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A YANG Data Model for Microwave Topology
draft-ye-ccamp-mw-topo-yang-02

Abstract

This document defines a YANG data model to describe the topologies of microwave/millimeter.

Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

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 April 25, 2019.

Table of Contents

1. Terminology and Definitions

The following acronyms are used in this document:

PNC Provisioning Network Controller

MDSC Multi Domain Service Coordinator

2. Introduction

This document defines a YANG data model to describe the topologies of microwave/millimeter(hereafter microwave is used to simplify the text). The microwave topology model augments the TE topology model defines in [I-D.ietf-teas-yang-te-topo].

The microwave topology model is expected to be used between a Provisioning Network Controller(PNC) and a Multi Domain Service Coordinator(MDSC)([RFC8453]). Possible use cases of microwave topology models include:

1. The microwave link frequency could be used to understand the current frequency usage, enabling a whole view of the network topology information, and as an input for network frequency planning.

2. The microwave radio link could change its bandwidth according to the environments under the adaptive modulation mode, e.g., the bandwidth will degrade when there's a heavy rain. To get to know of current microwave link bandwidth is important for path computation and service provisioning across different technologies/networks.

3. Due to bandwidth changing feature, availability is normally used to describe the microwave radio link characteristic. [RFC8330] defines a mechanism to report bandwidth-availability information through OSPF-TE. It's also necessary to include the information in the YANG data model to optimize the path/route computation.

3. YANG Data Model (Tree Structure)

3.1. The YANG Tree

```
module: ietf-microwave-topology
  augment /nw:networks/nw:network/nw:network-types/tet:te-topology:
    +--rw mw-topology!
  augment /nw:networks/nw:network/nt:link/tet:te/tet:te-link-attributes:
        +--rw mw-link-frequency?             uint32
        +--rw mw-link-channel-separation?    uint32
        +--ro mw-link-nominal-bandwidth?     uint64
        +--ro mw-link-current-bandwidth?     uint64
        +--ro mw-link-unreserved-bandwidth uint64
        +--rw mw-link-availability* [availability]
       +--rw availability                decimal64
       +--ro mw-link-bandwidth           uint64
  augment /nw:networks/nw:network/nw:node/nt:termination-point /tet:te:
    +-- mp interface-root?
```

3.2. Relationship with microwave interface YANG model

The microwave topology model is expected to be used between a PNC and a MDSC. [I-D.ietf-ccamp-mw-yang] defines an interface YANG model for microwave radio link which is used between the PNC and the physical device for device configuration. The PNC is able to convert the information received from the topology model into the interface model. For example, the link frequency in the topology model is mapped to the tx-frequency of the carrier termination in the interface model.

If the purpose is to access more information of the microwave interface YANG model through the microwave topology model, a schema mount mechanism could be used, see the "interface-root" in the microwave topology model. [I-D.ietf-netmod-schema-mount] defines a mechanism to add the schema trees defined by a set of YANG modules onto a mount point defined in the schema tree in some YANG module. The current defined schema mount mechanism allows mounting of complete data models only. If complete mounting of the microwave interface YANG model is not neceesary, a deviation model could be created to remove unneeded schema in the microwave interface model, and be mounted to the topology model.

3.3. Relationship with client topology model

Ethernet is the most common client signal over microwave link. The Ethernet topology is an overlay TE topology on microwave topology. When an ETH service is transported by a single microwave radio link, the ETH link is supported by the microwave tunnel in underlay microwave topology, the microwave tunnel is supported by the microwave link. Please be noted that the tunnel in microwave topology is normally one-hop tunnel without intermediate node. Appendix A.1 shows some JSON example of Ethernet link over single microwave link. When an ETH service is transported over two microwave radio links, the ETH link is supported by the microwave tunnel in underlay microwave topology, the microwave tunnel is supported by the two microwave links. TTP Local Link Connectivity List is a List of TE links terminated by the TTP hosting TE node[I-D.ietf-teas-yang-te-topo]. It's used to associated with the two LTP to the TTP in microwave topology. Appendix A.2 shows some JSON example of Ethernet link over two microwave links.

3.4. Model applicability to other technology

TBA

4. YANG Module

```
<CODE BEGINS> file "ietf-microwave-topology.yang"

module ietf-microwave-topology {
 yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-microwave-topology";

  prefix "mwtopo";

  import ietf-network {
    prefix "nw";
  }

  import ietf-network-topology {
    prefix "nt";
  }

  import ietf-te-topology {
    prefix "tet";
  }

/*
 *import ietf-routing-types {
 * prefix "rt-types";
 * }
 */

  import ietf-yang-schema-mount {
       prefix yangmnt;
       reference "draft-ietf-netmod-schema-mount: YANG Schema Mount";
     }

 organization
  "Internet Engineering Task Force (IETF) CCAMP WG";
 contact
  "
  WG List: <mailto:ccamp@ietf.org>

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  ";
```

```
   description
    "This is a module for microwave topology.";
    revision 2018-10-22 {
      description
      "change the type of serveral data nodes.";
      reference "";
    }

     revision 2018-06-30 {
      description
      "Updated version to add mount point to the interface model.";
      reference "";
    }

     revision 2018-03-05 {
      description
      "Initial version.";
      reference "";
    }

     feature root-radio-if{
      description
          "This feature means that root for microwave radio
       interface model is supported.";
     }

    /*
     * Groupings
     */
    grouping mw-link-attributes {
       description "Microwave link attributes";

           leaf mw-link-frequency {
             type uint32;
             units "kHz";
             description "Frequency of the link";
             }

           leaf mw-link-channel-separation {
             type uint32;
             units "kHz";
             description "The distance
              between adjacent channels in a radio frequency channel
              arrangement used in this link";
             reference "ETSI EN 302 217-1";
             }

            leaf mw-link-nominal-bandwidth {
```

```
              type uint64;
              units "Kbps";
              config false;
              description "The nominal bandwidth of the link";
            }

            leaf mw-link-current-bandwidth {
             type uint64;
             units "Kbps";
             config false;
             description "The current bandwidth of the link";
             }

            leaf mw-link-unreserved-bandwidth {
             type uint64;
             units "Kbps";
             config false;
             description "The unreserved bandwidth of the link is
                      mw-link-current-bandwidth minus occupied bandwidth
                      on mw link";
             }

            list mw-link-availability{
              key "availability";
              description "List of availability and corresponding
                           link bandwidth";

              leaf availability {
                type decimal64 {
                  fraction-digits 4;
                  range "0..99.9999";
                }
                description "Availability level of the link";
              }

              leaf mw-link-bandwidth {
                type uint64;
                units "Kbps";
                config false;
                description "The link bandwidth corresponding
                             to the availability level";
              }
            }

        container "interface-root" {
             if-feature root-radio-if;
             description
               "Container for mount point.";
```

```
            yangmnt:mount-point "interface-root" {
              description
                "Root for microwave radio interface model.
                            It could contain an interface instance.";
            }
          }
        }

  /*
   * Data nodes
   */
   augment "/nw:networks/nw:network/nw:network-types/"
        + "tet:te-topology" {
    container mw-topology {
      presence "indicates a topology type of microwave.";
      description "microwave topology type";
    }
    description "augment network types to include microwave network";
  }

  augment "/nw:networks/nw:network/nt:link/tet:te/"
        + "tet:te-link-attributes" {
    when "../../../nw:network-types/tet:te-topology/"
       + "mwtopo:mw-topology" {
      description "This augment is only valid for microwave.";
    }
    description "Microwave link augmentation";

    uses mw-link-attributes;
  }

 }
<CODE ENDS>
```

5. 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][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. These are the subtrees and data nodes and their sensitivity/vulnerability:

TBD.(list subtrees and data nodes and state why they are sensitive)

Some of 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:

TBD.(list subtrees and data nodes and state why they are sensitive)

6. IANA Considerations

IANA has assigned a new URI from the "IETF XML Registry" [RFC3688].

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

IANA has recorded a YANG module name in the "YANG Module Names" registry [RFC6020] as follows:

```
Name: ietf-microwave-topology
Namespace: urn:ietf:params:xml:ns:yang:ietf-microwave-topology
Prefix: mwtopo
Reference: RFC xxxx
```

7. References

7.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <https://www.rfc-editor.org/info/rfc2119>.

[RFC3688] Mealling, M., "The IETF XML Registry", BCP 81, RFC 3688, DOI 10.17487/RFC3688, January 2004, <https://www.rfc-editor.org/info/rfc3688>.

[RFC6020] Bjorklund, M., Ed., "YANG - A Data Modeling Language for the Network Configuration Protocol (NETCONF)", RFC 6020, DOI 10.17487/RFC6020, October 2010, <https://www.rfc-editor.org/info/rfc6020>.

[RFC6241] Enns, R., Ed., Bjorklund, M., Ed., Schoenwaelder, J., Ed., and A. Bierman, Ed., "Network Configuration Protocol (NETCONF)", RFC 6241, DOI 10.17487/RFC6241, June 2011, <https://www.rfc-editor.org/info/rfc6241>.

[RFC6242] Wasserman, M., "Using the NETCONF Protocol over Secure Shell (SSH)", RFC 6242, DOI 10.17487/RFC6242, June 2011, <https://www.rfc-editor.org/info/rfc6242>.

[RFC8040] Bierman, A., Bjorklund, M., and K. Watsen, "RESTCONF Protocol", RFC 8040, DOI 10.17487/RFC8040, January 2017, <https://www.rfc-editor.org/info/rfc8040>.

[RFC8341] Bierman, A. and M. Bjorklund, "Network Configuration Access Control Model", STD 91, RFC 8341, DOI 10.17487/RFC8341, March 2018, <https://www.rfc-editor.org/info/rfc8341>.

[RFC8446] Rescorla, E., "The Transport Layer Security (TLS) Protocol Version 1.3", RFC 8446, DOI 10.17487/RFC8446, August 2018, <https://www.rfc-editor.org/info/rfc8446>.

7.2. Informative References

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Ahlberg, J., Ye, M., Li, X., Spreafico, D., and M. Vaupotic, "A YANG Data Model for Microwave Radio Link", draft-ietf-ccamp-mw-yang-10 (work in progress), October 2018.

[I-D.ietf-netmod-schema-mount]
Bjorklund, M. and L. Lhotka, "YANG Schema Mount", draft-ietf-netmod-schema-mount-12 (work in progress), October 2018.

[I-D.ietf-teas-yang-te-topo]
Liu, X., Bryskin, I., Beeram, V., Saad, T., Shah, H., and O. Dios, "YANG Data Model for Traffic Engineering (TE) Topologies", draft-ietf-teas-yang-te-topo-18 (work in progress), June 2018.

[RFC8330] Long, H., Ye, M., Mirsky, G., D'Alessandro, A., and H. Shah, "OSPF Traffic Engineering (OSPF-TE) Link Availability Extension for Links with Variable Discrete Bandwidth", RFC 8330, DOI 10.17487/RFC8330, February 2018, <https://www.rfc-editor.org/info/rfc8330>.

[RFC8453] Ceccarelli, D., Ed. and Y. Lee, Ed., "Framework for Abstraction and Control of TE Networks (ACTN)", RFC 8453, DOI 10.17487/RFC8453, August 2018, <https://www.rfc-editor.org/info/rfc8453>.

Appendix A. Appendix A Examples of microwave topology

A.1. Appendix A.1 A topology with single microwave radio link

Microwave is a transport technology which can be used to transport client services, such as ETH. When an ETH service is transported by a single microwave radio link, the topology could be shown as the Figure 3. Note that the figure just shows an example, there might be other possiblities to demonstrate the topology.

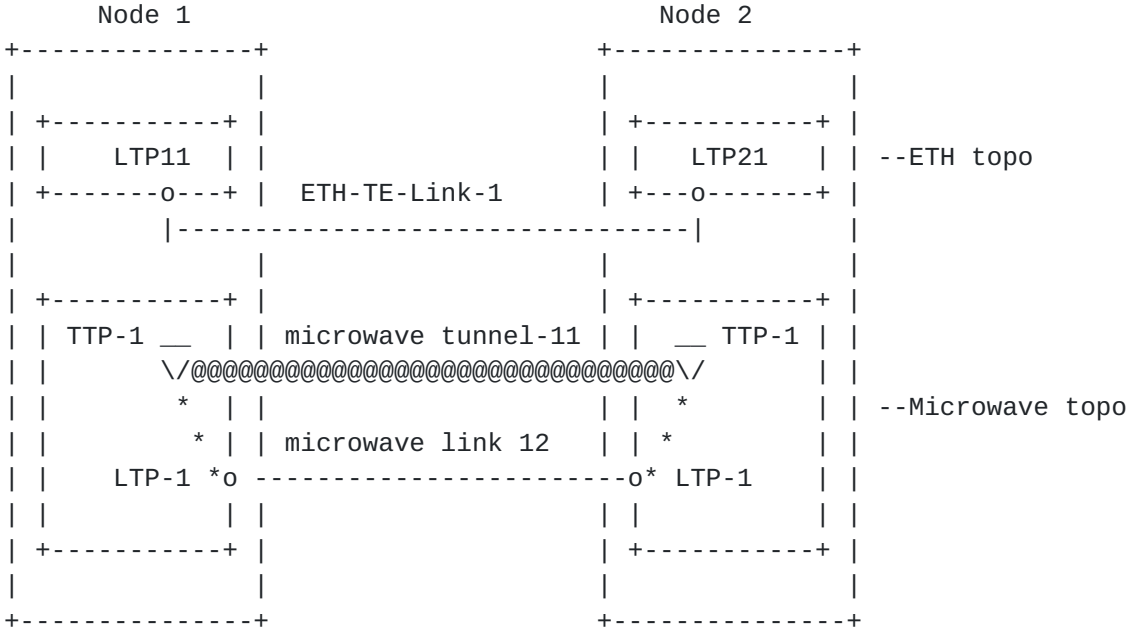

Figure 3: ETH transported on a single microwave radio link

In the above ETH topology, the ETH-TE-link is encoded in JSON as below:

```
  ...
  "ietf-network-topology:link": [
    {
      "link-id": "N1,LTP11,N2,LTP21",
      "source": {
        "source-node": "N1",
        "source-tp": "LTP11"
      }
      "destination": {
        "dest-node": "N2",
        "dest-tp": "LTP21"
      }
    }
  ]
  "ietf-te-topology:link/te/te-link-attributes/": [
    {
      "ietf-te-topology:underlay": {
            "enabled": ture,
            "primary-path":{
             "path-element": {
               "path-element-id": "MW-11"
                   //no backup-path
                   //no protection-type
             }
            }
            "tunnel-termination-points": {
              "source": "N1/TTP-1",
                  "destination": "N2/TTP-1"
            }
            "tunnels" : {
             "sharing": "false",
             "tunnel":{
               "tunnel-name": "MW-11",
                   "sharing": "false"
             }
            }
           }
        }
  ]
```

Note that the example above just shows the particular ETH link, not the full ETH topology.

In the microwave topology, the microwave link is encoded in JSON as below:

```
...
"ietf-network-topology:link": [
  {
    "link-id": "N1,LTP1,N2,LTP1",
    "source": {
      "source-node": "N1",
      "source-tp": "LTP1"
    }
    "destination": {
      "dest-node": "N2",
      "dest-tp": "LTP1"
    }
  }
]
"ietf-te-topology:link/te/te-link-attributes": [
  {
       "ietf-microwave-topology:mw-link-frequency":  10728000,
       "ietf-microwave-topology:mw-link-channel-separation": "28000",
       "ietf-microwave-topology:mw-link-nominal-bandwidth": "1000",
       "ietf-microwave-topology:mw-link-current-bandwidth": "1000",
       "ietf-microwave-topology:mw-link-unreserved-bandwidth": "400",
       "ietf-microwave-topology:mw-link-availability":{
        "availability":"99.99",
        "mw-link-bandwidth": "1000"
       }
      }
]
```

A.2. Appendix A.2 A topology with microwave radio links bundling

When a ETH service is transported over two microwave radio links, the topologies could be shown as in Figure 4. Note that the figure just shows one example, there might be other possiblities to demonstrate the topology.

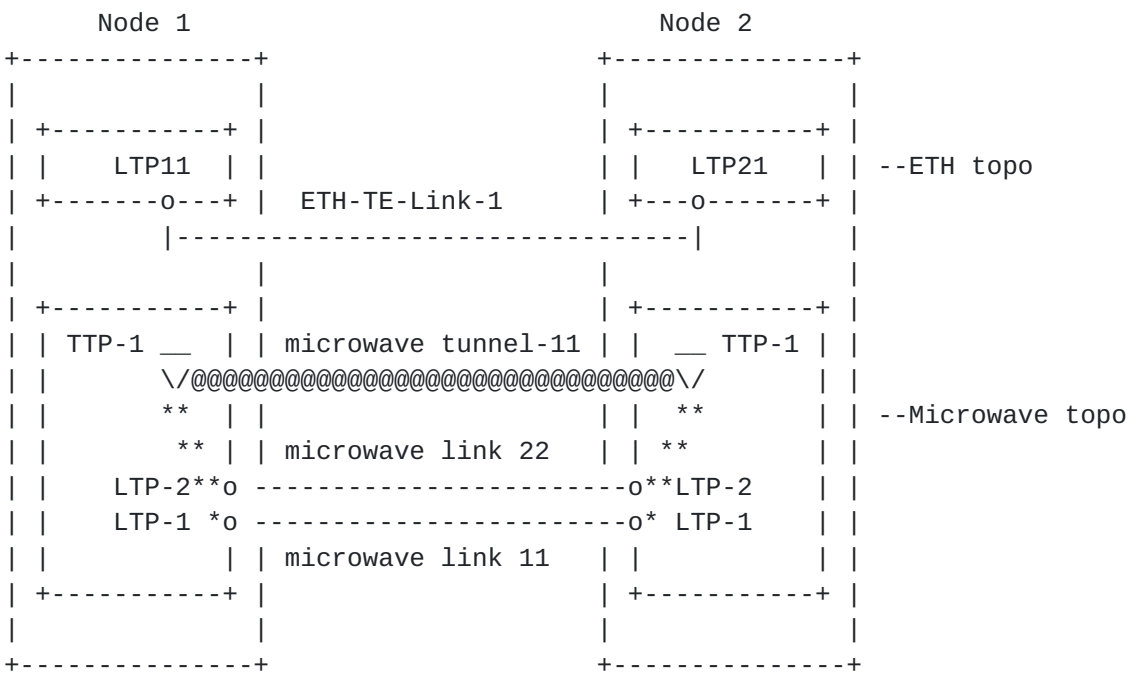

Figure 4: ETH transported on two microwave radio links

In the ETH topology, the ETH-TE-link is encoded in JSON as below:

```
    ...
    "ietf-network-topology:link": [
      {
        "link-id": "N1,LTP11,N2,LTP21",
        "source": {
          "source-node": "N1",
          "source-tp": "LTP11"
        }
        "destination": {
          "dest-node": "N2",
          "dest-tp": "LTP21"
        }
      }
    ]

      "ietf-te-topology:link/te/te-link-attributes/": [
      {
        "ietf-te-topology:underlay": {
              "enabled": ture,
              "primary-path":{
               "path-element": {
                 "path-element-id": "MW-11"
                     //no backup-path
                     //no protection-type
               }
              }
              "tunnel-termination-points": {
                "source": "N1/TTP-1",
                    "destination": "N2/TTP-1"
              }
              "tunnels" : {
               "sharing": "false",
               "tunnel":{
                 "tunnel-name": "MW-11",
                     "sharing": "false"
               }
              }
             }
          }
    ]
```

Note that the example above just shows the specific ETH link, not the full ETH topology.

In the microwave topology, the micorwave link is encoded in JSON as below:

```
...
```

```
  "ietf-network-topology:link": [
    {
      "link-id": "N1,LTP1,N2,LTP1",
      "source": {
        "source-node": "N1",
        "source-tp": "LTP1"
      }
      "destination": {
        "dest-node": "N2",
        "dest-tp": "LTP1"
      }
          "ietf-te-topology:link/te/te-link-attributes": [
     {
          "ietf-microwave-topology:mw-link-frequency":  10728000,
          "ietf-microwave-topology:mw-link-channel-separation": "28000",
          "ietf-microwave-topology:mw-link-nominal-bandwidth": "1000",
          "ietf-microwave-topology:mw-link-current-bandwidth": "1000",
"ietf-microwave-topology:mw-link-unreserved-bandwidth": "400",
          "ietf-microwave-topology:mw-link-availability":{
             "availability":"99.99",
             "mw-link-bandwidth": "1000"
           }
          }
     ]
    }
        {
      "link-id": "N1,LTP1,N2,LTP1",
      "source": {
        "source-node": "N1",
        "source-tp": "LTP2"
      }
      "destination": {
        "dest-node": "N2",
        "dest-tp": "LTP2"
      }
         "ietf-te-topology:link/te/te-link-attributes": [
     {
          "ietf-microwave-topology:mw-link-frequency":  10756000,
          "ietf-microwave-topology:mw-link-channel-separation": "28000",
          "ietf-microwave-topology:mw-link-nominal-bandwidth": "1000",
          "ietf-microwave-topology:mw-link-current-bandwidth": "1000",
          "ietf-microwave-topology:mw-link-unreserved-bandwidth": "400",
          "ietf-microwave-topology:mw-link-availability":{
             "availability":"99.99",
             "mw-link-bandwidth": "1000"
           }
          }
     ]
```

```
    }
  ]

  "ietf-te-topology:node/te/tunnel-termination-point/"
  +"local-link-connectivities":{
    "te-node-tunnel-termination-point-llc-list":[
                {
              "link-tp-ref": LTP1
                }
           {
              "link-tp-ref": LTP2
                }
        ]
  }
```

Note that the example above just shows the microwave component links, it doesn't show the full microwave topology.

Appendix B. Contributors

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