Network Working Group
Internet-Draft
Intended status: Standards Track
Expires: 6 July 2024

B. Wu
D. Dhody
Huawei Technologies
V.P. Beeram
Juniper Networks
T. Saad
Cisco Systems
S. Peng
ZTE Corporation
3 January 2024

A YANG Data Model for Network Resource Partitions (NRPs)

draft-wdbsp-teas-nrp-yang-04

Abstract

A Network Resource Partition (NRP) is a collection of resources identified in ~~the~~ an underlay network to support services (like IETF Network Slices) that need logical network structures ~~with~~ to fulfil a set of ~~required~~ Service Level Objectives (SLOs) and Service Level Expectations (SLEs) ~~characteristics to be created~~. This document defines a YANG data model for Network Resource Partitions (NRPs). ~~The model can be used, in particular, for the realization of the IETF Network Slice Services in IP/MPLS networks.~~

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on 6 July 2024.

Commenté [BMI1]: Two models are defined in the document

Commenté [BMI2]: I would align the wording here with what is indicated in the 1st sentence of the introduction.

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1. Introduction

As specified in Section 7.4 of [I-D.ietf-teas-ietf-network-slices], a~~n~~ Network Resource Partition (NRP) is a collection of resources identified in ~~the~~ an underlay network to support the IETF Network Slice service (or any other service that needs logical network structures with required characteristics to be created). [I-D.ietf-teas-ietf-network-slices] defines a framework for IETF Network Slice Services, which provide connectivity coupled with network resources commitment between a number of Service Demarcation Points (SDPs) over a shared network infrastructure. The IETF Network Slice service is expressed in terms of one or more connectivity constructs, which can be of a connection type (point-to-point (P2P), point-to-multipoint (P2MP), or any-to-any (A2A)) and any combination of these types. One or more connectivity constructs from one or more IETF Network Slices are mapped to an NRP for ensuring Service Level Objective (SLO) and Service Level Expectation (SLE) and network scalability.

This document defines a YANG module ~~of fro~~ NRPs. An IETF Network Slice Controller (NSC) can use it to manage NRP instances in order to implement Network Slice Services.

An NRP Policy [I-D.ietf-teas-ns-ip-mpls] is a policy construct that enables instantiation of mechanisms in support of service specific control and data planes behaviors on ~~select~~ a subset of topological elements

Commenté [BMI3]: I don't remember this was from the framework.

Commenté [BMI4]: Consider moving this text up.

Commenté [BMI5]: Two models are defined in this doc.

Commenté [BMI6]: I'm afraid this makes this I-D normative.

associated with the NRP. Section 3.1 ~~NRP.Section 3.1~~ describes the detailed definition
of NRP policy in NRP instantiation.

According to the YANG model classification of [RFC8309], the NRP~~NRPs~~ model is a network configuration model, also referred to as "network model" as per [RFC8969].

NMDA.A

2. Terminology

The following terms are defined in [RFC6241] and are used in this specification:

* configuration data

* state data

The following terms are defined in [RFC7950] and are used in this specification:

* augment

* data model

* data node

The terminology for describing YANG data models is found in [RFC7950].

The tree diagram used in this document follows the notation defined in [RFC8340].

3. NRP~~s~~ Data Model

There are multiple modes of NRPs operations ~~to be supported as follows~~:

* NRPs instantiation: Depending on the ~~slice~~ Slice ~~service~~ Service types and also
  network status, there can be at least two ~~types of~~ approaches for implementing NRPs. One method
  is to create an NRP instance before the network controller
  processes ~~the~~ a IETF Network Slice ~~service~~ Service request. Another one is
  that the network controller may ~~start~~ decide creating an NRP instance
  while ~~configuring~~ implementing the IETF Network Slice ~~service~~ Service request.

* NRPs modification: When the capacity of an existing NPR link is close to a maximum capacity, the bandwidth of the link could be increased.
  And when an NRP links or nodes resources are insufficient, new NRP links and nodes could be added.

Commenté [BMI7]: Do we need to add a similar mention for the "device model" in the doc?

Commenté [BMI8]: Add a sentence to indicate that the modules are NMDA compliant

Commenté [BMI9]: Please use consistent terms vs. framework.

Commenté [BMI10]: That is?

Commenté [BMI11]: Also, operator guidance/rules/policies.

Commenté [BMI12]: There are many requests

Commenté [BMI13]: This is not specific to link resources.

* NRPs Deletion: If ~~the~~ an NSC determines that no ~~slice~~ Slice ~~service~~ Service is using an NRP, the NSC can delete the NRP instance.

* NRPs Monitoring: The NSC can use the NRPs model to track and monitor NRP~~'s~~s resources status and usage.

3.1. NRPs Instantiation

An NRP policy specifies the rules for determining the topology associated with the NRP and ~~dictates~~ triggers how an NRP can be realized in IP/MPLS networks using one of three partition modes. The NRP policy dictates if the partitioning of the shared network resources can be achieved in (a) ~~just~~ the data plane only, or in (b) ~~just~~ the control plane only, or in (c) both the control and data planes.

The NRP policy modes (a) and (c) require the forwarding engine on each NRP capable node to identify the traffic belonging to a specific NRP and to apply the corresponding Per-Hop Behavior (PHB) or forwarding mechanism that determines the forwarding treatment of the packets belonging to the NRP. When catering to IETF Network Slices, this NRP identification is referred to as the NRP selector and may comprises of traffic streams from one or more connectivity constructs (belonging to one or more IETF network slices) mapped to a specific NRP. The NRP policy modes (b) and (c) require the distributed/ centralized resource reservation management.

'nrp-policy' is defined to enable NRP Stateful Traffic Engineering (NRP-TE) [I-D.ietf-teas-nrp-scalability][I-D.ietf-teas-ns-ip-mpls] and/or NRP IGP forwarding in IP/MPLS networks.

The high-level model structure of NRP policy ~~defined by~~ as modeled in this document is ~~as~~ shown in Figure 1:

```
module: ietf-nrp
  augment /nw:networks:
    +--rw nrp-policies
       +--rw nrp-policy* [name]
          +--rw name                    string
          +--rw nrp-id?                 uint32
          +--rw mode?                   identityref
          +--rw resource-reservation
          |     ...
          +--rw selector
          |     ...
          +--rw phb-profile?            string
          +--rw topology
                ...
```

Figure 1: NRP Policy subtree high-level structure

The 'networks' container from the 'ietf-network' module [RFC8345] provides a placeholder for an inventory of nodes in the network. This container is augmented to ~~carry~~ include a set of NRP policies.

Commenté [BMI14]: Another example, is when merging NRPs.

Commenté [BMI15]: Indicates? Infers?

a mis en forme : Surlignage

The 'nrp-policies' container ~~carries~~ includes a list of NRP policies. Each
'nrp-policy' entry is identified by a name and holds the set of attributes needed to instantiate an NRP. Each entry also ~~carries~~ has an
'nrp-id' leaf which uniquely identifies the NRP created by the enforcement of this policy.

The description of the 'nrp-policies' data nodes are as follows, and the other key elements of each 'nrp-policy' entry are discussed in the following sub-sections.

* 'nrp-id': Is an identifier that is used to uniquely identify an NRP instance within an NSC network scope.

* 'mode': Refers to control plane resource partition, data plane resource partition, or a combination of both types.

3.1.1. Resource Reservation

The 'resource-reservation' container specifies the bandwidth resource allocated to an NRP instance, or can be overridden by the configuration of the link specific 'resource-reservation' nodes of 'nrp-topology'.

```
+--rw resource-reservation
  +--rw (max-bw-type)?
     +--:(bw-value)
     |  +--rw maximum-bandwidth?           uint64
     +--:(bw-percentage)
        +--rw maximum-bandwidth-percent?   rt-types:percentage
```

Figure 2: NRP Resource Reservation YANG subtree structure

3.1.2. NRP Selector

NRP selector defines the data plane encapsulation types and values that are used to identify NRP-specific network resources.

[I-D.ietf-teas-nrp-scalability] discusses several candidate NRP selector encapsulation schemes, including IP, MPLS, ~~or~~ and SRv6, for example, the IPv6 Hop-by-Hop extension header defined in [I-D.ietf-6man-enhanced-vpn-vtn-id], or the SRv6 SID defined in [I-D.ietf-spring-sr-for-enhanced-vpn]. Since the MPLS encapsulation schemes are still under discussion, the model only provides a place holder for future updates. Additionally, the use of NRP-specific IP addresses to identify NRP resources, or the use of specific ACLs, are optional NRP selector mechanisms.

```
+--rw selector
|  +--rw ipv4
|  |  +--rw destination-prefix*   inet:ipv4-prefix
|  +--rw ipv6
|  |  +--rw (selector-type)?
|  |     +--:(dedicated)
|  |     |  +--rw ipv6-hbh-eh?          uint32
|  |     +--:(srv6-sid-derived)
|  |     |  +--rw srv6-sid*             inet:ipv6-prefix
```

Commenté [BMI16]: Should this be used as a key as well in the model?

Commenté [BMI17]: Redundant with the previous sentence.

Why both a name and an id are needed to identify an NRP policy?

Commenté [BMI18]: Do we need to define BW per direction? Or this assumes symmetric reservation?

a mis en forme : Surlignage

```
|  |     +--:(ipv6-destination-derived)
|  |        +--rw destination-prefix*   inet:ipv6-prefix
|  +--rw mpls
|  +--rw acl-ref*   nrp-acl-ref
```

Figure 3: NRP Selector YANG subtree structure

3.1.3. Per-Hop Behavior (PHB)

PHB and NRP selector are combined mechanisms. PHB is used to specify the forwarding treatment of packets belonging to a specific NRP selector, such as bandwidth control, congestion control (e.g., Section 3.4 of [RFC3644]). The exact definition of PHB is locally defined by the device or controller managing the NRPs. The 'phb-profile' leaf carries a name of a PHB profile available on the topological element where the policy is being enforced. Some examples of "phb-probile" may be standard PHBs, such as "Assured Forwarding (AF)", "Expedited Forwarding (EF)", or a customized local policies, such as "High", "Low", "Standard".

```
+--rw phb-profile?            string
```

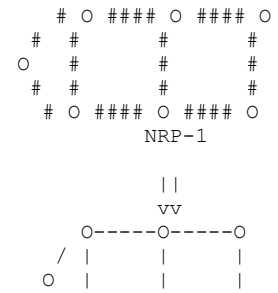
Figure 4: PHB YANG subtree structure

3.1.4. NRP Topology

'nrp-topology' defines a ~~dedicated~~ customized ~~NRP~~ topology used for an NRP.

When an NRP support IGP ~~forwarding~~routing, the topology of the NRP must be congruent with an IGP instance. The ~~.The~~ topology used for IGP route computation and forwarding can be derived using Multi-Topology Routing (MTR) ~~or Flex-algo. Multi-Topology Routing (MTR) is defined in~~ [RFC4915]~~,~~ [RFC5120]~~, and~~ [I-D.ietf-lsr-isis-sr-vtn-mt] or Flex-algo ~~is defined in~~ [RFC9350].

Figure 5 shows an example of NRP-1 enabling "igp-congruent", which indicates that this NRP instance uses the same IGP topology with the specified 'multi-topology-id' or 'algo-id'. As ~~illustrated~~shown in Figure 5, NRP-1 has different link resource attributes from those of the IGP, but shares the same ~~the~~ nodes and termination ~~point~~ points (TPs) of the IGP topology.



a mis en forme : Surlignage

Commenté [BMI19]: Do we need to support a mechanism to expose the list of supported profiles in a network?

If we have that supported, then a leafref would be appropriate here instead of string.

Commenté [BMI20]: Add a pointer

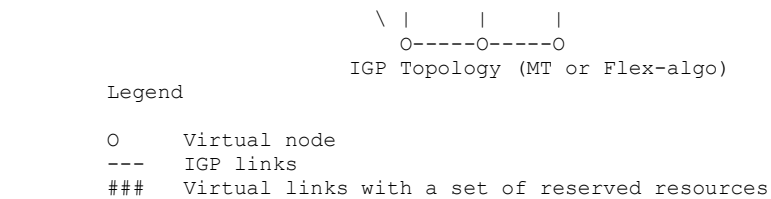


Figure 5: IGP Congruency Example

The 'selection' container consists of a list of select subset of links of an underlay topology or a pre-built topology.

The 'filter' container consists of a list of filters where each entry references a topology filter [I-D.bestbar-teas-yang-topology-filter]. The topological elements that satisfy the membership criteria ~~can~~may ~~optionally~~ override the default "resource-reservation" and "nrp-selector" specific leafs.

Commenté [BMI21]: I would avoid depending on another yet individual draft.

Commenté [BMI22]: You may provide an example to illustrate the intended behavior

```
+--rw topology
   +--rw igp-congruent!
   |  +--rw multi-topology-id?   uint32
   |  +--rw algo-id?             uint32
   |  +--rw sharing?             boolean
   +--rw (topology-type)?
      +--:(selection)
      |  +--rw select
      |     +--rw topology-group* [group-id]
      |        +--rw group-id                string
      |        +--rw base-topology-ref
      |        |     ...
      |        +--rw links* [link-ref]
      |        |     ...
      |        +--rw resource-reservation
      |        |     ...
      |        +--rw link-partition-type?
      |        |       identityref
      |        +--rw phb-profile?            string
      +--:(filter)
         +--rw filters
            +--rw filter* [filter-ref]
               +--rw filter-ref
               |       nrp-topo-filter-ref
               +--rw resource-reservation
               |     ...
               +--rw selector
               |     ...
               +--rw phb-profile?            string
```

Figure 6: NRP Topology YANG subtree structure

3.2. NRPs ~~M~~monitoring

The NRP~~s~~ model can be used to ~~track and~~ monitor the operational status

and resource usage of NRPs.

```
  augment /nw:networks/nw:network/nw:network-types:
    +--rw nrp!
  augment /nw:networks/nw:network/nw:node:
    +--ro nrp
       +--ro nrp-aware-dp-id
              ...
  augment /nw:networks/nw:network/nt:link:
    +--ro nrp
       +--ro link-partition-type?   identityref
       +--ro bandwidth-value?       uint64
       +--ro nrp-aware-dp-id
       |     ...
       +--ro statistics
              ...
  augment /nw:networks/nw:network/nw:node:
    +--ro nrps* [nrp-id]
       +--ro nrp-id    uint32
       +--ro nrp
              ...
  augment /nw:networks/nw:network/nt:link:
    +--ro nrps* [nrp-id]
       +--ro nrp-id                 uint32
       +--ro link-partition-type?   identityref
       +--ro bandwidth-value?       uint64
       +--ro nrp-aware-dp-id
              ...
```

Figure 7: NRPs Monitoring YANG subtree structure

3.3. NRPs Device Model Description

The device-specific NRPs model is defined in module 'ietf-nrp-device' as shown in Figure 10, which augments NRPs YANG data model in Figure 9 and adds interface attributes, including resource reservation, NRP selector, and PHB profile, that are specific to an NRP device.

Figure ~~below~~ 8 shows the tree diagram of the device NRPs YANG model defined in modules 'ietf-nrp-device.yang'.

```
module: ietf-nrp-device
  augment /nw:networks/nrp:nrp-policies/nrp:nrp-policy:
    +--rw interfaces
       +--rw interface* [interface]
          +--rw interface               if:interface-ref
          +--rw resource-reservation
          |  +--rw (max-bw-type)?
          |     +--:(bw-value)
          |     |     ...
          |     +--:(bw-percentage)
          |           ...
          +--rw selector
          |  +--rw ipv4
          |  |  +--rw destination-prefix*   inet:ipv4-prefix
          |  +--rw ipv6
```

Commenté [BMI23]: This is not a device model as it relies on a network model.

Commenté [BMI24]: ??

Commenté [BMI25]: To be defined

```
|  |  +--rw (selector-type)?
|  |        ...
|  +--rw mpls
|  |  +--rw (selector-type)?
|  |        ...
|  +--rw acl-ref*   nrp-acl-ref
+--rw phb-profile?            string
```

Figure 8: NRPs Device YANG subtree high-level structure

4. NRPs ~~Yang~~ YANG Module

The 'ietf-nrp' module uses types defined in [RFC8345], [RFC8294],[RFC8776], [RFC6991], [RFC8519], [I-D.ietf-spring-srv6-yang], and [I-D.bestbar-teas-yang-topology-filter].

```
<CODE BEGINS> file "ietf-nrp@2024-01-03.yang"
module ietf-nrp {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-nrp";
  prefix nrp;

  import ietf-network {
    prefix nw;
    reference
      "RFC 8345: A YANG Data Model for Network Topologies, Section X";
  }
  import ietf-network-topology {
    prefix nt;
    reference
      "RFC 8345: A YANG Data Model for Network Topologies, Section X
";
  }

  import ietf-routing-types {
    prefix rt-types;
    reference
      "RFC 8294: Common YANG Data Types for the Routing Area";
  }
  import ietf-te-types {
    prefix te-types;
    reference
      "RFC 8776: Traffic Engineering Common YANG Types";
  }
  import ietf-te-packet-types {
    prefix te-packet-types;
    reference
      "RFC 8776: Traffic Engineering Common YANG Types";
  }
  import ietf-inet-types {
    prefix inet;
    reference
      "RFC 6991: Common YANG Data Types";
  }
  import ietf-access-control-list {
    prefix acl;
    reference
```

```
      "RFC 8519: YANG Data Model for Network Access Control Lists
       (ACLs)";
  }
  import ietf-srv6-types {
    prefix srv6-types;
    reference
      "draft-ietf-spring-srv6-yang: YANG Data Model for SRv6 Base
       and Static";
  }
  import ietf-topology-filter {
    prefix topo-filt;
    reference
      "draft-bestbar-teas-yang-topology-filter: YANG Data Model
       for Topology Filter";
  }

  organization
    "IETF Traffic Engineering Architecture and Signaling (TEAS)
     Working Group";
  contact
    "WG Web:   <https://datatracker.ietf.org/wg/teas/>
     WG List:  <mailto:teas@ietf.org>

     Editor:   Bo Wu
               <mailto:lana.wubo@huawei.com>



     Editor:   Dhruv Dhody
               <mailto:dhruv.ietf@gmail.com>

     Editor:   Vishnu Pavan Beeram
               <mailto:vbeeram@juniper.net>

     Editor:   Tarek Saad
               <mailto:tsaad.net@gmail.com>

     Editor:   Shaofu Peng
               <mailto:peng.shaofu@zte.com.cn>";
  description
    "This YANG module defines a data model for
     Network Resource Partitions (NRPs) managmentmanagement.

     Copyright (c) 2024 IETF Trust and the persons identified as
     authors of the code.  All rights reserved.

     Redistribution and use in source and binary forms, with or
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     Relating to IETF Documents
        (https://trustee.ietf.org/license-info).

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

  revision 2024-01-03 {
```

a mis en forme : Surlignage

```
  description
    "Initial revision.";
  reference
    "RFC XXXX: A YANG Data Model for Network Resource
     Partitions (NRPs)";
}

/*
 * I D E N T I T I E S
 */

identity nrp-partition-mode {
  description
    "Base identity for NRP partition type.";
}

identity nrp-control-plane-partition {
  base nrp-partition-mode;
  description
    "Identity for NRP control plane partition.";
}

identity nrp-data-plane-partition {
  base nrp-partition-mode;
  description
    "Identity for NRP data plane partition.";
}

identity nrp-hybrid-plane-partition {
  base nrp-partition-mode;
  description
    "Identity for bBoth control and data planes partitions of NRP.";
}

identity nrp-link-partition-type {
  description
    "Base identity for NRP interface partition type.";
}

identity virtual-sub-interface-partition {
  base nrp-link-partition-type;
  description
    "Identity for NRP virtual interface or sub-interface partition,
     e.g., FlexE.";
}

identity queue-partition {
  base nrp-link-partition-type;
  description
    "Identity for NRP queue partition type.";
}

/*
 * T Y P E D E F S
 */

typedef nrp-acl-ref {
  type leafref {
```

Commenté [BMI26]: No need to repeat "identity" as this already defined as an identity.

```
      path "/acl:acls/acl:acl/acl:name";
    }
    description
      "This type is uUsed to reference an ACL.";
  }

  typedef nrp-topo-filter-ref {
    type leafref {
      path "/nw:networks/topo-filt:topology-filters/"
         + "topo-filt:topology-filter/topo-filt:name";
    }
    description
      "This type is used to reference a Topology Filter.";
    reference
      "draft-bestbar-teas-yang-topology-filter: YANG Data Model
       for Topology Filter";
  }

  /*
   * Grouping - NRP Resource Reservation
   */

  grouping nrp-resource-reservation {
    description
      "Grouping for NRP resource reservation.";
    container resource-reservation {
      description
        "Container for NRP resource reservation.";
      choice max-bw-type {
        description
          "Choice of maximum bandwidth specification.";
        case bw-value {
          leaf maximum-bandwidth {
            type uint64;
            units "bits/second";
            description
              "The maximum bandwidth allocated to an NRP
               - specified as absolute value.";
          }
        }
        case bw-percentage {
          leaf maximum-bandwidth-percent {
            type rt-types:percentage;
            description
              "The maximum bandwidth allocated to an NRP
               - specified as percentage of link
               capacity.";
          }
        }
      }
    }
  }

  /*
   * Grouping - NRP Selector Configuration
   */

  grouping nrp-selector-config {
```

a mis en forme : Surlignage

```
      description
        "Grouping for NRP selector configuration.";
      container selector {
        description
          "Container for NRP selector.";
        container ipv4 {
          description
            "Container for IPv4 NRP selector.";
          leaf-list destination-prefix {
            type inet:ipv4-prefix;
            description
              "Any prefix from the specified set of IPv4
               destination prefixes can be the selector.";
          }
        }
        container ipv6 {
          description
            "Container for IPv6 NRP selector.";
          choice selector-type {
            description
              "Choices for IPv6 selector type.";
            case dedicated {
              leaf ipv6-hbh-eh {
                type uint32;
                description
                  "The selector value carried in Hop-by-Hop
                   Option of IPv6 extension header.";
                reference
                  "draft-ietf-6man-enhanced-vpn-vtn-id: Carrying Virtual
                   Transport Network (VTN) Information in IPv6 Extension
                   Header";
              }
            }
            case srv6-sid-derived {
              leaf-list srv6-sid {
                type srv6-types:srv6-sid;
                description
                  "Any SID from the specified set of SRv6 SID can
                   be the selector.";
                reference
                  "draft-ietf-spring-sr-for-enhanced-vpn: Segment
                   Routing based Virtual Transport Network (VTN) for
                   Enhanced VPN";
              }
            }
            case ipv6-destination-derived {
              leaf-list destination-prefix {
                type inet:ipv6-prefix;
                description
                  "Any prefix from the specified set of IPv6
                   destination prefixes can be the selector.";
              }
            }
          }
        }
        container mpls {
          description
            "Container for MPLS NRP selector. This is a placeholder
```

Commenté [BMI27]: Do we exclude that a combination can be used a selector?

```
              for future updates based on the MPLS solutions.";
          }
          leaf-list acl-ref {
            type nrp-acl-ref;
            description
              "Selection is done based on the specified list of ACLs.";
            reference
              "RFC 8519: YANG Data Model for Network Access Control Lists
               (ACLs)";
          }
        }
      }

      /*
       * Grouping - NRP QoS PHB profile
       */

      grouping nrp-qos-phb-profile {
        description
          "Grouping for NRP QoS PHB profile.";
        leaf phb-profile {
          type string;
          description
            "PHB profile identifier, specifying the forwarding treatment
             of packets belonging to a specific NRP selector, such as
             bandwidth control, congestion control
             (e.g., Section 3.4 of [RFC3644]).  The PHB may be standard
PHB,
             such as Assured Forwarding (AF), Expedited Forwarding (EF),
             or a customized local policy, such as 'High', 'Low',
             'Standard'.";
        }
      }

      /*
       * Grouping - NRP IGP congruent
       */

      grouping nrp-igp-congruent {
        description
          "Grouping for NRP IGP congruent attributes.";
        container igp-congruent {
          presence "Indicates NRP IGP congruency.";
          description
            "The presence of the container node describes NRP IGP
             congruent, which indicates that the NRP instance uses the
same
             IGP topology with the specified 'multi-topology-id'
             and 'algo-id'. That is, the nodes and termination point of
the
             NRP topology and the IGP topology are the same, while the
link
             attributes of the NRP are different from those of the IGP.";
          leaf multi-topology-id {
            type uint32;
            description
              "Indicates the MT-id of the NRP IGP instance.";
            reference
```

```
            "RFC 5120:  M-ISIS: Multi Topology (MT) Routing in
             Intermediate System to Intermediate Systems (IS-ISs)
             RFC 4915:  Multi-Topology (MT) Routing in OSPF";
          }
          leaf algo-id {
            type uint32;
            description
              "Indicates the algo-id of the NRP IGP instance.";
            reference
              "RFC 9350: IGP Flexible Algorithm";
          }
          leaf sharing {
            type boolean;
            default "true";
            description
              "'true' if the ~~the~~ NRP IGP instance can be shared with
               other NRPs;
               'false' if the ~~the~~ NRP IGP instance is dedicated
               to this NRP.";
          }
        }
      }

      /*
       * Grouping - NRP Topology Filter
       */

      grouping nrp-topology-filter {
        description
          "Grouping for NRP filter topology.";
        container filters {
          description
            "Container for filters.";
          list filter {
            key "filter-ref";
            description
              "List of filters.";
            leaf filter-ref {
              type nrp-topo-filter-ref;
              description
                "Reference to a specific topology filter from the
                 list of global topology filters.";
            }
            uses nrp-resource-reservation;
            uses nrp-selector-config;
            uses nrp-qos-phb-profile;
          }
        }
      }

      /*
       * Grouping - NRP Select Topology
       */

      grouping nrp-select-topology {
        description
          "NRP topology specified by selection.";
        container select {
```

Commenté [BMI28]: Double check if a default is needed here given that this is a reusable grouping. Please check 8407.

a mis en forme : Surlignage

```
      description
        "The container of NRP select topology.";
      list topology-group {
        key "group-id";
        description
          "List of groups for NRP topology elements (node or links)
           that share common attributes.";
        leaf group-id {
          type string;
          description
            "The NRP topology group identifier.";
        }
        container base-topology-ref {
          description
            "Container for the base topology reference.";
          uses nw:network-ref;
        }
        list links link {
          key "link-ref";
          description
            "A list of links with common attributes";
          leaf link-ref {
            type leafref {
              path
                "/nw:networks/nw:network[nw:network-id=current()"
              + "/../../base-topology-ref/network-ref]"
              + "/nt:link/nt:link-id";
            }
            description
              "A reference to a link in the base topology.";
          }
        }
        uses nrp-resource-reservation;
        leaf link-partition-type {
          type identityref {
            base nrp-link-partition-type;
          }
          description
            "Indicates the resource reservation type of an NRP link.";
        }
        uses nrp-qos-phb-profile;
      }
    }
  }

  /*
   * Grouping - NRP Topology
   */

  grouping nrp-topology {
    description
      "Grouping for NRP topology.";
    container topology {
      description
        "Container for NRP topology.";
      uses nrp-igp-congruent;
      choice topology-type {
        description
```

Commenté [BMI29]: List name should be singular. Please refer to 8407bis

Commenté [BMI30]: Why not reusing the "grouping link-ref" from RFC8345?

```
        "Choice of NRP topology type.";
      case selection {
        uses nrp-select-topology;
      }
      case filter {
        uses nrp-topology-filter;
      }
    }
  }
}

/*
 * Grouping - NRP Policy
 */

grouping nrp-pol {
  description
    "Grouping for NRP policies.";
  container nrp-policies {
    description
      "Container for nrp policies.";
    list nrp-policy {
      key "name";
      unique "nrp-id";
      description
        "List of NRP policies.";
      leaf name {
        type string;
        description
          "A string that uniquely identifies the NRP policy.";
      }
      leaf nrp-id {
        type uint32;
        description
          "A 32-bit ID that uniquely identifies the NRP
           created by the enforcement of this NRP policy.";
      }
      leaf mode {
        type identityref {
          base nrp-partition-mode;
        }
        default "nrp-hybrid-plane-partition";
        description
          "Indicates the resource partition mode of the NRP, such as
           control plane partition, data plane partition,
           or hybrid partition.";
      }
      uses nrp-resource-reservation;
      uses nrp-selector-config;
      uses nrp-qos-phb-profile;
      uses nrp-topology;
    }
  }
}

/*
 * Grouping - NRP Selector State
 */
```

```
grouping nrp-selector-state {
  description
    "The grouping of NRP selector.";
  container selector {
    config false;
    description
      "The container of NRP selector.";
    leaf srv6 {
      type srv6-types:srv6-sid;
      description
        "Indicates the SRv6 SID value as the NRP selector.";
    }
  }
}

/*
 * Grouping - NRP node attributes
 */

grouping nrp-node-attributes {
  description
    "NRP node scope attributes.";
  container nrp {
    config false;
    description
      "Containing NRP attributes.";
    uses nrp-selector-state;
  }
}

/*
 * Grouping - NRP Link Attributes
 */

grouping nrp-link-attributes {
  description
    "NRP link scope attributes.";
  leaf link-partition-type {
    type identityref {
      base nrp-link-partition-type;
    }
    config false;
    description
      "Indicates the resource partition type of an NRP link.";
  }
  leaf bandwidth-value {
    type uint64;
    units "bits/second";



    config false;
    description
      "Bandwidth allocation for the NRP as absolute value.";
  }
  uses nrp-selector-state;
}
```

Commenté [BMI31]: May restrict the usability of the grouping

Commenté [BMI32]: Idem as above.

Commenté [BMI33]: Idem as above.

```
/*
 * Grouping - NRP Bandwidth Metrics
 */

grouping nrp-bandwidth-metrics {
  description
    "Grouping for NRP bandwidth metrics.";
  leaf one-way-available-bandwidth {
    type uint64;
    units "bits/second";
    description
      "Available bandwidth that is defined to be NRP link
       bandwidth minus bandwidth utilization.."; .";
  }
  leaf one-way-utilized-bandwidth {
    type uint64;
    units "bits/second";
    description
      "Bandwidth utilization that represents the actual
       utilization of the link (i.e., as measured in the router).";
  }
}

// nrp-link-statistics

grouping nrp-statistics-per-link {
  description
    "Statistics attributes per NRP link.";
  container statistics {
    config false;
    description
      "Statistics for NRP link.";
    leaf admin-status {
      type te-types:te-admin-status;
      description
        "The administrative state of the link.";
    }
    leaf oper-status {
      type te-types:te-oper-status;
      description
        "The current operational state of the link.";
    }
    uses nrp-bandwidth-metrics;
    uses te-packet-types:one-way-performance-metrics-packet;
  }
}

// nrp-network-type

grouping nrp-network-type {
  description
    "Identifies the network type to be NRP.";
  container nrp {
    presence "Indicates NRP network topology.";
    description
      "The presence of the container node indicates NRP network.";
  }
```

Commenté [BMI34]: These do not display timestamps to track changes.

So vpn-common

```
}

/*
 * Augment - Network Resource Partition Policies.
 */

augment "/nw:networks" {
  description
    "Augment networks with NRP policies.";
  uses nrp-pol;
}

/*
 * Augment - NRP type.
 */

augment "/nw:networks/nw:network/nw:network-types" {
  description
    "Indicates the network type of NRP";
  uses nrp-network-type;
}

/*
 * Augment - NRP node operational status.
 */

augment "/nw:networks/nw:network/nw:node" {
  when '../nw:network-types/nrp:nrp' {
    description
      "Augment only for NRP network topology.";
  }
  description
    "Augments node configuration and state.";
  uses nrp-node-attributes;
}

/*
 * Augment - NRP link operational status.
 */

augment "/nw:networks/nw:network/nt:link" {
  when '../nw:network-types/nrp:nrp' {
    description
      "Augments only for NRP network topology.";
  }
  description
    "Augment link configuration and state.";
  container nrp {
    config false;
    description
      "Containing NRP attributes.";
    uses nrp-link-attributes;
    uses nrp-statistics-per-link;
  }
}

/*
 * Augment - Native topology with NRPs node operational status.
```

```
     */

    augment "/nw:networks/nw:network/nw:node" {
      description
        "Augments node with NRPs aware attributes.";
      list nrps nrp {
        key "nrp-id";
        config false;
        description
          "List of NRPs.";
        leaf nrp-id {
          type uint32;
          description
            "NRP identifier.";
        }
        uses nrp-node-attributes;
      }
    }

    /*
     * Augment - Native topology with NRPs link operational status.
     */

    augment "/nw:networks/nw:network/nt:link" {
      description
        "Augment link with NRPs aware attributes.";
      list nrps {
        key "nrp-id";
        config false;
        description
          "List of NRPs.";
        leaf nrp-id {
          type uint32;
          description
            "NRP identifier";
        }
        uses nrp-link-attributes;
      }
    }
  }
  <CODE ENDS>
```

Figure 9: NRPs data model YANG module

5. NRPs Device YANG Mmodule

The device NRPs YANG module ('ietf-nrp-device') models augments the NRPs YANG module ('ietf-nrp') and adds the attributes of NRP interfaces that are local to an NRP device.

The device NRPs YANG module imports the following module(s): ietf-interfaces defined in [RFC8343], ietf-network defined in [RFC8345], and grouping defined in this document.

```
<CODE BEGINS> file "ietf-nrp-device@2024-01-03.yang"
module ietf-nrp-device {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-nrp-device";
```

Commenté [BMI35]: List name should be singular. Please refer to 8407bis

Commenté [BMI36]: Nodes may not be NRP-compliant. Should a feature be defined here?

Commenté [BMI37]: List name should be singular. Please refer to 8407bis

Commenté [BMI38]: I'm not sure this is the right root to make the augment.

```
      prefix nrp-dev;

      /* Import IETF Network module */

      import ietf-network {
        prefix nw;
        reference
          "RFC 8345: RFC 8345: A YANG Data Model for Network Topologies,
    Section X";
      }

      /* Import IETF interface module */

      import ietf-interfaces {
        prefix if;
        reference
          "RFC_8343: A YANG Data Model for Interface Management";
      }

      /* Import NRPs module */

      import ietf-nrp {
        prefix nrp;
        reference
          "RFC_XXXX: A YANG Data Model for Network Resource
           ___________Partitions (NRPs)";
      }

      organization
        "IETF Traffic Engineering Architecture and Signaling (TEAS)
         Working Group";
      contact
        "WG Web:   <https://datatracker.ietf.org/wg/teas/>
         WG List:  <mailto:teas@ietf.org>

         Editor:   Bo Wu
                   <mailto:lana.wubo@huawei.com>

         Editor:   Dhruv Dhody
                   <mailto:dhruv.ietf@gmail.com>

         Editor:   Vishnu Pavan Beeram
                   <mailto:vbeeram@juniper.net>

         Editor:   Tarek Saad
                   <mailto:tsaad.net@gmail.com>

         Editor:   Shaofu Peng
                   <mailto:peng.shaofu@zte.com.cn>";
      description
        "This YANG module defines a data model for Network Resource
         Partitions (NRPs) device configurations and states. The model
         fully conforms to the Network Management Datastore
         Architecture (NMDA).

         Copyright (c) 2024 IETF Trust and the persons identified as
         authors of the code.  All rights reserved.
```

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

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

    // RFC Ed.: replace XXXX with actual RFC number and remove this
    // note.
    // RFC Ed.: update the date below with the date of RFC publication
    // and remove this note.

    revision 2024-01-03 {
      description
        "Initial revision.";
      reference
        "RFCXXXX: A YANG Data Model for Network Resource Partitions
(NRPs)
         Device";
    }

    /* NRP device configuraiton */

    augment "/nw:networks/nrp:nrp-policies/nrp:nrp-policy" {
      description
        "NRP policy list.";
      /* NRP Interface Configuration Data */
      container interfaces {
        description
          "Configuration data model for NRP interfaces.";
        list interface {
          key "interface";
          description
            "NRP interfaces.";
          leaf interface {
            type if:interface-ref;
            description
              "NRP interface name.";
          }
          uses nrp:nrp-resource-reservation;
          uses nrp:nrp-selector-config;
          uses nrp:nrp-qos-phb-profile;
        }
      }
    }
  }
  <CODE ENDS>
```

Figure 10: NRPs Device data model YANG module

6. Security Considerations

The YANG models defined in this document 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 [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 model 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.

nrp-link: A malicious client could attempt to remove a link from a topology, add a new link. In each case, the structure of the topology would be sabotaged, and this scenario could, for example, result in an NRP topology that is less than optimal.

The entries in the nodes above include the whole network configurations corresponding with the NRP, and indirectly create or modify the PE or P device configurations. Unexpected changes to these entries could lead to service disruption and/or network misbehavior.

7. IANA Considerations

This document registers a URI in the IETF XML registry [RFC3688]. Following the format in [RFC3688], the following registration is requested to be made:

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

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

This document requests to register a YANG module in the YANG Module Names registry [RFC7950].

```
Name: ietf-nrp
Namespace: urn:ietf:params:xml:ns:yang:ietf-nrp
Maintained by IANA: N
Prefix: nrp
Reference: RFC XXXX

Name: ietf-nrp-device
Namespace: urn:ietf:params:xml:ns:yang:ietf-nrp-device
Maintained by IANA: N
Prefix: nrp-dev
Reference: RFC XXXX
```

8. Acknowledgments

The authors would like to thank Krzysztof Szarkowicz, Jie Dong, Qin Wu, Yao Zhao, Zhenbing Li, Ying Cheng, Liyan Gong, and many others for their helpful comments and suggestions.

9. Contributor

The following individuals, authors of [I-D.bestbar-teas-yang-nrp-policy] and [I-D.wd-teas-nrp-yang], contributed to this consolidated document:

Xufeng Liu
IBM Corporation
Email: xufeng.liu.ietf@gmail.com

Mohamed Boucadair
Orange
Email: mohamed.boucadair@orange.com

Daniele Ceccarelli

Bin Wen
Comcast
Email: Bin_Wen@cable.comcast.com

Ran Chen
ZTE Corporation
Email: chen.ran@zte.com.cn

Luis M. Contreras
Telefonica
Email: luismiguel.contrerasmurillo@telefonica.com

Ying Cheng
China Unicom
Email: chengying10@chinaunicom.cn

Liyan Gong
China Mobile
Email: gongliyan@chinamobile.com

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"If a YANG module contains reference or "description" statements that refer to an I-D, then the I-D is included as an informative reference. "

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[RFC8309] Wu, Q., Liu, W., and A. Farrel, "Service Models Explained", RFC 8309, DOI 10.17487/RFC8309, January 2018, <https://www.rfc-editor.org/info/rfc8309>.

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Appendix A. An Example

This section contains an example of an instance data tree in JSON encoding [RFC7951]. The example below instantiates an NRP for the topology that is depicted in the following diagram. There are three nodes, D1, D2, and D3. D1 has three termination points, 1-0-1, 1-2-1, and 1-3-1. D2 has three termination points as well, 2-1-1, 2-0-1, and 2-3-1. D3 has two termination points, 3-1-1 and 3-2-1. In addition there are six links, two between each pair of nodes with

one going in each direction.

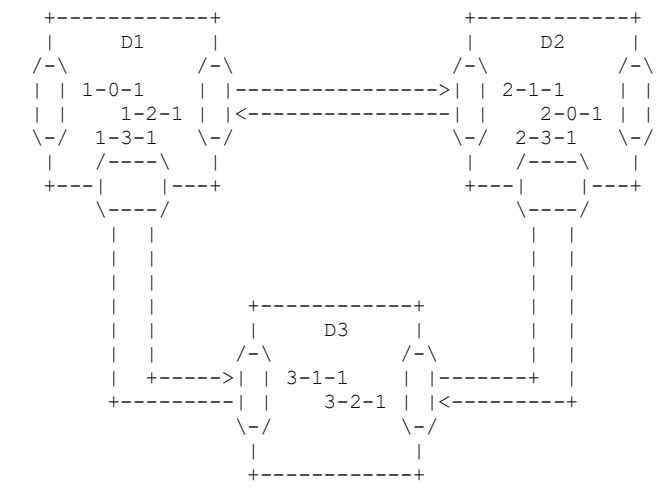

Figure 11: An NRP Instance Example

An corresponding IGP congruent NRP instance data tree is depicted below:

```
{
  "ietf-network:networks": {
    "nrp-policies": {
      "nrp-policy": [
        {
          "name": "NRP1",
          "nrp-id": "~~foo~~example:nrp-example1",
          "mode": "ietf-nrp:nrp-hybrid-plane-partition",
          "resource-reservation": {
            "bw-value": "10000"
          },
          "selector": {
            "ipv6": {
              "ipv6-hbh-eh:": "100"
            }
          },
          "phb-profile:": "High",
          "topology": {
            "igp-congruent": {
              "multi-topology-id": "2"
            },
            "select": {
              "topology-group": [
                {
                  "group-id": "access-group",
                  "base-topology-ref": {
                    "network-ref": "native-topology"
                  },
                  "link": [
                    {
```

Commenté [BMI41]: Should be prefixed.

Commenté [BMI42]: As per rfc8407bis

```
                    "link-ref": "D1,1-2-1,D2,2-1-1"
                  },
                  {
                    "link-ref": "D2,2-1-1,D1,1-2-1"
                  },
                  {
                    "link-ref": "D1,1-3-1,D3,3-1-1"
                  },
                  {
                    "link-ref": "D3,3-1-1,D1,1-3-1"
                  },
                  {
                    "link-ref": "D2,2-3-1,D3,3-2-1"
                  },
                  {
                    "link-ref": "D3,3-2-1,D2,2-3-1"
                  }
                ],
                "link-partition-type": "virtual-sub-interface-
partition"
              }
            ]
          }
        }
      }
    ]
  }
}
```

Commenté [BMI43]: Update all the refs to use URIs as link is defined as "inet:uri"

Figure 12: Instance data tree

In addition, an exampe of an NRP that supports the control plane partition mode is shown in the following figure.

```
{
  "ietf-network:networks": {
    "nrp-policies": {
      "nrp-policy": [
        {
          "name": "NRP2",
          "nrp-id": "foo:nrp-example2",
          "mode": "nrp-control-plane-partition",
          "resource-reservation": {
            "bw-value": "10000"
          },
          "phb-profile:": "EF",
          "topology": {
            "filters": {
              "filter": [
                {
                  "filter-ref": "te-topology-filter1"
                }
              ]
            }
          }
        }
      ]
```

Commenté [BMI44]: Idem as above

```
      }
    }
  }
```

Appendix B. NRPs YANG Module Tree

Figure 13 shows the full tree diagram of the NRPs YANG model defined in module 'ietf-nrp.yang'.

```
module: ietf-nrp
  augment /nw:networks:
    +--rw nrp-policies
       +--rw nrp-policy* [name]
          +--rw name                    string
          +--rw nrp-id?                 uint32
          +--rw mode?                   identityref
          +--rw resource-reservation
          |  +--rw (max-bw-type)?
          |     +--:(bw-value)
          |     |  +--rw maximum-bandwidth?           uint64
          |     +--:(bw-percentage)
          |        +--rw maximum-bandwidth-percent?
          |                 rt-types:percentage
          +--rw selector
          |  +--rw ipv4
          |  |  +--rw destination-prefix*   inet:ipv4-prefix
          |  +--rw ipv6
          |  |  +--rw (selector-type)?
          |  |     +--:(dedicated)
          |  |     |  +--rw ipv6-hbh-eh?          uint32
          |  |     +--:(srv6-sid-derived)
          |  |     |  +--rw srv6-sid*
          |  |     |          inet:ipv6-prefix
          |  |     +--:(ipv6-destination-derived)
          |  |        +--rw destination-prefix*
          |  |                inet:ipv6-prefix
          |  +--rw mpls
          |  +--rw acl-ref*   nrp-acl-ref
          +--rw phb-profile?            string
          +--rw topology
             +--rw igp-congruent!
             |  +--rw multi-topology-id?   uint32
             |  +--rw algo-id?             uint32
             |  +--rw sharing?             boolean
             +--rw (topology-type)?
                +--:(selection)
                |  +--rw select
                |     +--rw topology-group* [group-id]
                |        +--rw group-id                string
                |        +--rw base-topology-ref
                |        |  +--rw network-ref?   leafref
                |        +--rw links* [link-ref]
                |        |  +--rw link-ref    leafref
                |        +--rw resource-reservation
                |        |  +--rw (max-bw-type)?
                |        |     +--:(bw-value)
                |        |     |  +--rw maximum-bandwidth?
                |        |     |          uint64
```

```
               |        |     +--:(bw-percentage)
               |        |        +--rw maximum-bandwidth-percent?
               |        |                 rt-types:percentage
               |        +--rw link-partition-type?
               |        |       identityref
               |        +--rw phb-profile?            string
               +--:(filter)
                  +--rw filters
                     +--rw filter* [filter-ref]
                        +--rw filter-ref
                        |       nrp-topo-filter-ref
                        +--rw resource-reservation
                        |  +--rw (max-bw-type)?
                        |     +--:(bw-value)
                        |     |  +--rw maximum-bandwidth?
                        |     |          uint64
                        |     +--:(bw-percentage)
                        |        +--rw maximum-bandwidth-percent?
                        |                 rt-types:percentage
                        +--rw selector
                        |  +--rw ipv4
                        |  |  +--rw destination-prefix*
                        |  |          inet:ipv4-prefix
                        |  +--rw ipv6
                        |  |  +--rw (selector-type)?
                        |  |     +--:(dedicated)
                        |  |     |  +--rw ipv6-hbh-eh?
                        |  |     |          uint32
                        |  |     +--:(srv6-sid-derived)
                        |  |     |  +--rw srv6-sid*
                        |  |     |          inet:ipv6-prefix
                        |  |     +--:(ipv6-destination-derived)
                        |  |        +--rw destination-prefix*
                        |  |                 inet:ipv6-prefix
                        |  +--rw mpls
                        |  +--rw acl-ref*   nrp-acl-ref
                        +--rw phb-profile?            string
augment /nw:networks/nw:network/nw:network-types:
  +--rw nrp!
augment /nw:networks/nw:network/nw:node:
  +--ro nrp
     +--ro selector
        +--ro srv6?   srv6-types:srv6-sid
augment /nw:networks/nw:network/nt:link:
  +--ro nrp
     +--ro link-partition-type?   identityref
     +--ro bandwidth-value?       uint64
     +--ro selector
     |  +--ro srv6?   srv6-types:srv6-sid
     +--ro statistics
        +--ro admin-status?
        |       te-types:te-admin-status
        +--ro oper-status?
        |       te-types:te-oper-status
        +--ro one-way-available-bandwidth?   uint64
        +--ro one-way-utilized-bandwidth?    uint64
        +--ro one-way-min-delay?             uint32
        +--ro one-way-max-delay?             uint32
```

```
          +--ro one-way-delay-variation?       uint32
          +--ro one-way-packet-loss?           decimal64
    augment /nw:networks/nw:network/nw:node:
      +--ro nrps* [nrp-id]
         +--ro nrp-id    uint32
         +--ro nrp
            +--ro selector
               +--ro srv6?   srv6-types:srv6-sid
    augment /nw:networks/nw:network/nt:link:
      +--ro nrps* [nrp-id]
         +--ro nrp-id                 uint32
         +--ro link-partition-type?   identityref
         +--ro bandwidth-value?       uint64
         +--ro selector
            +--ro srv6?   srv6-types:srv6-sid
```

Figure 13

Appendix C. NRPs Device YANG Module Tree

Figure 14 shows the full tree diagram of the NRPs device YANG model defined in module 'ietf-nrp-device.yang'.

```
module: ietf-nrp-device
  augment /nw:networks/nrp:nrp-policies/nrp:nrp-policy:
    +--rw interfaces
       +--rw interface* [interface]
          +--rw interface              if:interface-ref
          +--rw resource-reservation
          |  +--rw (max-bw-type)?
          |     +--:(bw-value)
          |     |  +--rw maximum-bandwidth?           uint64
          |     +--:(bw-percentage)
          |        +--rw maximum-bandwidth-percent?
          |                 rt-types:percentage
          +--rw selector
          |  +--rw ipv4
          |  |  +--rw destination-prefix*   inet:ipv4-prefix
          |  +--rw ipv6
          |  |  +--rw (selector-type)?
          |  |     +--:(dedicated)
          |  |     |  +--rw ipv6-hbh-eh?          uint32
          |  |     +--:(srv6-sid-derived)
          |  |     |  +--rw srv6-sid*
          |  |     |          srv6-types:srv6-sid
          |  |     +--:(ipv6-destination-derived)
          |  |        +--rw destination-prefix*
          |  |                 inet:ipv6-prefix
          |  +--rw mpls
          |  +--rw acl-ref*   nrp-acl-ref
          +--rw phb-profile?           string
```

Figure 14

Authors' Addresses

Bo Wu
Huawei Technologies

101 Software Avenue, Yuhua District
Nanjing
Jiangsu, 210012
China
Email: lana.wubo@huawei.com

Dhruv Dhody
Huawei Technologies
Divyashree Techno Park
Bangalore 560066
Karnataka
India
Email: dhruv.ietf@gmail.com

Vishnu Pavan Beeram
Juniper Networks
Email: vbeeram@juniper.net

Tarek Saad
Cisco Systems
Email: tsaad.net@gmail.com

Shaofu Peng
ZTE Corporation
Email: peng.shaofu@zte.com.cn