Abstract

This document defines a data model for the Babel routing protocol. The data model is defined using the YANG data modeling language.

Requirements Language

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 BCP 14 [RFC2119][RFC8174] when, and only when, they appear in all capitals, as shown here.

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1. Introduction

This document defines a data model for the Babel routing protocol [I-D.ietf-babel-rfc6126bis]. The data model is defined using YANG 1.1 [RFC7950] data modeling language and is Network Management Datastore Architecture (NDMA) [RFC8342] compatible. It is based on the Babel Information Model [I-D.ietf-babel-information-model].

1.1. Note to RFC Editor

Artwork in this document contains shorthand references to drafts in progress. Please apply the following replacements and remove this note before publication.

- "XXXX" --> the assigned RFC value for this draft both in this draft and in the YANG models under the revision statement.

- "ZZZZ" --> the assigned RFC value for Babel Information Model [I-D.ietf-babel-information-model]
1.2. Definitions and Acronyms

1.3. Tree Diagram Annotations

For a reference to the annotations used in tree diagrams included in this draft, please see YANG Tree Diagrams [RFC8340].

2. Babel Module

This document defines a YANG 1.1 [RFC7950] data model for the configuration and management of Babel. The YANG module is based on the Babel Information Model [I-D.ietf-babel-information-model].

2.1. Information Model

There are a few things that should be noted between the Babel Information Model and this data module. The information model mandates the definition of some of the attributes, e.g. babel-implementation-version or the babel-self-router-id. These attributes are marked a read-only objects in the information module as well as in this data module. However, there is no way in the data module to mandate that a read-only attribute be present. It is up to the implementation of this data module to make sure that the attributes that are marked read-only and are mandatory are indeed present.

2.2. Tree Diagram

The following diagram illustrates a top level hierarchy of the model. In addition to information like the version number implemented by this device, the model contains subtrees on constants, interfaces, routes and security.
module: ietf-babel
  augment /rt:routing/rt:control-plane-protocols/rt:control-plane-protocol:
    +--rw babel!
      +--ro version?                string
      +--rw enable                  boolean
      +--ro router-id               binary
      +--ro link-properties*        identityref
      +--ro sequence-number?        uint16
      +--ro metric-comp-algorithms* identityref
      +--ro security-supported*     identityref
      +--ro hmac-algorithms*        identityref
      +--ro dtls-cert-types*        identityref
      +--rw stats-enable?           boolean
      +--rw constants |
      | ...                     |
      +--rw interfaces* [reference] |
      | ...                     |
      +--rw hmac* [name]     |
      | ...                     |
      +--rw dtls* [name]     |
    ...

augment /rt:routing/rt:ribs/rt:rib/rt:routes/rt:route:
  +--ro routes* [prefix]
    +--ro prefix               inet:ip-prefix
    +--ro router-id?           binary
    +--ro neighbor?            leafref
    +--ro received-metric?     uint16
    +--ro calculated-metric?   uint16
    +--ro seqno?               uint16
    +--ro next-hop?            inet:ip-address
    +--ro feasible?            boolean
    +--ro selected?            boolean

The interfaces subtree describes attributes such as interface object that is being referenced, the type of link as enumerated by Babel Link Properties, and whether the interface is enabled or not.

The constants subtree describes the UDP port used for sending and receiving Babel messages, and the multicast group used to send and receive announcements on IPv6.

The routes subtree describes objects such as the prefix for which the route is advertised, a reference to the neighboring route, and next-hop address.

Finally, for security two subtree are defined to contain HMAC keys and DTLS certificates. The hmac subtree contains keys used with the
HMAC security mechanism. The boolean flag babel-hmac-default-apply indicates whether the set of HMAC keys is automatically applied to new interfaces. The dtls subtree contains certificates used with DTLS security mechanism. Similar to the HMAC mechanism, the boolean flag babel-dtls-default-apply indicates whether the set of DTLS certificates is automatically applied to new interfaces.

2.3. YANG Module

This module augments A YANG Data Model for Interface Management [RFC8343], YANG Routing Management [RFC8349], and imports definitions from Common YANG Data Types [RFC6991].

<CODE BEGINS> file "ietf-babel@2019-07-22.yang"

module ietf-babel {  
yang-version 1.1;  
namespace "urn:ietf:params:xml:ns:yang:ietf-babel";  
prefix babel;  

import ietf-yang-types {  
prefix yt;  
reference "RFC 6991 - Common YANG Data Types.";  
}  
import ietf-inet-types {  
prefix inet;  
reference "RFC 6991 - Common YANG Data Types.";  
}  
import ietf-interfaces {  
prefix if;  
reference "RFC 8343 - A YANG Data Model for Interface Management";  
}  
import ietf-routing {  
prefix "rt";  
reference "RFC 8349 - YANG Routing Management";  
}  

organization  
"IETF Babel routing protocol Working Group";

contact  
"WG Web: http://tools.ietf.org/wg/babel/  
WG List: babel@ietf.org"
description
"This YANG module defines a model for the Babel routing protocol.

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

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

revision 2019-07-22 {
  description
    "Initial version.";
  reference
    "RFC XXX: Babel YANG Data Model.";
}

/*
 * Identities
 */
identity link-property {
  description
    "Base identity from which all Babel Link Types are derived.";
}

identity other {
  base "link-property";
  description
    "No link property information available.";
}

identity tunnel {
  base "link-property";
  description
    "A tunneled interface over unknown physical link.";
}
identity wired {
    base "link-property";
    description
        "A wired link with fixed physical properties.";
}

identity wireless {
    base "link-property";
    description
        "Wireless link type for Babel Routing Protocol.";
}

identity metric-comp-algorithms {
    description
        "Base identity from which all Babel metric comp algorithms are derived.";
}

identity k-out-of-j {
    base "metric-comp-algorithms";
    description
        "k-out-of-j algorithm.";
}

identity etx {
    base "metric-comp-algorithms";
    description
        "Expected Transmission Count.";
}

/ *
* Babel security type identities
*/

identity security-supported {
    description
        "Base identity from which all Babel security types are derived.";
}

identity hmac {
    base security-supported;
    description
        "HMAC supported.";
}

identity dtls {
    base security-supported;
    description
        "Datagram Transport Layer Security (DTLS) supported.";
    reference
        "Jethanandani & Stark Expires January 23, 2020 [Page 7]"
identity hmac-algorithms {
  description
    "Base identity for all Babel HMAC algorithms.";
}

identity hmac-sha256 {
  base hmac-algorithms;
  description
    "HMAC-SHA256 algorithm supported.";
}

identity blake2s {
  base hmac-algorithms;
  description
    "BLAKE2s algorithm supported.";
  reference
    "RFC 7693, The BLAKE2 Cryptographic Hash and Message Authentication Code (MAC).";
}

identity dtls-cert-types {
  description
    "Base identity for Babel DTLS certificate types.";
}

identity x-509 {
  base dtls-cert-types;
  description
    "X.509 certificate type.";
}

identity raw-public-key {
  base dtls-cert-types;
  description
    "Raw Public Key type.";
}

/*
 * Babel routing protocol identity.
*/
identity babel {
  base "rt:routing-protocol";
  description
    "Babel routing protocol";
}

/*
* Features
*/

/*
* Features supported
*/

/*
* Typedefs
*/

/*
* Groupings
*/
grouping routes {
  list routes {
    key "prefix";
    config false;
    leaf prefix {
      type inet:ip-prefix;
      description
        "Prefix (expressed in ip-address/prefix-length format) for which this route is advertised.";
      reference
        "RFC ZZZZ, Babel Information Model, Section 3.6.";
    }
    leaf router-id {
      type binary;
      description
        "router-id of the source router for which this route is advertised.";
      reference
        "RFC ZZZZ, Babel Information Model, Section 3.6.";
    }
    leaf neighbor {
      type leafref {
        path "/rt:routing/rt:control-plane-protocols/" +
"rt:control-plane-protocol/babel/interfaces/" +
"neighbor-objects/neighbor-address";
}
description
"Reference to the babel-neighbors entry for the neighbor
that advertised this route.";
reference
"RFC ZZZZ, Babel Information Model, Section 3.6.";
}

leaf received-metric {
  type uint16;
  description
  "The metric with which this route was advertised by the
  neighbor, or maximum value (infinity) to indicate a the
  route was recently retracted and is temporarily
  unreachable. this metric will be 0 (zero) if the route
  was not received from a neighbor but was generated
  through other means. Either babel-route-calculated-metric
  or babel-route-received-metric MUST be provided.";
  reference
  "RFC ZZZZ, Babel Information Model, Section 3.6,
  draft-ietf-babel-rfc6126bis, The Babel Routing Protocol,
  Section 3.5.5.";
}

leaf calculated-metric {
  type uint16;
  description
  "A calculated metric for this route. How the metric is
calculated is implementation-specific. Maximum value
(infinity) indicates the route was recently retracted
and is temporarily unreachable. Either
babel-route-calculated-metric or
babel-route-received-metric MUST be provided.";
  reference
  "RFC ZZZZ, Babel Information Model, Section 3.6,
  draft-ietf-babel-rfc6126bis, The Babel Routing Protocol,
  Section 3.5.5.";
}

leaf seqno {
  type uint16;
  description
  "The sequence number with which this route was advertised.";
  reference
  "RFC ZZZZ, Babel Information Model, Section 3.6.";
}
leaf next-hop {
  type inet:ip-address;
  description
      "The next-hop address of this route. This will be empty if
      this route has no next-hop address."
  reference
      "RFC ZZZZ, Babel Information Model, Section 3.6."
}

leaf feasible {
  type boolean;
  description
      "A boolean flag indicating whether this route is feasible."
  reference
      "RFC ZZZZ, Babel Information Model, Section 3.6,
      draft-ietf-babel-rfc6126bis, The Babel Routing Protocol,
      Section 3.5.1."
}

leaf selected {
  type boolean;
  description
      "A boolean flag indicating whether this route is selected,
      i.e., whether it is currently being used for forwarding and
      is being advertised."
  reference
      "RFC ZZZZ, Babel Information Model, Section 3.6."
}

description
  "A set of babel-route-obj objects. Includes received and
  routes routes."
reference
  "RFC ZZZZ, Babel Information Model, Section 3.1."

description
  "Common grouping for routing used in RIB augmentation."
}

/*
 * Data model
 */

augment "/rt:routing/rt:control-plane-protocols/" +
  "rt:control-plane-protocol" {
  when "derived-from-or-self(rt:type, 'babel')" {
    description
      "Augmentation is valid only when the instance of routing type
      is of type 'babel'.";
  }
}
description
"Augment the routing module to support features such as VRF."
reference
"YANG Routing Management, RFC 8349, Lhotka & Lindem, March 2018."

container babel {
  presence "A Babel container."

  leaf version {
    type string;
    config false;
    description
    "The name and version of this implementation of the Babel protocol.";
    reference
    "RFC ZZZZ, Babel Information Model, Section 3.1.";
  }

  leaf enable {
    type boolean;
    mandatory true;
    description
    "When written, it configures whether the protocol should be enabled. A read from the <running> or <intended> datastore therefore indicates the configured administrative value of whether the protocol is enabled or not.

    A read from the <operational> datastore indicates whether the protocol is actually running or not, i.e. it indicates the operational state of the protocol.";
    reference
    "RFC ZZZZ, Babel Information Model, Section 3.1.";
  }

  leaf router-id {
    type binary;
    config false;
    mandatory "true";
    description
    "Every Babel speaker is assigned a router-id, which is an arbitrary string of 8 octets that is assumed to be unique across the routing domain";
    reference
    "RFC ZZZZ, Babel Information Model, Section 3.1, rfc6126bis, The Babel Routing Protocol. Section 3.";
  }
}
leaf-list link-properties {
  type identityref {
    base link-property;
  }
  config false;
  min-elements 1;
  description
    "Lists the collections of link properties supported by this
    instance of Babel. Valid enumeration values are defined
    in the Babel Link Properties registry.";
  reference
    "RFC ZZZZ, Babel Information Model, Section 3.1.";
}

leaf sequence-number {
  type uint16;
  config false;
  description
    "Sequence number included in route updates for routes
    originated by this node.";
  reference
    "RFC ZZZZ, Babel Information Model, Section 3.1.";
}

leaf-list metric-comp-algorithms {
  type identityref {
    base "metric-comp-algorithms";
  }
  config false;
  min-elements 1;
  description
    "List of cost compute algorithms supported by this
    implementation of Babel.";
  reference
    "RFC ZZZZ, Babel Information Model, Section 3.1.";
}

leaf-list security-supported {
  type identityref {
    base "security-supported";
  }
  config false;
  min-elements 1;
  description
    "Babel security mechanism used by this implementation or
    per interface.";
  reference
    "RFC ZZZZ, Babel Information Model, Section 3.1.";
leaf-list hmac-algorithms {
  type identityref {
    base hmac-algorithms;
  }
  config false;
  description
    "List of supported HMAC computation algorithms. Possible values include 'HMAC-SHA256', 'BLAKE2s'.";
  reference
    "RFC ZZZZ, Babel Information Model, Section 3.1.";
}

leaf-list dtls-cert-types {
  type identityref {
    base dtls-cert-types;
  }
  config false;
  description
    "List of supported DTLS certificate types. Possible values include 'X.509' and 'RawPublicKey'.";
  reference
    "RFC ZZZZ, Babel Information Model, Section 3.1.";
}

leaf stats-enable {
  type boolean;
  description
    "Indicates whether statistics collection is enabled (true) or disabled (false) on all interfaces, including neighbor-specific statistics (babel-nbr-stats).";
}

container constants {
  leaf udp-port {
    type inet:port-number;
    default "6696";
    description
      "UDP port for sending and receiving Babel messages. The default port is 6696.";
    reference
      "RFC ZZZZ, Babel Information Model, Section 3.2.";
  }

  leaf mcast-group {
    type inet:ip-address;
    default "ff02::0:0:0:0:1:6";
  }
}
description
  "Multicast group for sending and receiving multicast announcements on IPv6."
reference
  "RFC ZZZZ, Babel Information Model, Section 3.2.";
}
description
  "Babel Constants object."
reference
  "RFC ZZZZ, Babel Information Model, Section 3.1.";
}
list interfaces {
  key "reference";

  leaf reference {
    type if:interface-ref;
    description
      "Reference to an interface object as defined by the data model (e.g., YANG, BBF TR-181); data model is assumed to allow for referencing of interface objects which may be at any layer (physical, Ethernet MAC, IP, tunneled IP, etc.). Referencing syntax will be specific to the data model. If there is no set of interface objects available, this should be a string that indicates the interface name used by the underlying operating system.";
    reference
      "RFC ZZZZ, Babel Information Model, Section 3.3.";
  }

  leaf enable {
    type boolean;
    default "true";
    description
      "If true, babel sends and receives messages on this interface. If false, babel messages received on this interface are ignored and none are sent.";
    reference
      "RFC ZZZZ, Babel Information Model, Section 3.3.";
  }

  leaf link-properties {
    type identityref {
      base link-property;
    }
    default "wired";
    description
      "Indicates the properties of the link. The value MUST be
one of those listed in the babel-supported-link-properties parameter. Valid enumeration values are identity-refs derived from properties identified in Babel Link Properties registry.

reference
"RFC ZZZZ, Babel Information Model, Section 3.3."

leaf metric-algorithm {
  type identityref {
    base metric-comp-algorithms;
  }
  default "k-out-of-j";
  description
    "Indicates the metric computation algorithm used on this interface. The value MUST be one of those listed in the babel-information-obj babel-metric-comp-algorithms parameter."
}

leaf mcast-hello-seqno {
  type uint16;
  config false;
  description
    "The current sequence number in use for multicast hellos sent on this interface."
  reference
    "RFC ZZZZ, Babel Information Model, Section 3.3."
}

leaf mcast-hello-interval {
  type uint16;
  config false;
  description
    "The current multicast hello interval in use for hellos sent on this interface."
  reference
    "RFC ZZZZ, Babel Information Model, Section 3.3."
}

leaf update-interval {
  type uint16;
  units centiseconds;
  config false;
  description
    "The current update interval in use for this interface. Units are centiseconds."
  reference

leaf hmac-enable {
  type boolean;
  description
    "Indicates whether the HMAC security mechanism is enabled (true) or disabled (false).";
  reference
    "RFC ZZZZ, Babel Information Model, Section 3.3."
}

leaf-list hmac-keys {
  type leafref {
    path "../../hmac/name";
  }
  description
    "List of references to the babel-hmac entries that apply to this interface. When an interface instance is created, all babel-hmac-key-sets instances with babel-hmac-default-apply 'true' will be included in this list.";
  reference
    "RFC ZZZZ, Babel Information Model, Section 3.3."
}

leaf hmac-algorithm {
  type identityref {
    base hmac-algorithms;
  }
  description
    "The name of the HMAC algorithm used on this interface. The value is one of the identities listed as part of babel-hmac-algorithms at a global level.";
  reference
    "RFC ZZZZ, Babel Information Model, Section 3.3."
}

leaf hmac-verify {
  type boolean;
  description
    "A Boolean flag indicating whether HMAC hashes in incoming Babel packets are required to be present and are verified. If this parameter is 'true', incoming packets are required to have a valid HMAC hash.";
  reference
    "RFC ZZZZ, Babel Information Model, Section 3.3."
}
leaf dtls-enable {
  type boolean;
  description "Indicates whether the DTLS security mechanism is enabled (true) or disabled (false).";
  reference "RFC ZZZZ, Babel Information Model, Section 3.3.";
}

leaf-list dtls-cert-prefer {
  type leafref { 
    path ".\..\..\dtls\certs\type"; 
  }
  ordered-by user;
  description "List of supported certificate types, in order of preference. The values MUST be among those listed in the babel-dtls-cert-types parameter. This list is used to populate the server_certificate_type extension in a Client Hello. Values that are present in at least one instance in the babel-dtls-certs object of a referenced babel-dtls instance and that have a non-empty babel-cert-private-key will be used to populate the client_certificate_type extension in a Client Hello.";
}
reference
    "RFC ZZZZ, Babel Information Model, Section 3.3.";
}

leaf packet-log-enable {
  type boolean;
  description
  "If true, logging of babel packets received on this interface is enabled; if false, babel packets are not logged.";
  reference
  "RFC ZZZZ, Babel Information Model, Section 3.3.";
}

leaf packet-log {
  type inet:uri;
  config false;
  description
  "A reference or url link to a file that contains a timestamped log of packets received and sent on babel-udp-port on this interface. The [libpcap] file format with .pcap file extension SHOULD be supported for packet log files. Logging is enabled / disabled by packet-log-enable.";
  reference
  "RFC ZZZZ, Babel Information Model, Section 3.3.";
}

container stats {
  config false;
  leaf sent-mcast-hello {
    type yt:counter32;
    description
    "A count of the number of multicast Hello packets sent on this interface.";
    reference
    "RFC ZZZZ, Babel Information Model, Section 3.4.";
  }

  leaf sent-mcast-update {
    type yt:counter32;
    description
    "A count of the number of multicast update packets sent on this interface.";
    reference
    "RFC ZZZZ, Babel Information Model, Section 3.4.";
  }
}
leaf received-packets {
  type yt:counter32;
  description
    "A count of the number of Babel packets received on
    this interface.";
  reference
    "RFC ZZZZ, Babel Information Model, Section 3.4.";
}

action reset {
  input {
    leaf reset-at {
      type yt:date-and-time;
      description
        "The time when the reset was issued.";
  }
  }
  output {
    leaf reset-finished-at {
      type yt:date-and-time;
      description
        "The time when the reset finished.";
  }
  }
  description
    "Statistics collection object for this interface.";
  reference
    "RFC ZZZZ, Babel Information Model, Section 3.3.";
}

list neighbor-objects {
  key "neighbor-address";
  config false;

  leaf neighbor-address {
    type inet:ip-address;
    description
      "IPv4 or v6 address the neighbor sends packets from.";
    reference
      "RFC ZZZZ, Babel Information Model, Section 3.5.";
  }

  leaf hello-mcast-history {
    type string;
    description
      "The multicast Hello history of whether or not the
      multicast Hello packets prior to babel-exp-mcast-
      hello-seqno were received, with a '1' for the most
recent Hello placed in the most significant bit and prior Hellos shifted right (with '0' bits placed between prior Hellos and most recent Hello for any not-received Hellos); represented as a string using utf-8 encoded hex digits where a '1' bit = Hello received and a '0' bit = Hello not received.";

reference
"RFC ZZZZ, Babel Information Model, Section 3.5.";

leaf hello-ucast-history {
  type string;
  description
  "The unicast Hello history of whether or not the unicast Hello packets prior to babel-exp-ucast-hello-seqno were received, with a '1' for the most recent Hello placed in the most significant bit and prior Hellos shifted right (with '0' bits placed between prior Hellos and most recent Hello for any not-received Hellos); represented as a string using utf-8 encoded hex digits where a '1' bit = Hello received and a '0' bit = Hello not received.";

reference
"RFC ZZZZ, Babel Information Model, Section 3.5.";
}

leaf txcost {
  type int32;
  default "0";
  description
  "Transmission cost value from the last IHU packet received from this neighbor, or maximum value (infinity) to indicates the IHU hold timer for this neighbor has expired description.";

reference
"RFC ZZZZ, Babel Information Model, Section 3.5.";
}

leaf exp-mcast-hello-seqno {
  type uint16;
  default "0";
  description
  "Expected multicast Hello sequence number of next Hello to be received from this neighbor; if multicast Hello packets are not expected, or processing of multicast packets is not enabled, this MUST be 0.";

reference
"RFC ZZZZ, Babel Information Model, Section 3.5.";
leaf exp-ucast-hello-seqno {
    type uint16;
    default "0";
    description
        "Expected unicast Hello sequence number of next Hello to be received from this neighbor; if unicast Hello packets are not expected, or processing of unicast packets is not enabled, this MUST be 0.";
    reference
        "RFC ZZZZ, Babel Information Model, Section 3.5.";
}

leaf ucast-hello-seqno {
    type uint16;
    description
        "Expected unicast Hello sequence number of next Hello to be received from this neighbor. If unicast Hello packets are not expected, or processing of unicast packets is not enabled, this MUST be 0.";
    reference
        "RFC ZZZZ, Babel Information Model, Section 3.5.";
}

leaf ucast-hello-interval {
    type uint16;
    units centiseconds;
    description
        "The current interval in use for unicast hellos sent to this neighbor. Units are centiseconds.";
    reference
        "RFC ZZZZ, Babel Information Model, Section 3.5.";
}

leaf rxcost {
    type int32;
    description
        "Reception cost calculated for this neighbor. This value is usually derived from the Hello history, which may be combined with other data, such as statistics maintained by the link layer. The rxcost is sent to a neighbor in each IHU.";
    reference
        "RFC ZZZZ, Babel Information Model, Section 3.5.";
}

leaf cost {
type int32;
description
"Link cost is computed from the values maintained in
the neighbor table. The statistics kept in the neighbor
table about the reception of Hellos, and the txcost
computed from received IHU packets."
reference
"RFC ZZZZ, Babel Information Model, Section 3.5.";
}

container stats {
  config false;
  leaf sent-ucast-hello {
    type yt:counter32;
    description
    "A count of the number of unicast Hello packets sent
to this neighbor.";
    reference
    "RFC ZZZZ, Babel Information Model, Section 3.6.";
  }

  leaf sent-ucast-update {
    type yt:counter32;
    description
    "A count of the number of unicast update packets sent
to this neighbor.";
    reference
    "RFC ZZZZ, Babel Information Model, Section 3.6.";
  }

  leaf sent-ihu {
    type yt:counter32;
    description
    "A count of the number of IHU packets sent to this
neighbor.";
    reference
    "RFC ZZZZ, Babel Information Model, Section 3.6.";
  }

  leaf received-hello {
    type yt:counter32;
    description
    "A count of the number of Hello packets received from
this neighbor.";
    reference
    "RFC ZZZZ, Babel Information Model, Section 3.6.";
  }
}
leaf received-update {
    type yt:counter32;
    description
        "A count of the number of update packets received from this neighbor.";
    reference
        "RFC ZZZZ, Babel Information Model, Section 3.6.";
}

leaf received-ihu {
    type yt:counter32;
    description
        "A count of the number of IHU packets received from this neighbor.";
    reference
        "RFC ZZZZ, Babel Information Model, Section 3.6.";
}

action reset {
    input {
        leaf reset-at {
            type yt:date-and-time;
            description
                "The time the reset was issued.";
        }
    }
    output {
        leaf reset-finished-at {
            type yt:date-and-time;
            description
                "The time when the reset operation finished.";
        }
    }
}

description
    "Statistics collection object for this neighbor.";
    reference
        "RFC ZZZZ, Babel Information Model, Section 3.6.";
}

description
    "A set of Babel Neighbor Object.";
    reference
        "RFC ZZZZ, Babel Information Model, Section 3.5.";

description
    "A set of Babel Interface objects.";
    reference
        "RFC ZZZZ, Babel Information Model, Section 3.3.";
list hmac {
    key "name";

    leaf name {
        type string;
        description "A string that uniquely identifies the hmac object."
    }

    leaf default-apply {
        type boolean;
        description "A Boolean flag indicating whether this babel-hmac instance is applied to all new interfaces, by default. If 'true', this instance is applied to new babel-interfaces instances at the time they are created, by including it in the babel-interface-hmac-keys list. If 'false', this instance is not applied to new babel-interfaces instances when they are created."
        reference "RFC ZZZZ, Babel Information Model, Section 3.8.";
    }

list keys {
    key "name";
    min-elements "1";

    leaf name {
        type string;
        mandatory "true";
        description "A unique name for this HMAC key that can be used to identify the key in this object instance, since the key value is not allowed to be read. This value can only be provided when this instance is created, and is not subsequently writable."
        reference "RFC ZZZZ, Babel Information Model, Section 3.9.";
    }

    leaf use-sign {
        type boolean;
        mandatory "true";
        description "Indicates whether this key value is used to sign sent Babel packets. Sent packets are signed using this key
leaf use-verify {
  type boolean;
  mandatory "true";
  description
    "Indicates whether this key value is used to verify incoming Babel packets. This key is used to verify incoming packets if the value is 'true'. If the value is 'false', no HMAC is computed from this key for comparing an incoming packet.";
  reference
    "RFC ZZZZ, Babel Information Model, Section 3.9.";
}

leaf value {
  type binary;
  mandatory "true";
  description
    "The value of the HMAC key. An implementation MUST NOT allow this parameter to be read. This can be done by always providing an empty string, or through permissions, or other means. This value MUST be provided when this instance is created, and is not subsequently writable.";
  reference
    "RFC ZZZZ, Babel Information Model, Section 3.9.";
}

action test {
  input {
    leaf test-string {
      type binary;
      mandatory "true";
      description
        "The test string on which this test has to be performed.";
    }
  }
  output {
    leaf resulting-hash {
      type binary;
      mandatory "true";
      description
        "The resulting HMAC hash value for the test string provided as input.";
    }
  }
}
"An operation that allows the HMAC key and hash algorithm to be tested to see if they produce an expected outcome. Input to this operation is a binary string. The implementation is expected to create a hash of this string using the babel-hmac-key-value and the babel-hmac-algorithm. The output of this operation is the resulting hash, as a binary string.");

reference
"RFC ZZZZ, Babel Information Model, Section 3.9.";
}
)

description
"A set of babel-hmac-keys-obj objects."
reference
"RFC ZZZZ, Babel Information Model, Section 3.8.";
}

description
"A babel-hmac-obj object. If this object is implemented, it provides access to parameters related to the HMAC security mechanism.");
reference
"RFC ZZZZ, Babel Information Model, Section 3.1.";
}

list dtls {
  key "name";

  leaf name {
    type string;
    description
    "TODO: This attribute does not exist in the model, but is needed for this model to work.";
  }

  leaf default-apply {
    type boolean;
    mandatory "true";
    description
    "A Boolean flag indicating whether this babel-dtls instance is applied to all new interfaces, by default. If 'true', this instance is applied to new babel-interfaces instances at the time they are created, by including it in the babel-interface-dtls-certs list. If 'false', this instance is not applied to new babel-interfaces instances when they are created.";
    reference
list certs {
  key "name";
  min-elements "1";

  leaf name {
    type string;
    description "A unique name that identifies the cert in the list.";
  }

  leaf value {
    type string;
    mandatory "true";
    description "The DTLS certificate in PEM format [RFC7468]. This value can only be provided when this instance is created, and is not subsequently writable.";
    reference "RFC ZZZZ, Babel Information Model, Section 3.11.";
  }

  leaf type {
    type identityref {
      base dtls-cert-types;
    } mandatory "true";
    description "The name of the certificate type of this object instance. The value MUST be the same as one of the enumerations listed in the babel-dtls-cert-types parameter. This value can only be provided when this instance is created, and is not subsequently writable.";
    reference "RFC ZZZZ, Babel Information Model, Section 3.11.";
  }

  leaf private-key {
    type binary;
    mandatory "true";
    description "The value of the private key. If this is non-empty, this certificate can be used by this implementation to provide a certificate during DTLS handshaking. An implementation MUST NOT allow this parameter to be read. This can be done by always providing an empty
  }
string, or through permissions, or other means. This value can only be provided when this instance is created, and is not subsequently writable.

reference
"RFC ZZZZ, Babel Information Model, Section 3.11.";

} action test {
  input {
    leaf test-string {
      type binary;
      mandatory "true";
      description
      "The test string on which this test has to be performed.";
    }
  }
  output {
    leaf resulting-hash {
      type binary;
      mandatory "true";
      description
      "The output of this operation is a binary string, and is the resulting hash computed using the certificate public key, and the SHA-256 hash algorithm.";
    }
  }
}

description
"A set of babel-dtls-keys-obj objects. This contains both certificates for this implementation to present for authentication, and to accept from others. Certificates with a non-empty babel-cert-private-key can be presented by this implementation for authentication."

reference
"RFC ZZZZ, Babel Information Model, Section 3.10.";

description
"A babel-dtls-obj object. If this object is implemented, it provides access to parameters related to the DTLS security mechanism."

reference
"RFC ZZZZ, Babel Information Model, Section 3.1";

description
"Babel Information Objects.";
augment "/rt:routing/rt:ribs/rt:rib/rt:routes/rt:route" {
  when "derived-from(rt:source-protocol, 'babel')" {
    description
    "Augmentation is valid for a routes whose source protocol is Babel.";
    description
    "Babel specific route attributes."
    uses routes;
  }
}

<CODE ENDS>

2.4. Example

The following snippet demonstrates how this data module can be configured. In this example, the routing protocol being configured is Babel, and statistics gathering is enabled.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<config xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <control-plane-protocols>
      <control-plane-protocol>
        <name>name:babel</name>
        <babel xmlns="urn:ietf:params:xml:ns:yang:ietf-babel">
          <enable>true</enable>
          <stats-enable>true</stats-enable>
        </babel>
      </control-plane-protocol>
    </control-plane-protocols>
  </routing>
</config>
```
3. IANA Considerations

This document registers one URIs and one YANG module.

3.1. URI Registrations


3.2. YANG Module Name Registration

This document registers one YANG module in the YANG Module Names registry YANG [RFC6020].

Name: ietf-babel
prefix: babel
reference: RFC XXXX

4. Security Considerations

The YANG module specified in this document defines a schema for data that is designed to be accessed via network management protocol such as NETCONF [RFC6241] or RESTCONF [RFC8040]. The lowest NETCONF layer is the secure transport layer and the mandatory-to-implement secure transport is 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 users to a pre-configured subset of all available NETCONF protocol operations and content.

There are a number of data nodes defined in the YANG module which are writable/created/deleted (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:

5. Acknowledgements

6. References
6.1. Normative References

[I-D.ietf-babel-rfc6126bis]


6.2. Informative References

[I-D.ietf-babel-information-model]

Appendix A.  An Appendix

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