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YANG Data Model for Network Resource Partition Policy  
draft-bestbar-teas-yang-nrp-policy-00

Abstract

A Network Resource Partition (NRP) is a collection of resources identified in the underlay network to support services (like IETF Network Slices) that need logical network structures with required characteristics to be created. An NRP policy is a policy construct that enables instantiation of mechanisms in support of service specific control and data plane behaviors on select topological elements associated with the NRP. This document defines a YANG data model for the management of NRP policies on NRP capable nodes and controllers in IP/MPLS networks.

Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [BCP 14](#) [[RFC2119](#)] [[RFC8174](#)] when, and only when, they appear in all capitals, as shown here.

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## [1.](#) Introduction

An IETF Network Slice [[I-D.ietf-teas-ietf-network-slices](#)] is a service that provides connectivity coupled with a set of specific commitments of network resources between a number of endpoints over a shared underlay network. The IETF Network Slice service is expressed in terms of one or more connectivity constructs. One or more connectivity constructs from one or more IETF Network Slices are mapped to a set of network resources called a Network Resource Partition (NRP). An NRP is a collection of resources identified in the underlay network to support the IETF Network Slice service (or any other service that needs logical network structures with required characteristics to be created). An NRP Policy [[I-D.bestbar-teas-ns-packet](#)] is a policy construct that enables instantiation of mechanisms in support of service specific control and data plane behaviors on select topological elements associated with the NRP.

An NRP policy specifies the rules for determining the topology associated with the NRP and dictates how an NRP can be realized in IP/MPLS networks using one of three modes. The NRP policy dictates if the partitioning of the shared network resources can be achieved in (a) just the data plane or in (b) just the control plane 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 flow aggregate and to apply the corresponding Per-Hop Behavior (PHB) that determines the forwarding treatment of the packets belonging to the flow aggregate. The identification of the flow aggregate that the packet belongs to and the corresponding forwarding treatment that needs to be applied to the packet is dictated by the NRP policy. When catering to IETF Network Slices, this flow aggregate is referred to as the Slice-Flow Aggregate [[I-D.bestbar-teas-ns-packet](#)] and 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 manager in the control plane to manage NRP resource reservation. The provisions for enabling NRP state aware traffic engineering (NRP-TE) [[I-D.bestbar-teas-ns-packet](#)] are dictated by the NRP policy.

This document defines a YANG data model for the management of NRP policies on NRP capable nodes and controllers in IP/MPLS networks.

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## [1.1.](#) Terminology

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

The reader is expected to be familiar with the terminology specified in [[I-D.ietf-teas-ietf-network-slices](#)] and [[I-D.bestbar-teas-ns-packet](#)].

## [1.2.](#) Tree Structure

A simplified graphical representation of the data model is presented in [Appendix A](#) of this document. The tree format defined in [[RFC8340](#)] is used for the YANG data model tree representation.

## [2.](#) NRP Policy Data Model

### [2.1.](#) Model Usage

A controller that consumes the IETF Network Slice service requests determines which specific connectivity constructs from one or more slices can be grouped together. This could be based on a specific set of SLOs and SLEs, or on any administrative or operational reason. A controller function that has visibility of the underlay network and its resources maps these connectivity constructs onto the NRP. It also constructs and distributes the network wide consistent NRP policy (using the data model defined in this document) to the relevant NRP capable nodes and controllers.

## 2.2. Model Structure

The high-level model structure defined by this document is as shown below:

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```
module: ietf-nrp-policy
  augment /nw:networks:
    +--rw nrp-policies
      +--rw nrp-policy* [name]
        +--rw name                string
        +--rw nrp-id?             uint32
        +--rw resource-reservation
          | + .....
        +--rw flow-agg-selector
          | + .....
        +--rw phb?                string
        +--rw topology
          +--rw filters
            +--rw filter* [filter-ref]
              + .....
            +--rw resource-reservation
              | + .....
            +--rw flow-agg-selector
              | + .....
            +--rw phb?            string
```

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 a set of NRP policies.

### [2.3.](#) NRP Policies

The 'nrp-policies' container carries a list of NRP policies. Each 'nrp-policy' entry is identified by a name and holds the set of attributes needed to instantiate the NRP. Each entry also carries an 'nrp-id' leaf which uniquely identifies the NRP created by the enforcement of this policy. The key elements of each nrp-policy entry are discussed in the following sub-sections.

#### [2.3.1.](#) Resource Reservation

The 'resource-reservation' container carries data nodes that are used to support NRP state aware bandwidth engineering. The data nodes in this container facilitate preference-based preemption of NRP state aware TE paths, sharing of resources amongst a group of NRPs and backup path bandwidth protection.

```
+--rw resource-reservation
|  +--rw preference?                               uint16
|  +--rw (max-bw-type)?
|  |  +--:(bw-value)
|  |  |  +--rw maximum-bandwidth?                 uint64
|  |  +--:(bw-percentage)
|  |  +--rw maximum-bandwidth-percent?
|  |  |  rt-types:percentage
|  +--rw shared-resource-groups*                  uint32
|  +--rw protection
|  |  +--rw backup-nrp-id?                         uint32
|  |  +--rw (backup-bw-type)?
|  |  |  +--:(backup-bw-value)
|  |  |  |  +--rw backup-bandwidth?                uint64
|  |  |  +--:(backup-bw-percentage)
```

```
|          +---rw backup-bandwidth-percent?  
|          rt-types:percentage
```

### [2.3.2.](#) Flow Aggregate Selector

The 'flow-agg-selector' container carries data nodes that specify the rules for identifying which packets belong to the flow aggregate that this NRP caters to.

```
+---rw flow-agg-selector  
| +---rw mpls  
| | +---rw (fas-type)?  
| | +---:(label)  
| | | +---rw (specification-type)?  
| | | +---:(derived)  
| | | | +---rw forwarding-label?          empty  
| | | +---:(explicit)
```



```

+---rw filters
  +---rw filter* [filter-ref]
    +---rw filter-ref
      |      nrp-policy-topo-filter-ref
    +---rw resource-reservation
      |  +---rw preference?                               uint16
      |  +---rw (max-bw-type)?
      |  |  +---:(bw-value)
      |  |  |  +---rw maximum-bandwidth?                 uint64
      |  |  +---:(bw-percentage)
      |  |  |  +---rw maximum-bandwidth-percent?
      |  |  |  |      rt-types:percentage
      |  +---rw shared-resource-groups*                 uint32
      +---rw protection
        +---rw backup-nrp-id?
          |      uint32
        +---rw (backup-bw-type)?
          +---:(backup-bw-value)
          |  +---rw backup-bandwidth?
          |  |      uint64
          +---:(backup-bw-percentage)
          |  +---rw backup-bandwidth-percent?
          |  |      rt-types:percentage
    +---rw flow-agg-selector
      +---rw mpls
        |  +---rw (fas-type)?
        |  |  +---:(label)
        |  |  |  +---rw (specification-type)?
        |  |  |  |  +---:(derived)
        |  |  |  |  |  +---rw forwarding-label?
        |  |  |  |  |  |      empty
        |  |  |  |  +---:(explicit)
        |  |  |  |  |  +---rw label?
        |  |  |  |  |  |      rt-types:mpls-label
        |  |  |  |  +---rw label-position?
        |  |  |  |  |  identityref
        |  |  |  |  +---rw label-position-offset?
        |  |  |  |  |      uint8
        |  |  +---:(label-ranges)
        |  |  |  +---rw label-range* [index]
        |  |  |  |  +---rw index
        |  |  |  |  |  string
        |  |  |  |  +---rw start-label?
        |  |  |  |  |  rt-types:mpls-label
        |  |  |  |  +---rw end-label?
        |  |  |  |  |  rt-types:mpls-label
        |  |  |  |  +---rw label-position?

```

```

| | | identityref
| | | +--rw label-position-offset?
| | | uint8
| | +--rw ipv4
| | | +--rw destination-prefix* inet:ipv4-prefix
| | +--rw ipv6
| | | +--rw (fas-type)?
| | | +--:(ipv6-destination)
| | | | +--rw destination-prefix*
| | | | inet:ipv6-prefix
| | | +--:(ipv6-hbh-eh)
| | | +--rw fas-hbh-eh* uint32
| | +--rw acl-ref* nrp-policy-acl-ref
+--rw phb? string

```

#### 2.4. YANG Module

```

<CODE BEGINS> file "ietf-nrp-policy@2022-03-07.yang"
module ietf-nrp-policy {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-nrp-policy";
  prefix nrp-pol;

  import ietf-inet-types {
    prefix inet;
    reference
      "RFC 6991: Common YANG Data Types";
  }
  import ietf-routing-types {
    prefix rt-types;
    reference
      "RFC 8294: Common YANG Data Types for the Routing Area";
  }
  import ietf-network {
    prefix nw;
    reference
      "RFC 8345: A YANG Data Model for Network Topologies";
  }
  import ietf-access-control-list {
    prefix acl;
    reference
      "RFC 8519: YANG Data Model for Network Access Control Lists
      (ACLs)";
  }
  import ietf-topology-filter {
    prefix topo-filt;

```

reference

["draft-bestbar-teas-yang-topology-filter"](#): YANG Data Model

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```
    for Topology Filter";  
}
```

organization

```
"IETF Traffic Engineering Architecture and Signaling (TEAS)  
Working Group.";
```

contact

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WG List:  <mailto:teas@ietf.org>
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```

description

```
"This YANG module defines a data model for managing Network  
Resource Partition Policies on Network Resource Partition  
capable nodes and controllers.
```

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

```
revision 2022-03-07 {
  description
    "Initial revision.";
  reference
    "RFC XXXX: YANG Data Model for Network Resource Partition
    Policies.";
}

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

/*
 * Identity:
 * MPLS Flow Aggregate Selector (FAS) Label Position Type.
 */

identity fas-mpls-label-position-type {
  description
    "Base identity for the position of the MPLS FAS label.";
}

identity fas-mpls-label-position-top {
  base fas-mpls-label-position-type;
  description
    "MPLS FAS label is at the top of the label stack.";
}

identity fas-mpls-label-position-bottom {
```

```

base fas-mpls-label-position-type;
description
  "MPLS FAS label is either at the bottom or at a specific
  offset from the bottom of the label stack.";
}

identity fas-mpls-label-position-indicator {
  base fas-mpls-label-position-type;
  description
    "MPLS FAS is preceded by a special purpose
    indicator label in the label stack.";
}

/*
 * T Y P E D E F S

```

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```

*/

typedef nrp-policy-acl-ref {
  type leafref {
    path "/acl:acls/acl:acl/acl:name";
  }
  description
    "This type is used to reference an ACL.";
}

typedef nrp-policy-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.";
}

/*
 * G R O U P I N G S
*/

/*
 * Grouping - MPLS FAS label location specific fields

```

```

*/

grouping nrp-pol-fas-mpls-label-location {
  description
    "Grouping for MPLS FAS label location specific fields.";
  leaf label-position {
    type identityref {
      base fas-mpls-label-position-type;
    }
    description
      "MPLS FAS label position.";
  }
  leaf label-position-offset {
    when "derived-from-or-self(..../label-position,"
      + "'nrp-pol:fas-mpls-label-position-bottom')" {
      description
        "MPLS label position offset is relevant only when the
        label-position is set to 'bottom'.";
    }
    type uint8;
    description
      "MPLS label position offset.";
  }
}

```

```

}

/*
 * Grouping - Flow-Aggregate Selector (FAS)
 */

grouping nrp-pol-flow-agg-selector {
  description
    "Grouping for Flow-Aggregate Selector (FAS).";
  container flow-agg-selector {
    description
      "Container for FAS.";
    container mpls {
      description
        "Container for MPLS FAS.";
      choice fas-type {
        description
          "Choices for MPLS FAS.";
      }
    }
  }
}

```

```

case label {
  choice specification-type {
    description
      "Choices for MPLS label specification.";
    case derived {
      leaf forwarding-label {
        type empty;
        description
          "MPLS FAS Label is derived from
            forwarding label.";
      }
    }
    case explicit {
      leaf label {
        type rt-types:mpls-label;
        description
          "MPLS FAS Label is explicitly
            specified.";
      }
      uses nrp-pol-fas-mpls-label-location;
    }
  }
}
case label-ranges {
  list label-range {
    key "index";
    unique "start-label end-label";
    description
      "Any label from the specified set of MPLS label
        ranges can be used as the FAS.";
  }
}

```

```

leaf index {
  type string;
  description
    "A string that uniquely identifies a label
      range.";
}
leaf start-label {
  type rt-types:mpls-label;
  must '. <= ../end-label' {
    error-message
      "The start-label must be less than or equal "

```



```

        destination prefixes can be the FAS.";
    }
}
case ipv6-hbh-eh {
    leaf-list fas-hbh-eh {
        type uint32;
        description
            "Set of FAS values carried in Hop-by-Hop
            Option of IPv6 extension header.";
    }
}
}
}
leaf-list acl-ref {
    type nrp-policy-acl-ref;
    description
        "Flow Aggregate selection is done based on the
        specified list of ACLs.";
}
}
}

/*
 * Grouping - NRP Policy Resource Reservation
 */

grouping nrp-pol-resource-reservation {
    description
        "Grouping for NRP policy resource reservation.";
    container resource-reservation {
        description
            "Container for NRP policy resource reservation.";
        leaf preference {
            type uint16;
            description
                "Control plane preference for the corresponding
                Network Resource Partition (NRP). A higher
                preference indicates a more favorable resource
                reservation than a lower preference.";
        }
        choice max-bw-type {
            description
                "Choice of maximum bandwidth specification.";
            case bw-value {

```

```
    leaf maximum-bandwidth {
      type uint64;
      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.";
    }
  }
}
leaf-list shared-resource-groups {
  type uint32;
  description
    "List of shared resource groups that an NRP
     shares its allocated resources with.";
}
container protection {
  description
    "Container for NRP protection reservation.";
  leaf backup-nrp-id {
    type uint32;
    description
      "The ID that identifies the NRP used for
       backup paths that protect primary paths
       setup over a specific NRP.";
  }
}
choice backup-bw-type {
  description
    "Choice of backup bandwidth specification.";
  case backup-bw-value {
    leaf backup-bandwidth {
      type uint64;
      description
        "The maximum bandwidth on a network resource that
         is allocated for backup traffic - specified as
         absolute value.";
    }
  }
}
case backup-bw-percentage {
  leaf backup-bandwidth-percent {
```



```

description
  "List of filters.";
leaf filter-ref {
  type nrp-policy-topo-filter-ref;
  description
    "Reference to a specific topology filter from the
    list of global topology filters.";
}

```

```

    uses nrp-pol-resource-reservation;
    uses nrp-pol-flow-agg-selector;
    uses nrp-pol-phb;
  }
}
}
}

/*
 * Grouping - Network Resource Partition Policies
 */

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.";
    }
    uses nrp-pol-resource-reservation;
    uses nrp-pol-flow-agg-selector;
    uses nrp-pol-phb;
    uses nrp-pol-topology;
}
}
}

/*
 * Augment - Network Resource Partition Policies.
 */
augment "/nw:networks" {
    description

```

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```

        "Augment networks with network resource partition
        policies.";
    uses nrp-pol;
}
}
<CODE ENDS>

```

### [3.](#) Acknowledgements

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### [4.](#) Contributors

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## 5. IANA Considerations

This document registers the following 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-policy  
Registrant Contact: The TEAS WG of the IETF.  
XML: N/A, the requested URI is an XML namespace.

This document registers a YANG module in the YANG Module Names registry [[RFC6020](#)].

name: ietf-nrp-policy  
namespace: urn:ietf:params:xml:ns:yang:ietf-nrp-policy  
prefix: sl-pol  
reference: RFCXXXX

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## 6. Security Considerations

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

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

The data nodes defined in this YANG module that are writable/creatable/deletable (i.e., config true, which is the default) 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:

- \* `"/networks/nrp-policies"`: This subtree specifies the configurations for NRP policies on a given network element. By manipulating these data nodes, a malicious attacker may cause unauthorized and improper behavior to be provided for the flow aggregate traffic on the network element.

The readable data nodes in this YANG module may be considered sensitive or vulnerable in some network environments. It is thus important to control read access (e.g., via `get`, `get-config`, or `notification`) to these data nodes. These are the subtrees and data nodes and their sensitivity/vulnerability:

- \* `"/networks/nrp-policies"`: Unauthorized access to this subtree can disclose the NRP policy definitions on the network element.

## [7.](#) References

### [7.1.](#) Normative References

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## [Appendix A.](#) Complete Model Tree Structure

```
module: ietf-nrp-policy
  augment /nw:networks:
    +--rw nrp-policies
      +--rw nrp-policy* [name]
        +--rw name                               string
        +--rw nrp-id?                            uint32
        +--rw resource-reservation
          | +--rw preference?                    uint16
          | +--rw (max-bw-type)?
          | | +--:(bw-value)
          | | | +--rw maximum-bandwidth?       uint64
          | | | +--:(bw-percentage)
          | | | +--rw maximum-bandwidth-percent?
          | | | |                               rt-types:percentage
          | +--rw shared-resource-groups*       uint32
          +--rw protection
            +--rw backup-nrp-id?                uint32
            +--rw (backup-bw-type)?
            +--:(backup-bw-value)
            | +--rw backup-bandwidth?          uint64
            +--:(backup-bw-percentage)
            +--rw backup-bandwidth-percent?
            |                               rt-types:percentage
        +--rw flow-agg-selector
          | +--rw mpls
          | | +--rw (fas-type)?
```



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```

|         | +--rw backup-bandwidth?
|         |         uint64
|         +---:(backup-bw-percentage)
|         | +--rw backup-bandwidth-percent?
|         |         rt-types:percentage
+--rw flow-agg-selector
| +--rw mpls
| | +--rw (fas-type)?
| | | +---:(label)
| | | | +--rw (specification-type)?
| | | | | +---:(derived)
| | | | | | +--rw forwarding-label?
| | | | | |         empty
| | | | | +---:(explicit)
| | | | | | +--rw label?
| | | | | |         rt-types:mpls-label
| | | | | +--rw label-position?
| | | | | | identityref
| | | | | +--rw label-position-offset?
| | | | |         uint8
| | | +---:(label-ranges)
| | | | +--rw label-range* [index]
| | | | | +--rw index
| | | | | | string
| | | | | +--rw start-label?
| | | | | | rt-types:mpls-label
| | | | | +--rw end-label?
| | | | | | rt-types:mpls-label
| | | | | +--rw label-position?
| | | | | | identityref
| | | | | +--rw label-position-offset?
| | | | |         uint8
| +--rw ipv4
| | +--rw destination-prefix* inet:ipv4-prefix
+--rw ipv6
| | +--rw (fas-type)?
| | | +---:(ipv6-destination)
| | | | +--rw destination-prefix*
| | | | | inet:ipv6-prefix
| | | +---:(ipv6-hbh-eh)
| | | | +--rw fas-hbh-eh* uint32
+--rw acl-ref* nrp-policy-acl-ref

```

+-rw phb?

string

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