Transport Network Slice
YANG Data Model

draft-liu-teas-transport-network-slice-yang-01

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Existing Network Topology Models

Network Topology Model
RFC8345
ietf-network-topology

L2 Topology Model
draft-ietf-i2rs-yang-l2-network-topology

L3 Topology Model
RFC8346

TE Topology Model
draft-ietf-teas-yang-te-topo

OTN Topology Model
draft-ietf-ccamp-otn-topo-yang
Augmentation for Network Slice

Network Topology Model
RFC8345
ietf-network-topology

L2 Topology Model
draft-ietf-i2rs-yang-l2-network-topology

L3 Topology Model
RFC8346

TE Topology Model
draft-ietf-teas-yang-te-topo

OTN Topology Model
draft-ietf-ccamp-otn-topo-yang

Network Slice Model
Transport Network Slice with TE

- Multiple inheritance:
  - Is both Network Slice topology and TE topology.
  - Uses multiple network types: “network-slice” and “te-topology”.

Diagram:
- Network Slice
- TE Topology
- ietf-te-topology
- Transport Network Slice with TE
Network Slice with L3 TE and SF Aware

- For L3 packet use cases
  - ietf-te-topology-packet provides extensions for packet network.
  - ietf-l3-unicast-topology provides extensions for L3 network.
  - ietf-te-topology-sf supports network services and functions.
ACTN for Network Slicing

- ACTN topology data models are based on the network topology model defined in RFC8345.
- The augmentations defined in this document are effective augmentations to the ACTN topology data models.
- The augmentations make the ACTN framework [RFC8453] and data models [I-D.ietf-teas-actn-yang] capable of slicing networks with the required network characteristics.
Transport Network Slicing – by Virtualization

Network Slice Blue

Provider Network

Virtual Devices

VR1

VR2

VR3

VR4

VR5

VR6

Customized topologies

supporting-node

supporting-link

Physical Devices

Native topology

Provider Network

Network Slice Red

Client topology

R1

R2

R3

R4

R2

R3

R4

Client topology

supporting-node

supporting-link
Use Case with Slicing – by Virtualization

- **Network Slice Blue**
  - PE 1
  - R1
  - R2
  - PE 2
  - R3
  - IP MPLS
  - Ethernet

- **Network Slice Red**
  - R2
  - R3
  - R4

- **Provider Network**
  - VR1
  - VR2
  - VR3
  - VR4
  - VR5
  - VR6

- **Customer Network**
  - Company site 1
  - Company site 2

- **Supporting Link**
  - Supporting-node

- **Customized topologies**
  - Supporting-link
Transport Network Slicing – by TE Overlay

Network Slice Blue

Network Slice Red

Provider Network with TE isolation

Provider Network with TE tunnels

TE tunnel for Network Slice Blue

TE tunnel for Network Slice Red
Transport Network Slicing – by TE Overlay

Company site 1
Customer Network

Company site 2
IP Service

Company site 3

Network Slice Blue
IP
OTN Tunnel
R1
R2
R3

Network Slice Red
R2
R3
R4

IP Tunnel

Provider Network with TE isolation
R1
R2
R3
R4

OTN Tunnel
module: ietf-network
  +--rw networks
    +--rw network* [network-id]
      +--rw network-id network-id
      +--rw network-types
    +--rw supporting-network* [network-ref]
      | +--rw network-ref -> /networks/network/network-id
    +--rw node* [node-id]
      | +--rw node-id node-id
      | +--rw supporting-node* [network-ref node-ref]
      | | +--rw network-ref -> ../../../supporting-network/network-ref
      | | +--rw node-ref -> /networks/network/node/node-id
      +--rw nt:termination-point* [tp-id]
        | +--rw nt:tp-id tp-id
        | +--rw nt:supporting-termination-point* [network-ref node-ref tp-ref]
        | | +--rw network-ref -> ../../../supporting-network/network-ref
        | | +--rw node-ref -> ../../../supporting-network/node/node-id
        | +--rw nt:link* [link-id]
          | +--rw nt:link-id link-id
          +--rw nt:source
            | +--rw nt:source-node? -> ../../../nw:node/node-id
          +--rw nt:destination
            | +--rw nt:dest-node? -> ../../../nw:node/node-id
          +--rw nt:supporting-link* [network-ref link-ref]
            +--rw network-ref -> ../../../nw:supporting-network/network-ref
            +--rw link-ref -> /nw:networks/network[nw:network-id=current()]/../network-ref/link/link-id
Transport Network Slice YANG Model Schema

```yang
++-rw networks
  ++-rw network* [network-id]
    ++-rw network-id network-id
    ++-rw network-types
      |  ++-rw ns:network-slice!
    ++-rw supporting-network* [network-ref]
      |  ++-rw network-ref -> /networks/network/network-id
    ++-rw node* [node-id]
      |  ++-rw node-id node-id
      |  ++-rw supporting-node* [network-ref node-ref]
      |  |  ++-rw nt:termination-point* [tp-id]
      |  |  |  |  ++-rw nt:tp-id tp-id
      |  |  |  ++-rw nt:supporting-termination-point* [network-ref node-ref tp-ref]
      |  ++-rw ns:network-slice
      |     ++-rw ns:isolation-level? identityref
      |     ++-rw ns:compute-node-id? string
      |     ++-rw ns:storage-id? string
    ++-rw nt:link* [link-id]
      |  ++-rw nt:link-id link-id
      |  ++-rw nt:source
      |  ++-rw nt:destination
      |  ++-rw nt:supporting-link* [network-ref link-ref]
      |  ++-rw ns:network-slice
      |     ++-rw ns:delay-tolerance? boolean
      |     ++-rw ns:periodicity* uint64
      |     ++-rw ns:isolation-level? identityref
    ++-rw ns:network-slice
     ++-rw ns:optimization-criterion? identityref
    ++-rw ns:delay-tolerance? boolean
    ++-rw ns:periodicity* uint64
    ++-rw ns:isolation-level? identityref
```
Data Instance Example – Native Topology

```json
{
    "ietf-network:networks": {
        "network": [
            {
                "network-id": "example-native-topology",
                "network-types": {
                },
                "node": [
                    {
                        "node-id": "R1",
                        "ietf-network-topology:termination-point": [
                            {
                                "tp-id": "1-0-1"
                            }
                        ],
                    },
                ],
                "ietf-network-topology:link": [
                    {
                        "link-id": "R1,1-0-1,,",
                        "source": {
                            "source-node": "R1",
                            "source-tp": "1-0-1"
                        }
                    }
                ]
            }
        ]
    }
}
```
Data Instance Example – Customized Blue

```json
{
  "ietf-network:networks": {
    "network": [
      {
        "network-id": "example-customized-blue-topology",
        "network-types": {
          "ietf-network-slice:network-slice": {}
        }
      },
      "supporting-network": [
        {
          "network-ref": "example-native-topology"
        }
      ],
      "node": [
        {
          "node-id": "VR1",
          "supporting-node": [
            {
              "network-ref": "example-native-topology",
              "node-ref": "R1"
            }
          ],
          "ietf-network-slice:network-slice": {
            "isolation-level": "ietf-network-slice:physical-memory-isolation"
          }
        }
      ]
    }
  },
  "ietf-network:networks": {
    "network": [
      {
        "link-id": ",,VR1,1-0-1",
        "destination": {
          "dest-node": "VR1",
          "dest-tp": "1-0-1"
        },
        "supporting-link": [
          {
            "network-ref": "example-native-topology",
            "link-ref": ",,R1,1-0-1"
          }
        ],
        "ietf-network-slice:network-slice": {
          "optimization-criterion": "ietf-te-types:of-minimize-cost-path",
          "isolation-level": "ietf-network-slice:physical-isolation"
        }
      }
    ],
  }
}
```
Data Instance Example – Customized Blue with TE

```
{
  "ietf-network:networks": {
    "network": [
      {
        "network-id": "example-customized-blue-topology",
        "ietf-te-topology:te-topology": {
        },
        "ietf-network-slice:network-slice": {
        }
      },
      "supporting-network": [
        {
          "network-ref": "example-native-topology"
        }
      ],
      "node": [
        {
          "node-id": "R1",
          "supporting-node": [
            {
              "network-ref": "example-native-topology",
              "node-ref": "R1"
            }
          ],
          "ietf-network-slice:network-slice": {
            "isolation-level": "ietf-network-slice:virtual-resource-isolation"
          }
        }
      ]
    },
    "link-id": "R1,1-2-1,R2,2-1-1",
    "source": {
      "source-node": "R1",
      "source-tp": "1-2-1"
    },
    "destination": {
      "dest-node": "R2",
      "dest-tp": "2-1-1"
    },
    "ietf-te-topology:te": {
      "te-link-attributes": {
        "underlay": {
          "enabled": true,
          "primary-path": {
            "network-ref": "example-native-topology",
            "path-element": [
              {
                "path-element-id": 10,
                "numbered-node-hop": {
                  "node-id": "1.0.1.5"
                }
              }
            ]
          }
        }
      },
      "ietf-network-slice:network-slice": {
        "isolation-level": "ietf-network-slice:virtual-resource-isolation"
      }
    }
  }
}
```
Next Steps

- Align the terminology with the consensus of the TEAS Network Slicing Design Team and TEAS Working Group.
- Further examine proper attributes to be included in this model.
- Welcome reviews and suggestions.
- Working Group adoption.