Network Working Group
Internet-Draft
Intended status: Standards Track
Expires: 30 March 2022

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26 September 2021

IETF Network Slice Service YANG Model
draft-wd-teas-ietf-network-slice-nbi-yang-05

Abstract

This document provides a YANG data model for the IETF Network Slice service. The model can be used by a IETF Network Slice Customer to manage IETF Network Slice from an IETF Network Slice Controller (NSC).

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 30 March 2022.

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1. Introduction

This document provides a YANG [RFC7950] data model for the IETF Network Slice service.

The YANG model discussed in this document is defined based on the description of the IETF Network Slice in [I-D.ietf-teas-ietf-network-slices], which is used to operate IETF Network Slices during the IETF Network Slice instantiation. This YANG model supports various operations on IETF Network Slices such as creation, modification, deletion, and monitoring.

The IETF Network Slice Controller (NSC) is a logical entity that allows customers to manage IETF network slices. Details related to the realization of IETF network slices that fulfil the request are internal to the entity that operates the network. Such details are deployment- and implementation-specific.

The NSC receives request from its customer-facing interface (e.g., from a management system). This interface carries data objects the IETF network slice user provides, describing the needed IETF network slices in terms of topology, target service level objectives (SLO), and also monitoring and reporting requirements. These requirements are then translated into technology-specific actions that are implemented in the underlying network using a network-facing interface. The details of IETF network slices realization are out of scope for this document.

The YANG model discussed in this document describes the requirements of an IETF Network Slice from the point of view of the customer. It is thus classified as customer service model in [RFC8309].

The IETF Network Slice operational state is included in the same tree as the configuration consistent with Network Management Datastore Architecture [RFC8342].

2. Conventions used in this document

The keywords "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 BCP14, [RFC2119], [RFC8174] when, and only when, they appear in all capitals, as shown here.

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

* client

* configuration data

* state data

This document makes use of the terms defined in [RFC7950].

This document also makes use of the terms introduced in the Framework for IETF Network Slices [I-D.ietf-teas-ietf-network-slices]:

This document defines the following term:

* IETF Network Slice Connection (NS-Connection): In the context of an IETF Network Slice, an IETF NS-Connection is an abstract entity which represents a particular connection between a pair of NSEs. An IETF Network Slice can has one or multiple NS-Connections.

2.1. Tree Diagrams

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

3. IETF Network Slice Service Model Usage

The intention of the IETF Network Slice service model is to allow the customer to manage IETF Network Slices. In particular, the model allows customers to operate in an abstract and technology-agnostic manner, with details of the IETF Network Slices realization hidden.

According to the [I-D.ietf-teas-ietf-network-slices] description, IETF Network Slices are applicable to use cases such as (but not limited to) network wholesale services, network infrastructure sharing among operators, NFV connectivity, Data Center Interconnect, and 5G E2E network slice.

As shown in Figure 1, in all these use-cases, the model is used by the higher management system to communicate with NSC for life cycle manage of IETF Network Slices including both enablement and monitoring. The interface is used to support dynamic IETF Network Slice creation and its lifecycle management to facilitate end-to-end network slice services.

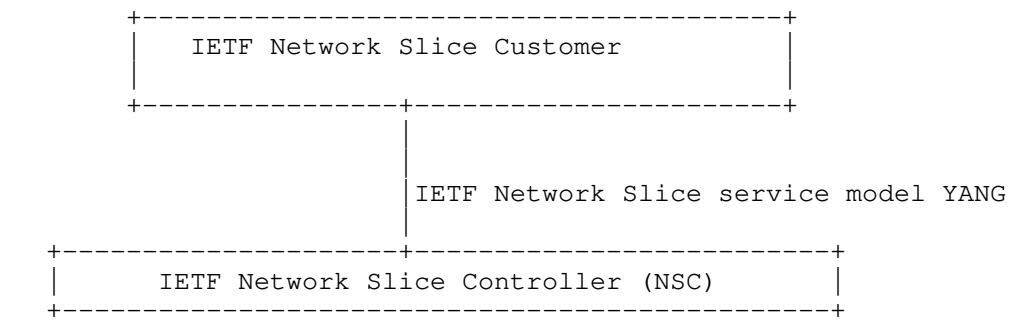


Figure 1: IETF Network Slice Service Reference Architecture

4. Background on IETF Network Slice Service Modeling

[I-D.ietf-teas-ietf-network-slices] defines the IETF Network Slice service model as a technology agnostic interface. That is, customer expresses requirements for a particular slice by specifying what is required rather than how that is to be achieved.

This section explains why a new YANG service data model is proposed for support of IETF network slice services. The following data models are considered:

* L3SM, L2SM and L1CSM models

* ACTN VN model

4.1. LxSM VPN Service Models

Currently, the three VPN service models defined at IETF are L3SM [RFC8299], L2SM [RFC8466], L1CSM [I-D.ietf-ccamp-l1csm-yang]. These models are related to specific VPN technologies. When using these models as a slicing service interface, customers need to be aware of the network's VPN technology so that right interfaces can be used.

The IETF network slice service requires a technology agnostic interface (similar to intent), to avoiding using multiple VPN models or other technology specific models.

4.2. ACTN VN Model Augmentation analysis

Abstraction and Control of TE Networks (ACTN - [RFC8453]) defines a virtual network (VN) service [I-D.ietf-teas-actn-vn-yang]. Figure 2 shows that the relationship of IETF network slice and ACTN framework.

ACTN VN is independent of VPN technologies, and relys on traffic engineering YANG model [RFC8795] to define VN service in terms of a topology with a single abstract node and its connectivity matrix.

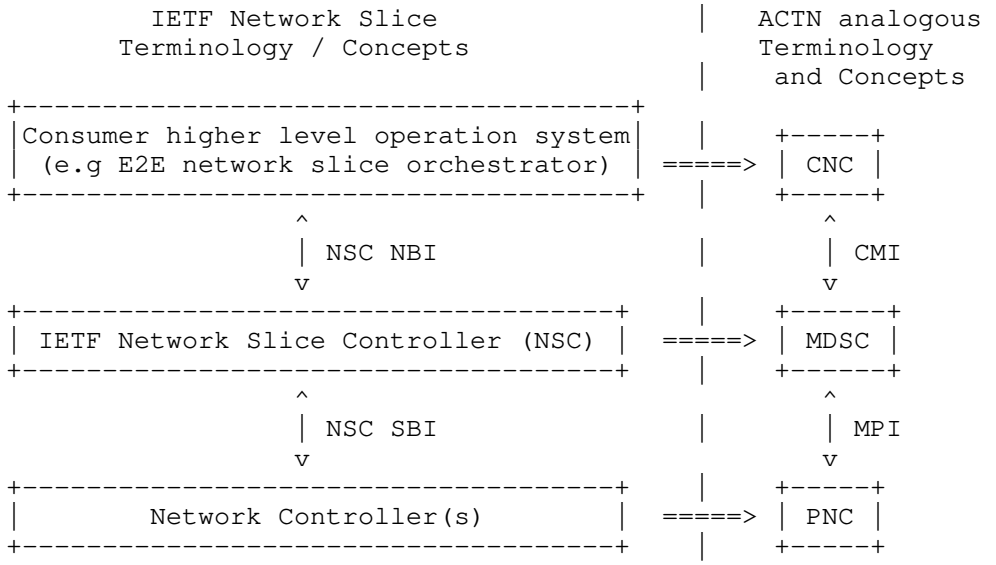


Figure 2: ACTN mapping

The ACTN VN model introduced in[I-D.ietf-teas-actn-vn-yang] is an abstract customer view of the TE network. Its YANG structure includes four components:

* VN: A Virtual Network (VN) is a network provided by a service provider to a customer for use and two types of VN has defined. The Type 1 VN can be seen as a set of edge-to-edge abstract links between VNAP.

* AP: An AP is a logical identifier used to identify the access link which is shared between the customer and the IETF scoped Network.

* VN-AP: A VN-AP is a logical binding between an AP and a given VN.

* VN-member: A VN-member is an abstract edge-to-edge link between any two APs or VN-APs.

Figure 3 illustrates the difference between AP/VNAPs in a VN and NSEs of IETF network slice. Though AP is a logical identifier, it maps to a access link between the customer nodes and provider nodes, which is also TP (Termination Port) of the provider node). When the access link changes, the VN connection matrix changes accordingly. For example, when the backup link of AP5/TP5 is added, the corresponding VN members, AP5-AP3 and AP5-AP4, also need to be added. These changes are underlying topology details. The slice service focuses on the connection matrix between C1, C2, and C3.

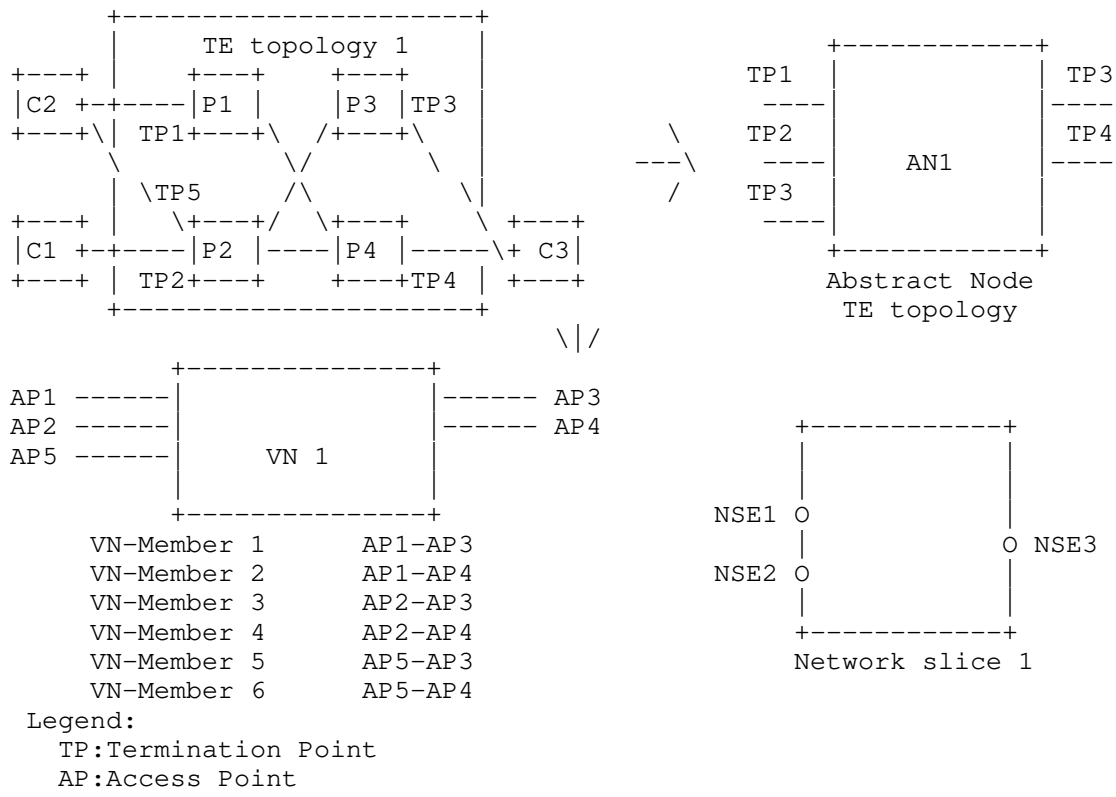


Figure 3: Difference between AP and NSE

In summary, the ACTN VN model cannot be used to model the IETF network slice service model because the VN model is tightly bound to the IETF TE Topology model and the constraints are buried deep inside the TE topology connectivity matrix and thus does not provide a clear mechanism to specify SLO/SLE of IETF network slice. The IETF network slice endpoint also does not ascribe to the concept of AP/VNAP. The realization of the IETF Network Slice does not necessarily require the slice network to support the TE technology. As the IETF network slice could be realized with non-TE techniques (FlexAlgo, MT). Reusing or augmenting VN model is problematic.

5. IETF Network Slice Service Model Overview

As defined in [I-D.ietf-teas-ietf-network-slices], an IETF Network Slice is a logical network topology connecting a number of endpoints using a set of shared or dedicated network resources that are used to satisfy specific service requirements. The logical topology types are: point-to-point, point-to-multipoint, multipoint-to-point, or multipoint-to-multipoint. The endpoints are conceptual points that could map to a device, application or a network function. And the specific service requirements, typically expressed as bandwidth, latency, latency variation, and other desired or required characteristics, such as security, MTU, traffic-type (e.g., IPv4, IPv6, Ethernet or unstructured) or a higher-level behavior to process traffic according to user-application (which may be realized using network function). An example of an IETF network slice is shown in Figure 4 .

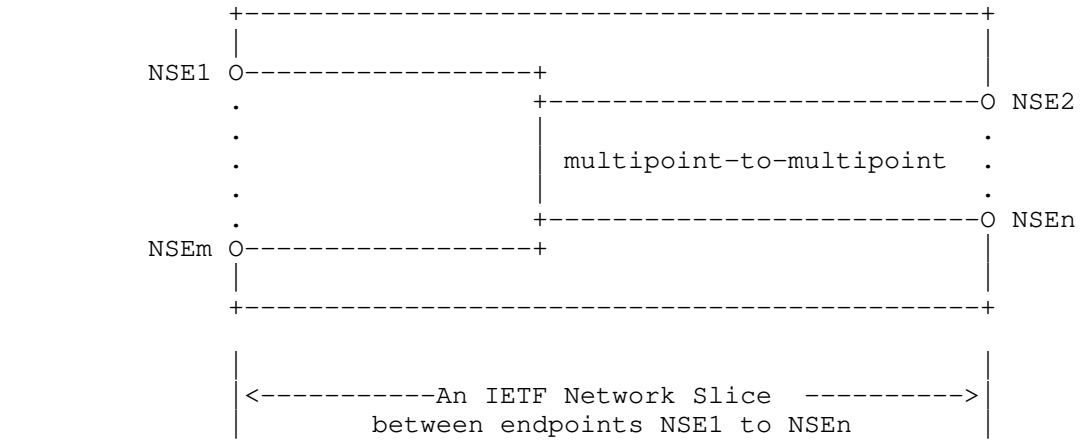


Figure 4: An IETF Network Slice Example

As shown in the example, an IETF network slice may have multiple NSEs. The NSEs are the ingress/egress points where traffic enters/ exits the IETF network slice. As the edge of the IETF network slice, the NSEs also delimit a topological network portion within which the committed SLOs apply.

When an NSC receives a message via its customer-facing interface for creation/modification of an IETF network slice, it uses the provided NSEs to retrieve the corresponding border link or "Provider Node"

(e.g., PE). The NSC further maps them to the appropriate service/tunnel/path endpoints in the underlying network. It then uses services/tunnels/paths to realize the IETF network slice.

The 'ietf-network-slice' module uses two main data nodes: list 'ietf-network-slice' and container 'ns-templates' (see Figure 5).

The 'ietf-network-slice' list includes the set of IETF Network slices managed within a provider network. 'ietf-network-slice' is the data structure that abstracts an IETF Network Slice. Under the "ietf-network-slice", list "ns-endpoint" is used to abstract the NSEs, e.g. NSEs in the example above. And list "ns-connection" is used to abstract connections between NSEs.

The 'ns-templates' container is used by the NSC to maintain a set of common network slice templates that apply to one or several IETF Network Slices.

The figure below describes the overall structure of the YANG module:

```
module: ietf-network-slice
  +--rw network-slices
     +--rw ns-slo-sle-templates
     |  +--rw ns-slo-sle-template* [id]
     |     +--rw id                        string
     |     +--rw template-description?   string
     +--rw network-slice* [ns-id]
        +--rw ns-id                      string
        +--rw ns-description?            string
        +--rw customer-name*             string
        +--rw ns-connectivity-type?      identityref
        +--rw (ns-slo-sle-policy)?
        |  +--:(standard)
        |  |  +--rw slo-sle-template?   leafref
        |  +--:(custom)
        |     +--rw slo-sle-policy
        |        +--rw policy-description?     string
        |        +--rw ns-metric-bounds
        |        |  +--rw ns-metric-bound* [metric-type]
        |        |     +--rw metric-type          identityref
        |        |     +--rw metric-unit          string
        |        |     +--rw value-description?   string
        |        |     +--rw bound?               uint64
        |        +--rw security*               identityref
        |        +--rw isolation?              identityref
        |        +--rw max-occupancy-level?    uint8
        |        +--rw mtu                     uint16
        |        +--rw steering-constraints
```

```
|           +--rw path-constraints
|           +--rw service-function
+--rw status
|  +--rw admin-enabled?   boolean
|  +--ro oper-status?     operational-type
+--rw ns-endpoints
|  +--rw ns-endpoint* [ep-id]
|     +--rw ep-id                          string
|     +--rw ep-description?                string
|     +--rw ep-role?                       identityref
|     +--rw location
|     |  +--rw altitude?    int64
|     |  +--rw latitude?    decimal64
|     |  +--rw longitude?   decimal64
|     +--rw node-id?                       string
|     +--rw ep-ip?                         inet:host
|     +--rw ns-match-criteria
|     |  +--rw ns-match-criterion* [match-type]
|     |     +--rw match-type    identityref
|     |     +--rw values* [index]
|     |        +--rw index    uint8
|     |        +--rw value?   string
|     +--rw ep-peering
|     |  +--rw protocol* [protocol-type]
|     |     +--rw protocol-type    identityref
|     |     +--rw attribute* [index]
|     |        +--rw index                     uint8
|     |        +--rw attribute-description?   string
|     |        +--rw value?                    string
|     +--rw ep-network-access-points
|     |  +--rw ep-network-access-point* [network-access-id]
|     |     +--rw network-access-id             string
|     |     +--rw network-access-description?   string
|     |     +--rw network-access-node-id?       string
|     |     +--rw network-access-tp-id?         string
|     |     +--rw network-access-tp-ip?         inet:host
|     |     +--rw mtu                           uint16
|     |     +--rw ep-rate-limit
|     |        +--rw incoming-rate-limit?
|     |        |       te-types:te-bandwidth
|     |        +--rw outgoing-rate-limit?
|     |                te-types:te-bandwidth
|     +--rw ep-rate-limit
|     |  +--rw incoming-rate-limit?   te-types:te-bandwidth
|     |  +--rw outgoing-rate-limit?   te-types:te-bandwidth
|     +--rw status
|     |  +--rw admin-enabled?   boolean
|     |  +--ro oper-status?     operational-type
```

```
|      +--ro ep-monitoring
|         +--ro incoming-utilized-bandwidth?
|         |       te-types:te-bandwidth
|         +--ro incoming-bw-utilization        decimal64
|         +--ro outgoing-utilized-bandwidth?
|         |       te-types:te-bandwidth
|         +--ro outgoing-bw-utilization        decimal64
|      +--rw ns-connections
|         +--rw ns-connection* [ns-connection-id]
|            +--rw ns-connection-id             uint32
|            +--rw ns-connection-description?   string
|            +--rw src
|            |  +--rw src-ep-id?   leafref
|            +--rw dest
|            |  +--rw dest-ep-id?   leafref
|            +--rw (ns-slo-sle-policy)?
|            |  +--:(standard)
|            |  |  +--rw slo-sle-template?      leafref
|            |  +--:(custom)
|            |     +--rw slo-sle-policy
|            |        +--rw policy-description?     string
|            |        +--rw ns-metric-bounds
|            |        |  +--rw ns-metric-bound* [metric-type]
|            |        |     +--rw metric-type          identityref
|            |        |     +--rw metric-unit          string
|            |        |     +--rw value-description?   string
|            |        |     +--rw bound?               uint64
|            |        +--rw security*               identityref
|            |        +--rw isolation?              identityref
|            |        +--rw max-occupancy-level?    uint8
|            |        +--rw mtu                     uint16
|            |        +--rw steering-constraints
|            |           +--rw path-constraints
|            |           +--rw service-function
|            +--rw monitoring-type?             ns-monitoring-type
|            +--ro ns-connection-monitoring
|               +--ro latency?      yang:gauge64
|               +--ro jitter?       yang:gauge32
|               +--ro loss-ratio?   decimal64
```

Figure 5

6. IETF Network Slice Templates

The 'ns-templates' container (Figure 5) is used by service provider of the NSC to define and maintain a set of common IETF Network Slice templates that apply to one or several IETF Network Slices. The exact definition of the templates is deployment specific to each network provider.

The model includes only the identifiers of SLO and SLE templates. When creation of IETF Network slice, the SLO and SLE policies can be easily identified.

The following shows an example where two network slice templates can be retrieved by the upper layer management system:

```
{
  "ietf-network-slices": {
    "ns-templates": {
      "slo-sle-template": [
       {
         "id":"GOLD-template",
         "template-description": "Two-way bandwidth: 1 Gbps,
          one-way latency 100ms "
         "sle-isolation":"ns-isolation-shared",
        },
       {
         "id":"PLATINUM-template",
         "template-description": "Two-way bandwidth: 1 Gbps,
           one-way latency 50ms "
         "sle-isolation":"ns-isolation-dedicated",
        },
       ],
      }
   }
}
```

7. IETF Network Slice Modeling Description

The 'ietf-network-slice' is the data structure that abstracts an IETF Network Slice of the IETF network. Each 'ietf-network-slice' is uniquely identified by an identifier: 'ns-id'.

An IETF Network Slice has the following main parameters:

* "ns-id": Is an identifier that is used to uniquely identify the IETF Network Slice within NSC.

* "ns-description": Gives some description of an IETF Network Slice service.

* "ns-connectivity-type": Indicates the network connectivity type for the IETF Network Slice: Hub-and-Spoke, any-to-any, or custom type.

* "status": Is used to show the operative and administrative status of the IETF Network Slice, and can be used as indicator to detect network slice anomalies.

* "customer-name": Is used to show the correlation between actual slice customers and IETF network slices. It can be used by the NSC for monitoring and assurance of the IETF network slices where NSC can notify the higher system by issuing the notifications. For example, multiple actual customers use a same network slice.

* "ns-slo-sle-policy": Defines SLO and SLE policies for the "ietf-network-slice". More description are provided in Section 7.2

The "ns-endpoint" is an abstrac entity that represents a set of matching rules applied to an IETF network edge device or a customer network edge device involved in the IETF Network Slice and each 'ns-endpoint' belongs to a single 'ietf-network-slice'. More description are provided in Section 7.3

7.1. IETF Network Slice Connectivity Type

Based on the customer's traffic pattern requirements, an IETF Network Slice connection type could be point-to-point (P2P), point-to-multipoint (P2MP), multipoint-to-point (MP2P), or multipoint-to-multipoint (MP2MP). The "ns-connectivity-type" under the node "ietf-network-slice" is used for this.

According to the network services defined in [I-D.ietf-opsawg-vpn-common], some well-known connectivity types are proposed for IETF network slices. The type could be any-to-any, Hub-and-Spoke (where Hubs can exchange traffic), and the custom. By default, the any-to-any is used. New connectivity type could be added via augmentation or by list of 'ns-connection' specified.

In addition, "ep-role" under the node "ns-endpoint" also needs to be defined, which specifies the role of the NSE in a particular Network Slice connectivity type. In the any-to-any, all NSEs MUST have the same role, which will be "any-to-any-role". In the Hub-and-Spoke, NSEs MUST have a Hub role or a Spoke role.

7.2. IETF Network Slice SLO and SLE Policy

As defined in [I-D.ietf-teas-ietf-network-slices], the SLO and SLE policy of an IETF Network Slice defines the minimum IETF Network Slice SLO attributes, and additional attributes can be added as needed.

"ns-slo-sle-policy" is used to represent specific SLO and SLE policies. During the creation of an IETF Network Slice, the policy can be specified either by a standard SLO and SLO template or a customized SLO and SLE policy.

The policy could both apply one per Network Slice or per connection 'ns-connection'.

The model allows multiple SLO and SLE attributes to be combined to meet different SLO and SLE requirements. For example, some NSs are used for video services and require high bandwidth, some NSs are used for key business services and request low latency and reliability, and some NSs need to provide connections for a large number of NSEs. That is, not all SLO or SLE attributes must be specified to meet the particular requirements of a slice.

"ns-metric-bounds" contains all these variations, which includes a list of "ns-metric-bound" and each "ns-metric-bound" could specify a particular "metric-type". "metric-type" is defined with YANG identity and the YANG module supports the following options:

"ns-slo-one-way-bandwidth": Indicates the guaranteed minimum bandwidth between any two NSE. And the bandwidth is unidirectional.

"ns-slo-two-way-bandwidth": Indicates the guaranteed minimum bandwidth between any two NSE. And the bandwidth is bidirectional.

"network-slice-slo-one-way-latency": Indicates the maximum one-way latency between two NSE.

"network-slice-slo-two-way-latency": Indicates the maximum round-trip latency between two NSE.

"ns-slo-one-way-delay-variation": Indicates the jitter constraint of the slice maximum permissible delay variation, and is measured by the difference in the one-way latency between sequential packets in a flow.

"ns-slo-two-way-delay-variation": Indicates the jitter constraint

of the slice maximum permissible delay variation, and is measured by the difference in the two-way latency between sequential packets in a flow.

"ns-slo-one-way-packet-loss": Indicates maximum permissible packet loss rate, which is defined by the ratio of packets dropped to packets transmitted between two endpoints.

"ns-slo-two-way-packet-loss": Indicates maximum permissible packet loss rate, which is defined by the ratio of packets dropped to packets transmitted between two endpoints.

"ns-slo-availability": Is defined as the ratio of up-time to total_time(up-time+down-time), where up-time is the time the IETF Network Slice is available in accordance with the SLOs associated with it.

Some other Network Slice SLOs or SLEs could be extended when needed.

Note: The definition of "slo-sle-policy" and "steering-constraints" will be updated when WG converge on the terms.

Note: RFC7297 shaping/policing for out of profile traffic.

The following shows an example where a network slice policy can be configured:

```
{
  "ietf-network-slices": {
    "ietf-network-slice": {
      "slo-policy": {
        "policy-description":"video-service-policy",
        "ns-metric-bounds": {
            "ns-metric-bound": [
             {
                "metric-type": "ns-slo-one-way-bandwidth",
                "metric-unit": "mbps"
                "bound": "1000"
             },
             {
                "metric-type": "ns-slo-availability",
                "bound": "99.9%"
             },
            ],
         }
      }
    }
  }
}
```

7.3. IETF Network Slice Endpoint (NSE)

An IETF Network Slice Endpoint has several characteristics:

* "ep-id": Uniquely identifies the NSE within Network Slice Controller (NSC). The identifier is a string that allows any encoding for the local administration of the IETF Network Slice.

* "location": Indicates NSE location information that facilities NSC easy identification of a NSE.

* "ep-role": Represents a connectivity type role of a NSE belonging to an IETF network slice, as described in Section 7.1. The "ep-role" leaf defines the role of the endpoint in a particular NS connectivity type. In the any-to-any, all NSEs MUST have the same role, which will be "any-to-any-role".

* "node-id": The NSE node information facilities NSC with easy identification of a NSE.

* "ep-ip": The NSE IP information facilities NSC with easy identification of a NSE.

* "ns-match-criteria": A matching policies to apply on a given NSE.

* "ep-network-access-points": The list of the interfaces attached to an edge device of the IETF Network Slice by which the customer traffic is received.

* "ep-rate-limit": Set the rate-limiting policies to apply on a given NSE, including ingress and egress traffic to ensure access security. When applied in the incoming direction, the rate-limit is applicable to the traffic from the NSE to the IETF scope Network that passes through the external interface. When Bandwidth is applied to the outgoing direction, it is applied to the traffic from the IETF Network to the NSE of that particular NS.

* "ep-protocol": Specify the protocol for a NSE for exchanging control-plane information, e.g. L1 signaling protocol or L3 routing protocols,etc.

* "status": Enable the control of the operative and administrative status of the NSE, can be used as indicator to detect NSE anomalies.

An NSE belong to a single IETF Network Slice. An IETF Network Slice involves two or more NSEs. An IETF Network Slice can be modified by adding new "ns-endpoint" or removing existing "ns-endpoint".

A NSE is used to define the matching rule on the customer traffic that can be injected to an IETF Network Slice. "network-slice-match-criteria" is defined to support different options. Classification can be based on many criteria, such as:

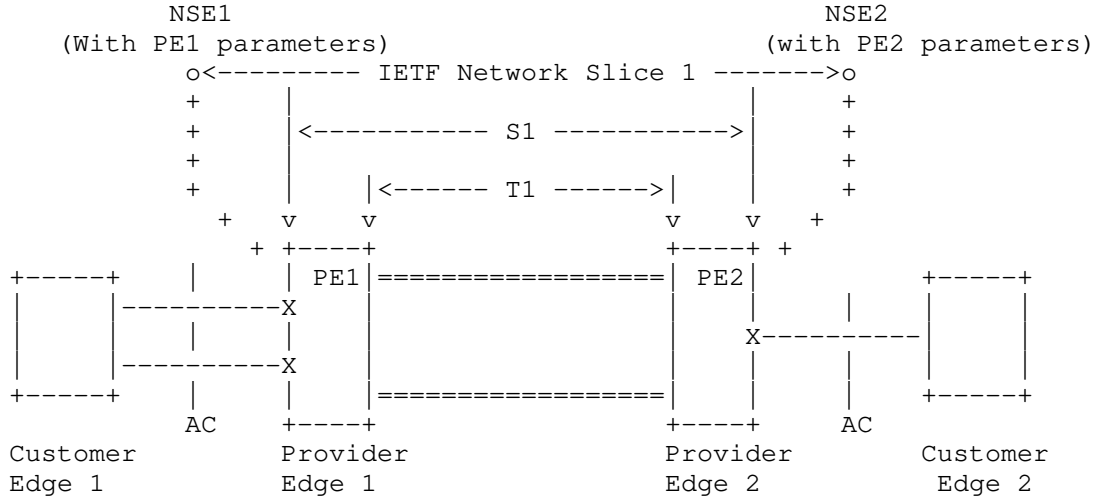
* Physical interface: Indicates all the traffic received from the interface belongs to the IETF Network Slice.

* Logical interface: For example, a given VLAN ID is used to identify an IETF Network Slice.

* Encapsulation in the traffic header: For example, a source IP address is used to identify an IETF Network Slice.

To illustrate the use of NSE parameters, the below are two examples. How the NSC realize the mapping is out of scope for this document.

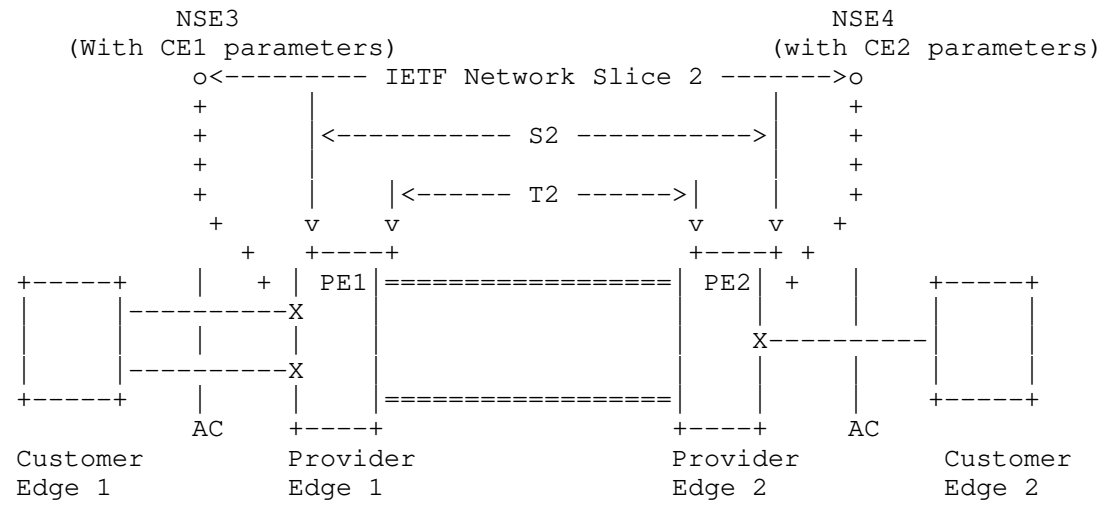
* NSE with PE parameters example: As shown in Figure 6 , customer of the IETF network slice would like to connect two NSEs to satisfy specific service, e.g., Network wholesale services. In this case, the IETF network slice endpoints are mapped to physical interfaces of PE nodes. The IETF network slice controller (NSC) uses 'node-id' (PE device ID), 'ep-network-access-points' (Two PE interfaces) to map the interfaces and corresponding services/tunnels/paths.



Legend:
O: Representation of the IETF network slice endpoints (NSE)
+: Mapping of NES to PE or CE nodes on IETF network
X: Physical interfaces used for realization of IETF network slice
S1: L0/L1/L2/L3 services used for realization of IETF network slice
T1: Tunnels used for realization of IETF network slice

Figure 6

* NSE with CE parameters example: As shown in Figure 7 , customer of the IETF network slice would like to connect two NSEs to provide connectivity between transport portion of 5G RAN to 5G Core network functions. In this scenario, the IETF network slice controller (NSC) uses 'node-id' (CE device ID) , 'ep-ip' (CE tunnel endpoint IP), 'network-slice-match-criteria' (VLAN interface), 'ep-network-access-points' (Two nexthop interfaces) to retrieve the corresponding border link or PE, and further map to services/tunnels/paths.



Legend:
O: Representation of the IETF network slice endpoints (NSE)
+: Mapping of NSE to PE or CE-PE interfaces on IETF network
X: Physical interfaces used for realization of IETF network slice
S2: L0/L1/L2/L3 services used for realization of IETF network slice
T2: Tunnels used for realization of IETF network slice

Figure 7

Note: The model needs to be optimized for better extension of other protocols or AC technologies.

8. IETF Network Slice Monitoring

An IETF Network Slice is a connectivity with specific SLO characteristics, including bandwidth, latency, etc. The connectivity is a combination of logical unidirectional connections, represented by 'ns-connection'.

This model also describes performance status of an IETF Network Slice. The statistics are described in the following granularity:

* Per NS connection: specified in 'ns-connection-monitoring' under the "ns-connection"

* Per NS Endpoint: specified in 'ep-monitoring' under the "ns-endpoint"

This model does not define monitoring enabling methods. The mechanism defined in [RFC8640] and [RFC8641] can be used for either periodic or on-demand subscription.

By specifying subtree filters or xpath filters to 'ns-connection' or 'ns-endpoint' ,so that only interested contents will be sent. These mechanisms can be used for monitoring the IETF Network Slice performance status so that the customer management system could initiate modification based on the IETF Network Slice running status.

Note: More critical events affecting service delivery need to be added.

9. IETF Network Slice Service Module

The "ietf-network-slice" module uses types defined in [RFC6991], [RFC8776].

<CODE BEGINS> file "ietf-network-slice@2021-07-20.yang"

```
module ietf-network-slice {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-network-slice";
  prefix ins;

  import ietf-inet-types {
    prefix inet;
    reference
      "RFC 6991: Common YANG Types.";
  }
  import ietf-yang-types {
    prefix yang;
    reference
      "RFC 6991: Common YANG Types.";
  }
  import ietf-te-types {
    prefix te-types;
    reference
      "RFC 8776: Common YANG Data Types for Traffic Engineering.";
  }

  organization
    "IETF Traffic Engineering Architecture and Signaling (TEAS)
     Working Group";
  contact
    "WG Web:  <https://tools.ietf.org/wg/teas/>
     WG List:  <mailto:teas@ietf.org>
     Editor: Bo Wu <lana.wubo@huawei.com>
           : Dhruv Dhody <dhruv.ietf@gmail.com>
```

```
            : Reza Rokui <reza.rokui@nokia.com>
            : Tarek Saad <tsaad@juniper.net>";
    description
      "This module contains a YANG module for the IETF Network Slice.

       Copyright (c) 2021 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 Simplified BSD License set
       forth in Section 4.c of the IETF Trust's Legal Provisions
       Relating to IETF Documents
       (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 2021-07-20 {
      description
        "initial version.";
      reference
        "RFC XXXX: A Yang Data Model for IETF Network Slice Operation";
    }

    /* Features */
    /* Identities */

    identity ns-isolation-type {
      description
        "Base identity for IETF Network slice isolation level.";
    }

    identity ns-isolation-shared {
      base ns-isolation-type;
      description
        "Shared resources (e.g. queues) are associated with the Network
         Slice traffic. Hence, the IETF network slice traffic can be
         impacted by effects of other services traffic sharing
         the same resources.";
    }

    identity ns-isolation-dedicated {
      base ns-isolation-type;
      description
        "Dedicated resources (e.g. queues) are associated with the
         Network Slice traffic. Hence, the IETF network slice traffic
         is isolated from other servceis traffic sharing the same
```

```
          resources.";
      }

      identity ns-security-type {
        description
          "Base identity for for IETF Network security level.";
      }

      identity ns-security-authenticate {
        base ns-security-type;
        description
          "IETF Network Slice requires authentication.";
      }

      identity ns-security-integrity {
        base ns-security-type;
        description
          "IETF Network Slice requires data integrity.";
      }

      identity ns-security-encryption {
        base ns-security-type;
        description
          "IETF Network Slice requires data encryption.";
      }

      identity ns-connectivity-type {
        description
          "Base identity for IETF Network Slice topology.";
      }

      identity any-to-any {
        base ns-connectivity-type;
        description
          "Identity for any-to-any IETF Network Slice topology.";
      }

      identity hub-spoke {
        base ns-connectivity-type;
        description
          "Identity for Hub-and-Spoke IETF Network Slice topology.";
      }

      identity custom {
        base ns-connectivity-type;
        description
          "Identity of a custom NS topology where Hubs can act as
           Spoke for certain parts of the network or Spokes as Hubs.";
```

```
  }

  identity endpoint-role {
    description
      "Base identity of a NSE role in an IETF Network Slice topology.";
  }

  identity any-to-any-role {
    base endpoint-role;
    description
      "Identity of any-to-any NS.";
  }

  identity spoke-role {
    base endpoint-role;
    description
      "A NSE is acting as a Spoke.";
  }

  identity hub-role {
    base endpoint-role;
    description
      "A NSE is acting as a Hub.";
  }

  identity ns-slo-metric-type {
    description
      "Base identity for IETF Network Slice SLO metric type.";
  }

  identity ns-slo-one-way-bandwidth {
    base ns-slo-metric-type;
    description
      "SLO bandwidth metric. Minimum guaranteed bandwidth between
       two endpoints at any time and is measured unidirectionally";
  }

  identity ns-slo-two-way-bandwidth {
    base ns-slo-metric-type;
    description
      "SLO bandwidth metric. Minimum guaranteed bandwidth between
       two endpoints at any time";
  }

  identity ns-slo-one-way-latency {
    base ns-slo-metric-type;
    description
      "SLO one-way latency is upper bound of network latency when
```

```
          transmitting between two endpoints. The metric is defined in
          RFC7679";
      }

      identity ns-slo-two-way-latency {
        base ns-slo-metric-type;
        description
          "SLO two-way latency is upper bound of network latency when
           transmitting between two endpoints. The metric is defined in
           RFC2681";
      }

      identity ns-slo-one-way-delay-variation {
        base ns-slo-metric-type;
        description
          "SLO one-way delay variation is defined by RFC3393, is the
           difference in the one-way delay between sequential packets
           between two endpoints.";
      }

      identity ns-slo-two-way-delay-variation {
        base ns-slo-metric-type;
        description
          "SLO two-way delay variation is defined by RFC5481, is the
           difference in the round-trip delay between sequential packets
           between two endpoints.";
      }

      identity ns-slo-one-way-packet-loss {
        base ns-slo-metric-type;
        description
          "SLO loss metric. The ratio of packets dropped to packets
           transmitted between two endpoints in one-way
           over a period of time as specified in RFC7680";
      }

      identity ns-slo-two-way-packet-loss {
        base ns-slo-metric-type;
        description
          "SLO loss metric. The ratio of packets dropped to packets
           transmitted between two endpoints in two-way
           over a period of time as specified in RFC7680";
      }

      identity ns-slo-availability {
        base ns-slo-metric-type;
        description
          "SLO availability level.";
```

```
    }

    identity ns-match-type {
      description
        "Base identity for IETF Network Slice traffic match type.";
    }

    identity ns-phy-interface-match {
      base ns-match-type;
      description
        "Use the physical interface as match criteria for the IETF
         Network Slice traffic.";
    }

    identity ns-vlan-match {
      base ns-match-type;
      description
        "Use the VLAN ID as match criteria for the IETF Network Slice
         traffic.";
    }

    identity ns-label-match {
      base ns-match-type;
      description
        "Use the MPLS label as match criteria for the IETF Network
         Slice traffic.";
    }

    identity peering-protocol-type {
      description
        "Base identity for NSE peering protocol type.";
    }

    identity peering-protocol-bgp {
      base peering-protocol-type;
      description
        "Use BGP as protocol for NSE peering with customer device.";
    }

    identity peering-static-routing {
      base peering-protocol-type;
      description
        "Use static routing for NSE peering with customer device.";
    }

    /*
     * Identity for availability-type
     */
```

```
identity availability-type {
  description
    "Base identity from which specific availability types are
     derived.";
}

identity level-1 {
  base availability-type;
  description
    "level 1: 99.9999%";
}

identity level-2 {
  base availability-type;
  description
    "level 2: 99.999%";
}

identity level-3 {
  base availability-type;
  description
    "level 3: 99.99%";
}

identity level-4 {
  base availability-type;
  description
    "level 4: 99.9%";
}

identity level-5 {
  base availability-type;
  description
    "level 5: 99%";
}

/* typedef */

typedef operational-type {
  type enumeration {
    enum up {
      value 0;
      description
        "Operational status UP.";
    }
    enum down {
      value 1;
      description
```

```
            "Operational status DOWN.";
        }
        enum unknown {
          value 2;
          description
            "Operational status UNKNOWN.";
        }
      }
      description
        "This is a read-only attribute used to determine the
         status of a particular element.";
    }

    typedef ns-monitoring-type {
      type enumeration {
        enum one-way {
          description
            "Represents one-way measurments monitoring type.";
        }
        enum two-way {
          description
            "represents two-way measurements monitoring type.";
        }
      }
      description
        "An enumerated type for monitoring on a IETF Network Slice
         connection.";
    }

    /* Groupings */

    grouping status-params {
      description
        "A grouping used to join operational and administrative status.";
      container status {
        description
          "A container for the administrative and operational state.";
        leaf admin-enabled {
          type boolean;
          description
            "The administrative status.";
        }
        leaf oper-status {
          type operational-type;
          config false;
          description
            "The operational status.";
        }
```

```
      }
    }

    grouping ns-match-criteria {
      description
        "A grouping for the IETF Network Slice match definition.";
      container ns-match-criteria {
        description
          "Describes the IETF Network Slice match criteria.";
        list ns-match-criterion {
          key "match-type";
          description
            "List of the IETF Network Slice traffic match criteria.";
          leaf match-type {
            type identityref {
              base ns-match-type;
            }
            description
              "Identifies an entry in the list of the IETF Network Slice
               match criteria.";
          }
          list values {
            key "index";
            description
              "List of match criteria values.";
            leaf index {
              type uint8;
              description
                "Index of an entry in the list.";
            }
            leaf value {
              type string;
              description
                "Describes the IETF Network Slice match criteria, e.g.
                 IP address, VLAN, etc.";
            }
          }
        }
      }
    }

    grouping ns-connection-group-metric-bounds {
      description
        "Grouping of Network Slice metric bounds that
         are shared amongst multiple connections of a Network
         Slice.";
      leaf ns-slo-shared-bandwidth {
        type te-types:te-bandwidth;
```

```
        description
          "A limit on the bandwidth that is shared amongst
           multiple connections of an IETF Network Slice.";
      }
    }

    grouping ns-sles {
      description
        "Indirectly Measurable Objectives of a IETF Network
         Slice.";
      leaf-list security {
        type identityref {
          base ns-security-type;
        }
        description
          "The IETF Network Slice security SLE(s)";
      }
      leaf isolation {
        type identityref {
          base ns-isolation-type;
        }
        default "ns-isolation-shared";
        description
          "The IETF Network Slice isolation SLE requirement.";
      }
      leaf max-occupancy-level {
        type uint8 {
          range "1..100";
        }
        description
          "The maximal occupancy level specifies the number of flows to
           be admitted.";
      }
      leaf mtu {
        type uint16;
        units "bytes";
        mandatory true;
        description
          "The MTU specifies the maximum length in octets of data
           packets that can be transmitted by the NS. The value needs
           to be less than or equal to the minimum MTU value of
           all 'ep-network-access-points' in the NSEs of the NS. ";
      }
      container steering-constraints {
        description
          "Container for the policy of steering constraints
           applicable to IETF Network Slice.";
        container path-constraints {
```

```
          description
            "Container for the policy of path constraints
             applicable to IETF Network Slice.";
        }
        container service-function {
          description
            "Container for the policy of service function
             applicable to IETF Network Slice.";
        }
      }
    }

    grouping ns-metric-bounds {
      description
        "IETF Network Slice metric bounds grouping.";
      container ns-metric-bounds {
        description
          "IETF Network Slice metric bounds container.";
        list ns-metric-bound {
          key "metric-type";
          description
            "List of IETF Network Slice metric bounds.";
          leaf metric-type {
            type identityref {
              base ns-slo-metric-type;
            }
            description
              "Identifies an entry in the list of metric type
               bounds for the IETF Network Slice.";
          }
          leaf metric-unit {
            type string;
            mandatory true;
            description
              "The metric unit of the parameter. For example,
               s, ms, ns, and so on.";
          }
          leaf value-description {
            type string;
            description
              "The description of previous value. ";
          }
          leaf bound {
            type uint64;
            default "0";
            description
              "The Bound on the Network Slice connection metric. A
               zero indicate an unbounded upper limit for the
```

```
                specific metric-type.";
            }
          }
        }
      }

      grouping ep-peering {
        description
          "A grouping for the IETF Network Slice Endpoint peering.";
        container ep-peering {
          description
            "Describes NSE peering attributes.";
          list protocol {
            key "protocol-type";
            description
              "List of the NSE peering protocol.";
            leaf protocol-type {
              type identityref {
                base peering-protocol-type;
              }
              description
                "Identifies an entry in the list of NSE peering
                 protocol type.";
            }
            list attribute {
              key "index";
              description
                "List of protocol attribute.";
              leaf index {
                type uint8;
                description
                  "Index of an entry in the list.";
              }
              leaf attribute-description {
                type string;
                description
                  "The description of the attribute. ";
              }
              leaf value {
                type string;
                description
                  "Describes the value of protocol attribute, e.g.
                   nexthop address, peer address, etc.";
              }
            }
          }
        }
      }
```

```
    grouping ep-network-access-points {
      description
        "Grouping for the endpoint network access definition.";
      container ep-network-access-points {
        description
          "List of network access points.";
        list ep-network-access-point {
          key "network-access-id";
          description
            "The IETF Network Slice network access points
             related parameters.";
          leaf network-access-id {
            type string;
            description
              "Uniquely identifier a network access point.";
          }
          leaf network-access-description {
            type string;
            description
              "The network access point description.";
          }
          leaf network-access-node-id {
            type string;
            description
              "The network access point node ID in the case of
               multi-homing.";
          }
          leaf network-access-tp-id {
            type string;
            description
              "The termination port ID of the EP network access
               point.";
          }
          leaf network-access-tp-ip {
            type inet:host;
            description
              "The IP address of the EP network access point.";
          }
          leaf mtu {
            type uint16;
            units "bytes";
            mandatory true;
            description
              "Maximum size in octets of a data packet that
               can traverse a NSE network access point. ";
          }
          /* Per ep-network-access-point rate limits */
          uses ns-rate-limit;
```

```
        }
      }
    }

    grouping endpoint-monitoring-parameters {
      description
        "Grouping for the endpoint monitoring parameters.";
      container ep-monitoring {
        config false;
        description
          "Container for endpoint monitoring parameters.";
        leaf incoming-utilized-bandwidth {
          type te-types:te-bandwidth;
          description
            "Incoming bandwidth utilization at an endpoint.";
        }
        leaf incoming-bw-utilization {
          type decimal64 {
            fraction-digits 5;
            range "0..100";
          }
          units "percent";
          mandatory true;
          description
            "To be used to define the bandwidth utilization
             as a percentage of the available bandwidth.";
        }
        leaf outgoing-utilized-bandwidth {
          type te-types:te-bandwidth;
          description
            "Outoing bandwidth utilization at an endpoint.";
        }
        leaf outgoing-bw-utilization {
          type decimal64 {
            fraction-digits 5;
            range "0..100";
          }
          units "percent";
          mandatory true;
          description
            "To be used to define the bandwidth utilization
             as a percentage of the available bandwidth.";
        }
      }
    }

    grouping common-monitoring-parameters {
      description
```

```
        "Grouping for link-monitoring-parameters.";
      leaf latency {
        type yang:gauge64;
        units "usec";
        description
          "The latency statistics per Network Slice connection.
           RFC2681 and RFC7679 discuss round trip times and one-way
           metrics, respectively";
      }
      leaf jitter {
        type yang:gauge32;
        description
          "The jitter statistics per Network Slice member
           as defined by RFC3393.";
      }
      leaf loss-ratio {
        type decimal64 {
          fraction-digits 6;
          range "0 .. 50.331642";
        }
        description
          "Packet loss as a percentage of the total traffic
           sent over a configurable interval. The finest precision is
           0.000003%. where the maximum 50.331642%.";
        reference
          "RFC 7810, section-4.4";
      }
    }

    grouping geolocation-container {
      description
        "A grouping containing a GPS location.";
      container location {
        description
          "A container containing a GPS location.";
        leaf altitude {
          type int64;
          units "millimeter";
          description
            "Distance above the sea level.";
        }
        leaf latitude {
          type decimal64 {
            fraction-digits 8;
            range "-90..90";
          }
          description
            "Relative position north or south on the Earth's surface.";
```

```
        }
        leaf longitude {
          type decimal64 {
            fraction-digits 8;
            range "-180..180";
          }
          description
            "Angular distance east or west on the Earth's surface.";
        }
      }
      // gps-location
    }

    // geolocation-container

    grouping ns-rate-limit {
      description
        "The Network Slice rate limit grouping.";
      container ep-rate-limit {
        description
          "Container for the asymmetric traffic control";
        leaf incoming-rate-limit {
          type te-types:te-bandwidth;
          description
            "The rate-limit imposed on incoming traffic.";
        }
        leaf outgoing-rate-limit {
          type te-types:te-bandwidth;
          description
            "The rate-limit imposed on outgoing traffic.";
        }
      }
    }

    grouping endpoint {
      description
        "IETF Network Slice endpoint related information";
      leaf ep-id {
        type string;
        description
          "unique identifier for the referred IETF Network
           Slice endpoint";
      }
      leaf ep-description {
        type string;
        description
          "endpoint name";
      }
```

```
      leaf ep-role {
        type identityref {
          base endpoint-role;
        }
        default "any-to-any-role";
        description
          "Role of the endpoint in the IETF Network Slice.";
      }
      uses geolocation-container;
      leaf node-id {
        type string;
        description
          "Uniquely identifies an edge node within the IETF slice
           network.";
      }
      leaf ep-ip {
        type inet:host;
        description
          "The address of the endpoint IP address.";
      }
      uses ns-match-criteria;
      uses ep-peering;
      uses ep-network-access-points;
      uses ns-rate-limit;
      /* Per NSE rate limits */
      uses status-params;
      uses endpoint-monitoring-parameters;
    }

    //ns-endpoint

    grouping ns-connection {
      description
        "The Network Slice connection is described in this container.";
      leaf ns-connection-id {
        type uint32;
        description
          "The Network Slice connection identifier";
      }
      leaf ns-connection-description {
        type string;
        description
          "The Network Slice connection description";
      }
      container src {
        description
          "the source of Network Slice link";
        leaf src-ep-id {
```

```
          type leafref {
            path "/network-slices/network-slice"
               + "/ns-endpoints/ns-endpoint/ep-id";
          }
          description
            "reference to source Network Slice endpoint";
        }
      }
      container dest {
        description
          "the destination of Network Slice link ";
        leaf dest-ep-id {
          type leafref {
            path "/network-slices/network-slice"
               + "/ns-endpoints/ns-endpoint/ep-id";
          }
          description
            "reference to dest Network Slice endpoint";
        }
      }
      uses ns-slo-sle-policy;
      /* Per connection ns-slo-sle-policy overrides
       * the per network slice ns-slo-sle-policy.
       */
      leaf monitoring-type {
        type ns-monitoring-type;
        description
          "One way or two way monitoring type.";
      }
      container ns-connection-monitoring {
        config false;
        description
          "SLO status Per network-slice endpoint to endpoint ";
        uses common-monitoring-parameters;
      }
    }

    //ns-connection

    grouping slice-template {
      description
        "Grouping for slice-templates.";
      container ns-slo-sle-templates {
        description
          "Contains a set of network slice templates to
           reference in the IETF network slice.";
        list ns-slo-sle-template {
          key "id";
```

```
          leaf id {
            type string;
            description
              "Identification of the Service Level Objective (SLO)
               and Service Level Expectation (SLE) template to be used.
               Local administration meaning.";
          }
          leaf template-description {
            type string;
            description
              "Description of the SLO &amp;amp; SLE policy template.";
          }
          description
            "List for SLO and SLE template identifiers.";
        }
      }
    }

    /* Configuration data nodes */

    grouping ns-slo-sle-policy {
      description
        "Network Slice policy grouping.";
      choice ns-slo-sle-policy {
        description
          "Choice for SLO and SLE policy template.
           Can be standard template or customized template.";
        case standard {
          description
            "Standard SLO template.";
          leaf slo-sle-template {
            type leafref {
              path "/network-slices"
                 + "/ns-slo-sle-templates/ns-slo-sle-template/id";
            }
            description
              "Standard SLO and SLE template to be used.";
          }
        }
        case custom {
          description
            "Customized SLO template.";
          container slo-sle-policy {
            description
              "Contains the SLO policy.";
            leaf policy-description {
              type string;
              description
```

```
                "Description of the SLO policy.";
            }
            uses ns-metric-bounds;
            uses ns-sles;
          }
        }
      }
    }

    container network-slices {
      description
        "IETF network-slice configurations";
      uses slice-template;
      list network-slice {
        key "ns-id";
        description
          "a network-slice is identified by a ns-id";
        leaf ns-id {
          type string;
          description
            "A unique network-slice identifier across an IETF NSC ";
        }
        leaf ns-description {
          type string;
          description
            "Give more description of the network slice";
        }
        leaf-list customer-name {
          type string;
          description
            "List of the customer that actually uses the slice.
             In the case that multiple customers sharing
             same slice service, e.g., 5G, customer name may
             help with operational management";
        }
        leaf ns-connectivity-type {
          type identityref {
            base ns-connectivity-type;
          }
          default "any-to-any";
          description
            "Network Slice topology.";
        }
        uses ns-slo-sle-policy;
        uses status-params;
        container ns-endpoints {
          description
            "Endpoints";
```

```
          list ns-endpoint {
            key "ep-id";
            uses endpoint;
            description
              "List of endpoints in this slice";
          }
        }
        container ns-connections {
          description
            "Connections container";
          list ns-connection {
            key "ns-connection-id";
            description
              "List of Network Slice connections.";
            uses ns-connection;
          }
        }
      }
      //ietf-network-slice list
    }
  }
  <CODE ENDS>
```

10. Security Considerations

The YANG module 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 module that are writable/creatable/deletable (i.e., config true, which is the default). These data nodes may be considered sensitive or vulnerable in some network environments. Write operations (e.g., edit-config) to these data nodes without proper protection can have a negative effect on network operations.

o /ietf-network-slice/network-slices/network-slice

The entries in the list above include the whole network configurations corresponding with the slice which the higher management system requests, 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.

11. 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-network-slice
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-network-slice
Namespace: urn:ietf:params:xml:ns:yang:ietf-network-slice
Prefix: ins
Reference: RFC XXXX

12. Acknowledgments

The authors wish to thank Mohamed Boucadair, Kenichi Ogaki, Sergio Belotti, Qin Wu, Susan Hares, Eric Grey, and many others for their helpful comments and suggestions.

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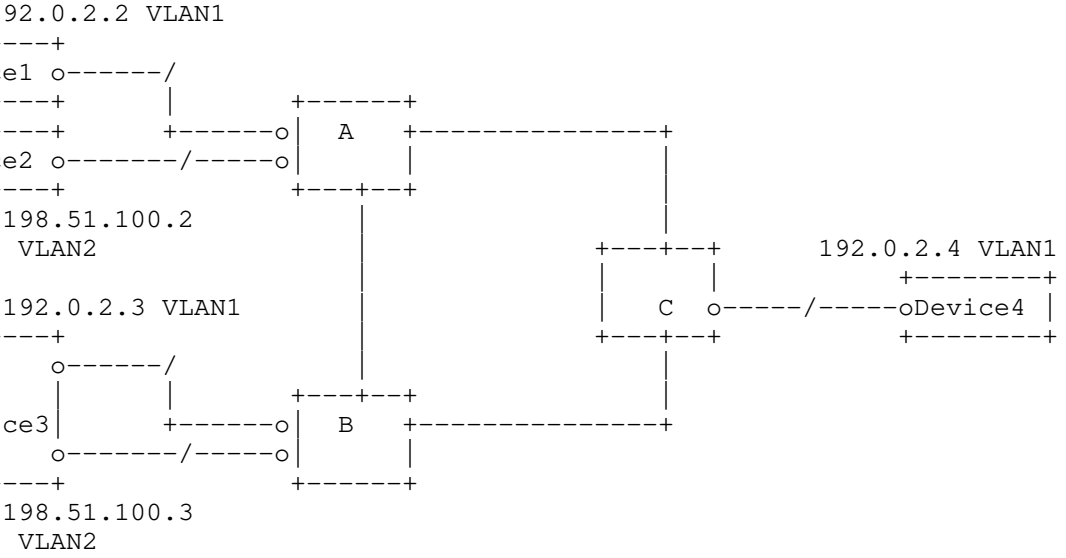
Appendix A. IETF Network Slice NBI Model Usage Example

The following example describes a simplified service configuration of two IETF Network slice instances:

* IETF Network Slice 1 on Device1, Device3, and Device4, with any-to-any connectivity type

* IETF Network Slice 2 on Device2, Device3, with any-to-any connectivity type




```
   POST: /restconf/data/ietf-network-slice:ietf-network-slices
   Host: example.com
   Content-Type: application/yang-data+json
{
   "network-slices":{
      "network-slice":[
         {
            "ns-id":"1",
            "ns-description":"slice1",
            "ns-connectivity-type":"any-to-any",
```

```
            "ns-endpoints":{
               "ns-endpoint":[
                {
                  "ep-id":"11",
                  "ep-description":"slice1 ep1 connected to device 1",
                  "ep-role":"any-to-any-role",
                  "ns-match-criteria":[
                      {
                         "match-type":"ns-vlan-match",
                         "value":[
                            {
                               "index":"1",
                               "value":"1"
                            }
                         ]
                      }
                   ]
                },
                {
                  "ep-id":"12",
                  "ep-description":"slice1 ep2 connected to device 3",
                  "ep-role":"any-to-any-role",
                  "ns-match-criteria":[
                     {
                       "match-type":"ns-vlan-match",
                       "value":[
                           {
                             "index":"1",
                             "value":"20"
                           }
                       ]
                      }
                  ]
                },
                {
                     "ep-id":"13",
                     "ep-description":"slice1 ep3 connected to device 4",
                     "ep-role":"any-to-any-role",
                     "ns-match-criteria":[
                        {
                           "match-type":"ns-vlan-match",
                           "value":[
                              {
                                 "index":"1",
                                 "value":"1"
                              }
                           ]
                        }
```

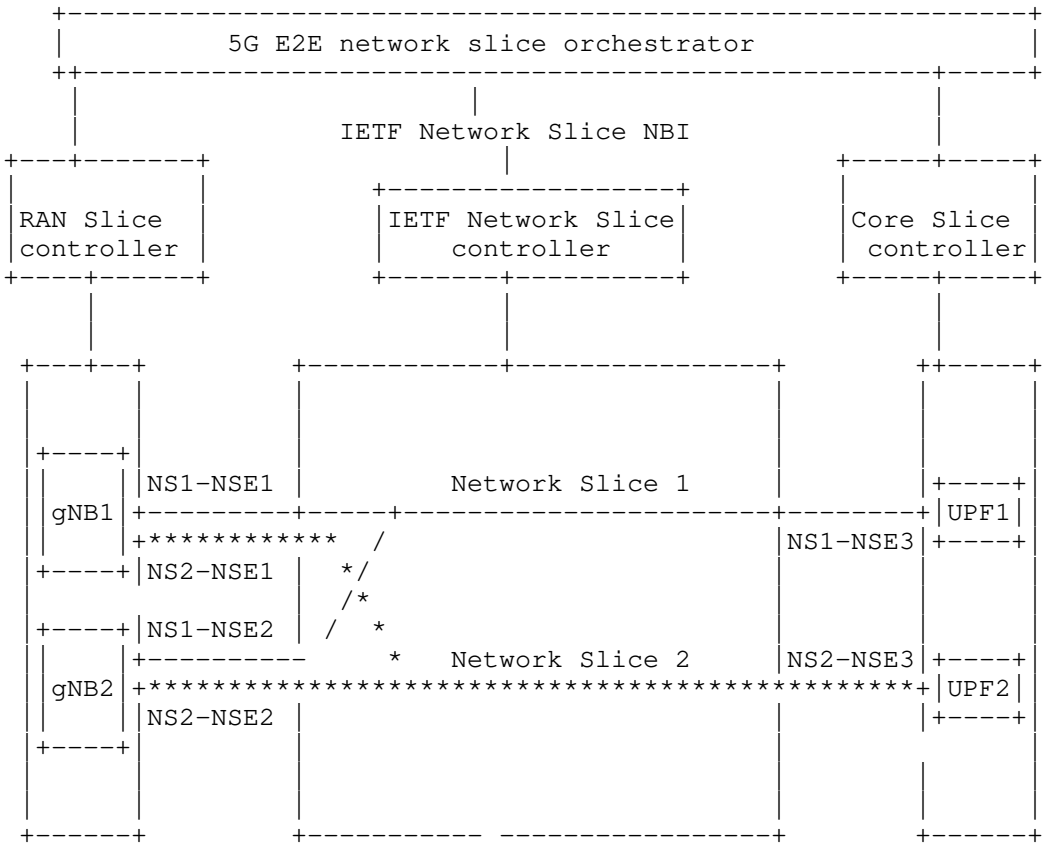
```
                    ]
                  }
              ]
            }
          },
           {
             "ns-id":"ns2",
             "ns-description":"slice2",
             "ns-connectivity-type":"any-to-any",
             "ns-endpoints":{
               "ns-endpoint":[
                  {
                      "ep-id":"21",
                      "ep-description":"slice2 ep1 connected to device 2",
                      "ep-role":"any-to-any-role",
                      "ns-match-criteria":[
                       {
                           "match-type":"ns-vlan-match",
                           "value":[
                            {
                               "index":"1",
                               "value":"2"
                            }
                            ]
                       }
                     ]
                   },
                   {
                       "ep-id":"22",
                       "ep-description":"slice2 ep2 connected to device 3",
                       "ep-role":"any-to-any-role",
                       "ns-match-criteria":[
                        {
                          "match-type":"ns-vlan-match",
                          "value":[
                           {
                              "index":"1",
                              "value":"2"
                           }
                         ]
                        }
                       ]
                     }
                   ]
                 }
              }
           ]
      }
```

}

Appendix B. Appendix B IETF Network Slice Match Criteria

5G is a use case of the IETF Network Slice and 5G End-to-end Network Slice Mapping from the view of IETF Network[I-D.geng-teas-network-slice-mapping]

defines two types of Network Slice interconnection and differentiation methods: by physical interface or by TNSII (Transport Network Slice Interworking Identifier). TNSII is a field in the packet header when different 5G wireless network slices are transported through a single physical interfaces of the IETF scoped Network. In the 5G scenario, "network-slice-match-criteria" refers to TNSII.



As shown in the figure, gNodeB 1 and gNodeB 2 use IP gNB1 and IP gNB2 to communicate with the IETF network, respectively. In addition, the traffic of NS1 and NS2 on gNodeB 1 and gNodeB 2 is transmitted through the same access links to the IETF slice network. The IETF slice network need to to distinguish different IETF Network Slice traffic of same gNB. Therefore, in addition to using "node-id" and "ep-ip" to identify a Network Slice Endpont, other information is needed along with these parameters to uniquely distinguish a NSE. For example, VLAN IDs in the user traffic can be used to distinguish the NSEs of gNBs and UPFs.

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