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 IETF Network Slice Service Mapping YANG Model

Abstract

This document provides a YANG data model to map IETF network slice service to Traffic Engineering (TE) models (e.g., the Virtual Network (VN) model or the TE Tunnel etc). It also supports mapping to the VPN Network models and Network Resource Partition (NRP) models. These models are referred to as IETF network slice service mapping model and are applicable generically for the seamless control and management of the IETF network slice service with underlying TE/VPN support.

The models are principally used for monitoring and diagnostics of the management systems to show how the IETF network slice service requests are mapped onto underlying network resource and TE/VPN models.

Status of This Memo

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1. Introduction

Data models are a representation of objects that can be configured or monitored within a system. Within the IETF, YANG [[RFC7950](#)] is the language of choice for documenting data models, and YANG models have been produced to allow configuration or modeling of a variety of network devices, protocol instances, and network services.

The YANG model discussed in this document augments the IETF Network Slice Service YANG model [[I-D.ietf-teas-ietf-network-slices](#)], which is used to operate IETF Network Slices during the IETF Network Slice instantiation. This provides a way to map IETF network slice service to Traffic Engineering (TE) models (e.g., the Virtual Network (VN) model or the TE Tunnel etc). Alternatively, it also supports mapping to the VPN Network models and Network Resource Partition (NRP) models.

The model supports:

- *A mapping of the IETF Network Slice with the Network Resource Partition (NRP). As per [[I-D.ietf-teas-ietf-network-slices](#)], NRP is a collection of resources (bufferage, queuing, scheduling, etc.) in the underlay network. The NRP YANG model is specified in [[I-D.wd-teas-nrp-yang](#)]. The IETF Network Slice can be mapped to the NRP directly.
- *A mapping of the IETF Network Slice with the VPN network models - LxNM. This mapping can be populated at the time of IETF network service realization. This mapping information is internal and used for monitoring and diagnostics purpose such as telemetry, auto-scaling, closed-loop automation. Note that the LxNM may further map to other TE resources as specified in [[I-D.ietf-teas-te-service-mapping-yang](#)]. Optionally, a mapping to the NRP can also be populated.
- *A mapping of the IETF Network Slice with the underlying TE resources directly. The TE resources could be in a form of VN, set of TE tunnels, TE abstract topology etc. This mapping can be populated by the network at the time of realization of the IETF network slice service. It is also possible to configure the mapping provided one is aware of NRP/VN/tunnels. This mapping mode is used only when there is an awareness of VN or TE by the consumer of the model. Otherwise this mapping information is internal and used for monitoring and diagnostics purpose such as telemetry, auto-scaling, closed-loop automation.
- *Possibility to request creation of a new VN/Tunnel to be binded to IETF network slice.
- *Indication to share the VN/Tunnel sharing (with or without modification) for the IETF network slice.
- *Support for configuration of underlying TE properties (as opposed to existing VN or tunnels).

Note: The RFC Editor will replace XXXX with the number assigned to the RFC once this draft becomes an RFC.

2. Conventions

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.

2.1. Tree Diagrams

A simplified graphical representation of the data model is used in this document. The meaning of the symbols in these diagrams is defined in [[RFC8340](#)].

2.2. Prefixes in Data Node Names

In this document, names of data nodes and other data model objects are often used without a prefix, as long as it is clear from the context in which YANG module each name is defined. Otherwise, names are prefixed using the standard prefix associated with the corresponding YANG module, as shown in Table 1.

Prefix	YANG module	Reference
nw	ietf-network	[RFC8345]
tsmt	ietf-te-service-mapping-types	[I-D.ietf-teas-te-service-mapping-yang]
l3vpn-ntw	ietf-l3vpn-ntw	[RFC9182]
l2vpn-ntw	ietf-l2vpn-ntw	[RFC9291]
ietf-ns	ietf-network-slice	[I-D.ietf-teas-ietf-network-slice-nbi-yang]
nrp	ietf-nrp	[I-D.wd-teas-nrp-yang]

Table 1

2.3. References in the Model

Following additional documents are referenced in the model defined in this document -

Document	Reference
Framework for IETF Network Slices	[I-D.ietf-teas-ietf-network-slices]

Table 2

3. Model Design

The YANG model specified in this document augments the IETF network slice service YANG model [[I-D.ietf-teas-ietf-network-slice-nbi-yang](#)].

Currently following mapping are supported:

*L3NM: The L3 network model (L3NM) describes a L3VPN Service in the Service Provider Network. It contains information of the Service Provider network and might include allocated resources.

It can be used by network controllers to manage and control the L3VPN Service configuration in the Service Provider network. This model maps an IETF network slice to a L3VPN ID.

*L2NM: The L2 network model (L2NM) describes a L2VPN Service in the Service Provider Network. It contains information of the Service Provider network and might include allocated resources. It can be used by network controllers to manage and control the L2VPN Service configuration in the Service Provider network. This model maps an IETF network slice to a L2VPN ID.

*TE: The TE mapping is specified in [\[I-D.ietf-teas-te-service-mapping-yang\]](#). The mapping can be done to the following TE resources:

- Virtual Networks (VN) [\[RFC8453\]](#)
- TE-Tunnels
- TE-Topology

*NRP: [\[I-D.ietf-teas-ietf-network-slices\]](#) defines IETF network slice services that provide connectivity coupled with network resources commitment between a number of endpoints over a shared network infrastructure and, for scalability concerns, defines NRP to host one or a group of network slice services according to characteristics including SLOs and SLEs. Along with mapping to VPN, this model maps an IETF network slice to a NRP ID.

3.1. Open Questions

The following open questions needs to be addressed in a future revision:

- *Is there a need/use-case to map IETF Network slice Connection Group and/or Connectivity Construct as well?
- *Is there a need/use-case to map IETF Network slice Service Demarcation Points (SDPs)?
- *Is there a need to indicate "map-type" (new, share) for NRP and VPNs?

4. Tree Structure

module: ietf-network-slice-mapping

```
augment /ietf-ns:network-slices/ietf-ns:network-slice:
  +--rw mapping!
    +--rw ns-mapping
      +--rw map-to? identityref
      +--rw (map)?
        +--:(nrp)
          | +--rw nrp-id?
          | -> /nw:networks/network/nrp:nrp/nrp-id
        +--:(l3vpn)
          | +--rw l3vpn-id? leafref
          | +--rw l3vpn-nrp-id?
          | -> /nw:networks/network/nrp:nrp/nrp-id
        +--:(l2vpn)
          | +--rw l2vpn-id? leafref
          | +--rw l2vpn-nrp-id?
          | -> /nw:networks/network/nrp:nrp/nrp-id
        +--:(te)
          +--rw type? identityref
          +--rw te-policy
            | +--rw path-affinities-values
            | | +--rw path-affinities-value* [usage]
            | | ...
            | +--rw path-affinity-names
            | | +--rw path-affinity-name* [usage]
            | | ...
            | +--rw protection-type? identityref
            | +--rw availability-type? identityref
          +--rw (te)?
            | +--:(vn)
            | | +--rw vn*
            | | -> /vn:virtual-network/vn/vn-id
            | +--:(te-topo)
            | | +--rw te-topology-identifier
            | | | ...
            | | +--rw abstract-node?
            | | -> /nw:networks/network/node/node-id
            | +--:(te-tunnel)
            | +--rw te-tunnel* te:tunnel-ref
            | +--rw sr-policy*
            | | [headend color-ref endpoint-ref]
            | | {sr-policy}?
            | | ...
          +--rw template-ref? leafref
            {template}?
```

5. YANG Model

```

<CODE BEGINS> file "ietf-network-slice-mapping@2023-03-12.yang"
module ietf-network-slice-mapping {
  yang-version 1.1;
  namespace
    "urn:ietf:params:xml:ns:yang:ietf-network-slice-mapping";
  prefix ietf-nsm;

  import ietf-network {
    prefix nw;
    reference
      "RFC 8345: A YANG Data Model for Network Topologies";
  }
  import ietf-network-slice {
    prefix ietf-ns;
    reference
      "I-D.ietf-teas-ietf-network-slice-nbi-yang: IETF Network Slice
        Service YANG Model";
  }
  import ietf-te-service-mapping-types {
    prefix tsmt;
    reference
      "I-D.ietf-teas-te-service-mapping-yang: Traffic Engineering
        (TE) and Service Mapping YANG Data Model";
  }
  import ietf-l3vpn-ntw {
    prefix l3vpn-ntw;
    reference
      "RFC 9182: A YANG Network Data Model for Layer 3 VPNs";
  }
  import ietf-l2vpn-ntw {
    prefix l2vpn-ntw;
    reference
      "RFC 9291: A Layer 2 VPN Network YANG Model";
  }
  import ietf-nrp {
    prefix nrp;
    reference
      "I-D.wd-teas-nrp-yang: A YANG Data Model for Network
        Resource Partition (NRP)";
  }

  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: Dhruv Dhody <dhruv.ietf@gmail.com>
        Bo Wu <lane.wubo@huawei.com>";

```

description

"This module contains a YANG module to map the IETF Network Slice with Traffic Engineering (TE) or VPN Network models.

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

revision 2023-03-12 {

description

"initial version.";

reference

"RFC XXXX: IETF Network Slice Service Mapping YANG Model";

}

identity map-to {

description

"Base identity from which specific map-to are derived.";

}

identity map-to-nrp {

base map-to;

description

"Map to Network Resource Partition (NRP)";

}

identity map-to-vpn {

base map-to;

description

"Map to VPN";

}

identity map-to-l3vpn {

base map-to-vpn;

description

"Map to L3VPN";

}

identity map-to-l2vpn {

base map-to-vpn;

description

```

    "Map to L2VPN";
}

identity map-to-l1vpn {
    base map-to-vpn;
    description
        "Map to L1VPN";
}

identity map-to-te {
    base map-to;
    description
        "Map to TE directly";
}

grouping ns-mapping {
    description
        "Mapping between IETF network slice and Network
        Resource Partition (NRP)/VPN/TE";
    container ns-mapping {
        description
            "The container for the mapping";
        leaf map-to {
            type identityref {
                base map-to;
            }
            description
                "Mapping to NRP/VPN/TE";
        }
        choice map {
            description
                "Mapping to NRP/VPN/TE";
            case nrp {
                leaf nrp-id {
                    type leafref {
                        path "/nw:networks/nw:network"
                            + "/nrp:nrp/nrp:nrp-id";
                    }
                    description
                        "A reference to NRP ID";
                    reference
                        "I-D.ietf-teas-ietf-network-slices: Framework
                        for IETF Network Slices";
                }
            }
            case l3vpn {
                leaf l3vpn-id {
                    type leafref {
                        path "/l3vpn-ntw:l3vpn-ntw"

```

```

        + "/l3vpn-ntw:vpn-services"
        + "/l3vpn-ntw:vpn-service"
        + "/l3vpn-ntw:vpn-id";
    }
    description
        "A reference to VPN ID";
}
leaf l3vpn-nrp-id {
    type leafref {
        path "/nw:networks/nw:network"
            + "/nrp:nrp/nrp:nrp-id";
    }
    description
        "An optional reference to NRP ID";
    reference
        "I-D.ietf-teas-ietf-network-slices: Framework
        for IETF Network Slices";
}
description
    "Mapping to L3NM";
reference
    "RFC9182: A YANG Network Data Model for
    Layer 3 VPNs";
}
case l2vpn {
    leaf l2vpn-id {
        type leafref {
            path "/l2vpn-ntw:l2vpn-ntw"
                + "/l2vpn-ntw:vpn-services"
                + "/l2vpn-ntw:vpn-service"
                + "/l2vpn-ntw:vpn-id";
        }
        description
            "A reference to VPN ID";
    }
    leaf l2vpn-nrp-id {
        type leafref {
            path "/nw:networks/nw:network"
                + "/nrp:nrp/nrp:nrp-id";
        }
        description
            "An optional reference to NRP ID";
        reference
            "I-D.ietf-teas-ietf-network-slices: Framework
            for IETF Network Slices";
    }
}
description
    "Mapping to L2NM";
reference

```

```

        "RFC 9291: A Layer 2 VPN Network YANG Model";
    }
    case te {
        uses tsmt:te-mapping;
        description
            "Mapping to TE directly";
        reference
            "I-D.ietf-teas-te-service-mapping-yang:
            Traffic Engineering (TE) and Service
            Mapping YANG Model";
    }
}
}
}

augment "/ietf-ns:network-slices/ietf-ns:network-slice" {
    description
        "IETF Network Slice augmented to include the mapping
        information to the network slice realization";
    container mapping {
        presence "Indicates Mapping information";
        description
            "Container to augment IETF network slice to
            include NRP / VPN / TE mappings";
        uses ns-mapping;
    }
}
}

```

<CODE ENDS>

6. Security Considerations

TBD

7. IANA Considerations

IANA is requested to make the following allocation for the URIs in the "ns" subregistry within the "IETF XML Registry" [[RFC3688](#)]:

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

IANA is requested to make the following allocation for the YANG module in the "YANG Module Names" registry [[RFC6020](#)]:

```
-----  
name:          ietf-network-slice-mapping  
namespace:     urn:ietf:params:xml:ns:yang:ietf-network-slice-mapping  
prefix:        ietf-nsm  
reference:     RFC XXXX  
-----
```

8. References

8.1. Normative References

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Appendix A. Acknowledgments

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Appendix B. Examples

TO be added in future revisions.

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