (read-write), "ro" state data (read-only), "-x" RPC operations, and "-n" notifications.

- o Symbols after data node names: "?" means an optional node, "!" a container with presence, and "*" denotes a "list" or "leaf-list".
- o Parentheses enclose choice and case nodes, and case nodes are also marked with a colon (":").
- o Ellipsis ("...") stands for contents of subtrees that are not shown.

```

module: ietf-rib-extension
augment /rt:routing/rt:routing-instance/rt:routing-protocols/
  rt:routing-protocol/rt:static-routes/v4ur:ipv4/v4ur:route/
  v4ur:next-hop/v4ur:next-hop-options:
  +--:(multi-next-hop)
    +--rw next-hop-entries* [interface address]
      +--rw interface      string
      +--rw address        inet:ipv4-address
      +--rw preference?    uint32
      +--rw tag?           uint32
augment /rt:routing/rt:routing-instance/rt:routing-protocols/
  rt:routing-protocol/rt:static-routes/v6ur:ipv6/v6ur:route/
  v6ur:next-hop/v6ur:next-hop-options:
  +--:(multi-next-hop)
    +--rw next-hop-entries* [interface address]
      +--rw interface      string
      +--rw address        inet:ipv6-address
      +--rw preference?    uint32
      +--rw tag?           uint32
augment /rt:routing/rt:routing-instance/rt:ribs/rt:rib:
  +--rw next-hop-dampen-enable?  boolean {next-hop-dampen}?
augment /rt:routing-state/rt:routing-instance/rt:ribs/rt:rib:
  +--ro next-hop-dampen-enable?  boolean
augment /rt:routing-state/rt:routing-instance/rt:ribs/rt:rib/rt:routes/
  rt:route:
  +--ro metric?    uint32
  +--ro tag?       uint32
augment /rt:routing-state/rt:routing-instance/rt:ribs/rt:rib/rt:routes/
  rt:route/rt:next-hop/rt:next-hop-options/rt:simple-next-hop:
  +--ro metric?    uint32
  +--ro tag?       uint32
  +--ro repair-path
    +--ro interface?  leafref
    +--ro address?    inet:ip-address
    +--ro metric?     uint32
    +--ro tag?        uint32
augment /rt:routing-state/rt:routing-instance/rt:ribs/rt:rib/rt:routes/
  rt:route/rt:next-hop/rt:next-hop-options/rt:special-next-hop:
  +--ro metric?    uint32

```



```

+--ro tag?          uint32
+--ro repair-path
  +--ro interface?  leafref
  +--ro address?    inet:ip-address
  +--ro metric?     uint32
  +--ro tag?        uint32
augment /rt:routing-state/rt:routing-instance/rt:ribs/rt:rib/rt:routes/
  rt:route/rt:next-hop/rt:next-hop-options:
+--:(multi-paths)
  +--ro path-entries*
    +--ro interface?  leafref
    +--ro address?    inet:ip-address
    +--ro metric?     uint32
    +--ro tag?        uint32
    +--ro repair-path
      +--ro interface?  leafref
      +--ro address?    inet:ip-address
      +--ro metric?     uint32
      +--ro tag?        uint32

```

4. RIB Extensions YANG Model

```

<CODE BEGINS> file "ietf-rib-extension@2015-10-16.yang"
module ietf-rib-extension {
  namespace "urn:ietf:params:xml:ns:yang:ietf-rib-extension";

  prefix rib;

  import ietf-inet-types {
    prefix "inet";
  }

  import ietf-routing {
    prefix "rt";
  }

  import ietf-ipv4-unicast-routing {
    prefix "v4ur";
  }

  import ietf-ipv6-unicast-routing {
    prefix "v6ur";
  }

  organization
    "Cisco Systems
     170 West Tasman Drive
     San Jose, CA 95134-1706

```



```
    USA";
  contact
    "Acee Lindem - acee@cisco.com
     Yingzhen QU - yiqu@cisco.com";

  description
    "This YANG module extends the generic data model for
     RIB by augmenting the ietf-netmod-routing-cfg
     model. It is intended that the module will be extended
     by vendors to define vendor-specific RIB parameters.
    ";

  revision 2015-10-16 {
    description
      "Initial revision.";
    reference
      "RFC XXXX: A YANG Data Model for RIB Extensions.";
  }

  feature next-hop-dampen {
    description
      "RIB next-hop dampening.";
  }

  grouping next-hop {
    description
      "Next-hop grouping.";
    leaf interface {
      type leafref {
        path "/rt:routing-state/rt:routing-instance/rt:interfaces/"
          + "rt:interface";
      }
      description
        "Outgoing interface.";
    }
    leaf address {
      type inet:ip-address;
      description
        "Address of the next-hop.";
    }
  }

  grouping attributes {
    description
      "Common attributes applicable to all paths.";
    leaf metric {
      type uint32;
      description "route metric.";
    }
  }
}
```



```
    }
    leaf tag {
      type uint32;
      description "route tag.";
    }
  }

  grouping path-attribute {
    description
      "Path attribute grouping.";
    uses attributes;
    container repair-path {
      uses next-hop;
      uses attributes;
      description
        "The IP Fast ReRoute (IPFRR) repair path.";
    }
  }

  augment "/rt:routing/rt:routing-instance/rt:routing-protocols/"
    + "rt:routing-protocol/rt:static-routes/v4ur:ipv4/"
    + "v4ur:route/v4ur:next-hop/v4ur:next-hop-options"
  {
    description
      "Augment recursive static route configuration.";
    case multi-next-hop {
      description
        "Multiple next-hop options";
      list next-hop-entries {
        key "interface address";
        leaf interface {
          type string;
          description
            "Outgoing interface name.";
        }
        leaf address {
          type inet:ipv4-address;
          description
            "Address of the next-hop.";
        }
        leaf preference {
          type uint32;
          default "1";
          description "route preference.";
        }
        leaf tag {
          type uint32;
          default "0";
        }
      }
    }
  }
```



```
        description "route tag.";
    }
    description
        "List of multiple next hops.";
    }
}

augment "/rt:routing/rt:routing-instance/rt:routing-protocols/"
+ "rt:routing-protocol/rt:static-routes/v6ur:ipv6/"
+ "v6ur:route/v6ur:next-hop/v6ur:next-hop-options"
{
    description
        "Augment recursive static route configuration.";
    case multi-next-hop {
        description
            "Multiple next-hop options";
        list next-hop-entries {
            key "interface address";
            leaf interface {
                type string;
                description
                    "Outgoing interface name.";
            }
            leaf address {
                type inet:ipv6-address;
                description
                    "Address of the next-hop.";
            }
            leaf preference {
                type uint32;
                default "1";
                description "route preference.";
            }
            leaf tag {
                type uint32;
                default "0";
                description "tag for this path.";
            }
        }
        description
            "List of multipath.";
    }
}

augment "/rt:routing/rt:routing-instance/rt:ribs/rt:rib"
{
    description
```



```
    "Augment configuration for RIB dampening enable/disable.";
  leaf next-hop-dampen-enable {
    if-feature next-hop-dampen;
    type boolean;
    default true;
    description "Enable rib next-hop dampening.";
  }
}

augment "/rt:routing-state/rt:routing-instance/rt:ribs/rt:rib"
{
  description
    "Augment operation state for RIB dampening enable/disable.";
  leaf next-hop-dampen-enable {
    type boolean;
    description "Rib next-hop dampening state.";
  }
}

augment "/rt:routing-state/rt:routing-instance/rt:ribs/rt:rib/"
  + "rt:routes/rt:route"
{
  description
    "Augment a route in RIB with tag.";
  uses attributes;
}

augment "/rt:routing-state/rt:routing-instance/rt:ribs/rt:rib/"
  + "rt:routes/rt:route/rt:next-hop/rt:next-hop-options/"
  + "rt:simple-next-hop"
{
  description
    "Add more parameters to a path.";
  uses path-attribute;
}

augment "/rt:routing-state/rt:routing-instance/rt:ribs/rt:rib/"
  + "rt:routes/rt:route/rt:next-hop/rt:next-hop-options/"
  + "rt:special-next-hop"
{
  description
    "Add more parameters to a path.";
  uses path-attribute;
}

augment "/rt:routing-state/rt:routing-instance/rt:ribs/rt:rib/"
  + "rt:routes/rt:route/rt:next-hop/rt:next-hop-options"
{
```



```
description
  "This case augments the 'next-hop-options' in the routing
  model.";
case multi-paths {
  description
    "ecmp";
  list path-entries {
    uses next-hop;
    uses path-attribute;
    description
      "List of multipaths.";
  }
}
}
}
}
<CODE ENDS>
```

5. Security Considerations

The YANG model augmentations defined herein do not introduce any security issues other than those already discussed in [\[ROUTING-CFG\]](#), and [\[NETCONF\]](#). If confidentiality is desired, the underlying NETCONF communication should be utilized as described in [\[NETCONF-SSH\]](#).

6. IANA Considerations

This document registers a URI in the IETF XML registry [\[XML-REGISTRY\]](#). Following the format in [RFC 3688](#), the following registration is requested to be made:

URI: urn:ietf:params:xml:ns:yang:ietf-rib

Registrant Contact: The IESG.

XML: N/A, the requested URI is an XML namespace.

This document registers a YANG module in the YANG Module Names registry [\[YANG\]](#).

name: ietf-acl namespace: urn:ietf:params:xml:ns:yang:ietf-rib
prefix: ietf-rib reference: RFC XXXX

7. References

7.1. Normative References

[RFC-KEYWORDS]

Bradner, S., "Key words for use in RFC's to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.

[ROUTING-CFG]

Lhothka, L. and A. Lindem, "A YANG Data Model for Routing Management", [draft-ietf-netmod-routing-cfg-17.txt](#) (work in progress), May 2015.

[YANG]

Bjorklund, M., "YANG - A Data Modeling Language for the Network Configuration Protocol (NETCONF)", [RFC 6020](#), October 2010.

7.2. Informative References

[NETCONF] Enns, R., Bjorklund, M., Schoenwaelder, J., and A. Bierman, "Network Configuration Protocol (NETCONF)", [RFC 6241](#), June 2011.

[NETCONF-SSH]

Wasserman, M., "Using NETCONF Protocol over Secure Shell (SSH)", [RFC 6242](#), June 2011.

[XML-REGISTRY]

Mealling, M., "The IETF XML Registry", [BCP 81](#), [RFC 3688](#), January 2004.

Appendix A. Acknowledgments

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