

TEAS Working Group
Internet-Draft
Intended status: Standards Track
Expires: 30 October 2022

I. Busi
Huawei Technologies
A. Guo
Futurewei Inc.
X. Liu
Volta Networks
T. Saad
Juniper Networks
R. Gandhi
Cisco Systems, Inc.
28 April 2022

A YANG Data Model for MPLS-TE Topology
draft-busizheng-teas-yang-te-mpls-topology-03

Abstract

This document describes a YANG data model for Multi-Protocol Label Switching (MPLS) with Traffic Engineering (MPLS-TE) networks.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of [BCP 78](#) and [BCP 79](#).

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at <https://datatracker.ietf.org/drafts/current/>.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on 30 October 2022.

Copyright Notice

Copyright (c) 2022 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to [BCP 78](#) and the IETF Trust's Legal Provisions Relating to IETF Documents (<https://trustee.ietf.org/license-info>) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components

Internet-Draft

MPLS-TE Topology YANG Model

April 2022

extracted from this document must include Revised BSD License text as described in Section 4.e of the [Trust Legal Provisions](#) and are provided without warranty as described in the Revised BSD License.

Table of Contents

1.	Introduction	2
1.1.	Tree Diagram	2
1.2.	Prefixes in Data Node Names	3
2.	MPLS-TE Types Overview	3
3.	MPLS-TE Topology Model Overview	4
3.1.	TE Label Augmentations	5
3.2.	MPLS-TP Topology	5
4.	YANG model for common MPLS-TE Types	6
5.	YANG model for MPLS-TE Topology	8
5.1.	YANG Tree	8
5.2.	YANG Code	9
6.	Security Considerations	12
7.	IANA Considerations	12
8.	References	12
8.1.	Normative References	12
8.2.	Informative References	12
	Acknowledgments	13
	Contributors	13
	Authors' Addresses	13

[1.](#) Introduction

This document describes a YANG data model for Multi-Protocol Label Switching (MPLS) with Traffic Engineering (MPLS-TE) networks.

This document also defines a collection of common data types and groupings in YANG data modeling language for MPLS-TE networks. These derived common types and groupings are intended to be imported by the MPLS-TE topology model, defined in this document, as well as by the MPLS-TE tunnel model, defined in [[I-D.ietf-teas-yang-te-mpls](#)].

Multi-Protocol Label Switching - Transport Profile (MPLS-TP) is a profile of the MPLS protocol that is used in packet switched transport networks and operated in a similar manner to other existing transport technologies (e.g., OTN), as described in [[RFC5921](#)]. The YANG model defined in this document can also be for MPLS-TP networks.

1.1. Tree Diagram

A simplified graphical representation of the data model is used in [Section 5.1](#) of this document. The meaning of the symbols in these diagrams is defined in [\[RFC8340\]](#).

1.2. Prefixes in Data Node Names

In this document, names of data nodes and other data model objects are prefixed using the standard prefix associated with the corresponding YANG imported modules, as shown in Table 1.

Prefix	YANG module	Reference
rt-types	ietf-routing-types	[RFC8294]
tet	ietf-te-topology	[RFC8795]
tet-pkt	ietf-te-topology-packet	[I-D.ietf-teas-yang-l3-te-topo]
te-packet-types	ietf-te-packet-types	[I-D.ietf-teas-yang-l3-te-topo]
mte-types	ietf-mpls-te-types	This document
tet-mpls	ietf-te-mpls-topology	This document

Table 1: Prefixes and corresponding YANG modules

2. MPLS-TE Types Overview

The module `ietf-mpls-te-types` contains the following YANG types and groupings which can be reused by MPLS-TE YANG models:

`load-balancing-type`:

This identify defines the types of load-balancing algorithms used on bundled MPLS-TE link.

te-mpls-label-hop:

This grouping is used for the augmentation of TE label for MPLS-TE path.

3. MPLS-TE Topology Model Overview

The MPLS-TE technology specific topology model augments the ietf-te-topology-packet YANG module, defined in [[I-D.ietf-teas-yang-l3-te-topo](#)], which in turns augment the generic ietf-te-topology YANG module, defined in [[RFC8795](#)], as shown in Figure 1.

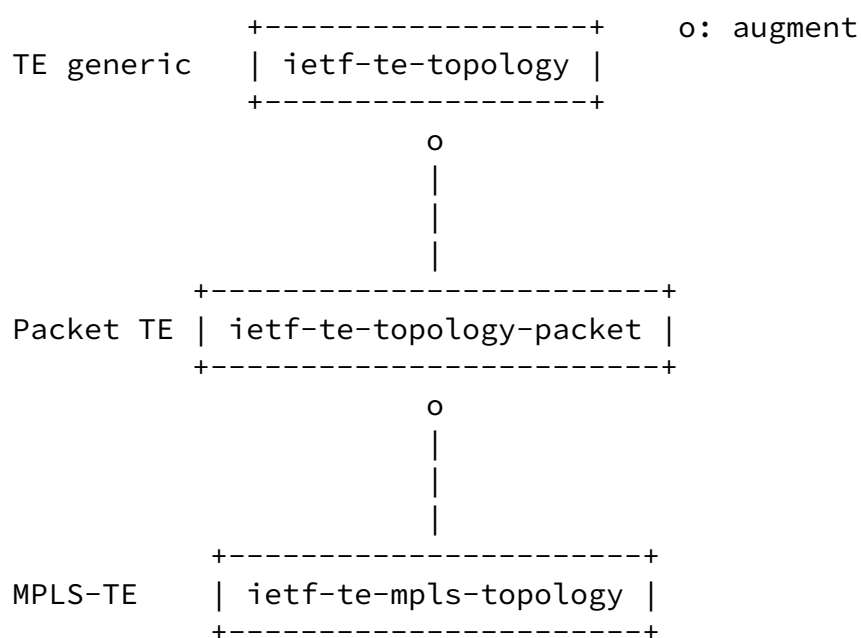


Figure 1: Relationship between MPLS-TE, Packet-TE and TE topology models

Given the guidance for augmentation in [[RFC8795](#)], the following technology-specific augmentations need to be provided:

- * A network-type to indicate that the TE topology is an MPLS-TE Topology, as follow:

```
augment /nw:networks/nw:network/nw:network-types/tet:te-topology
    /tet-pkt:packet:
    +--rw mpls-topology!
```

- * TE Label Augmentations as described in [Section 3.1](#).

Note: TE Bandwidth Augmentations for paths, LSPs and links are provided by the ietf-te-topology-packet module, defined in [[I-D.ietf-teas-yang-l3-te-topo](#)].

[3.1](#). TE Label Augmentations

In MPLS-TE, the label allocation is done by NE, information about label values availability is not necessary to be provided to the controller. Moreover, MPLS-TE tunnels are currently established within a single domain.

Therefore this document does not define any MPLS-TE technology-specific augmentations, of the TE Topology model, for the TE label since no TE label related attributes should be instantiated for MPLS-TE Topologies.

Open issue: shall this module allows the setup of MPLS-TE multi-domain tunnels?

[3.2](#). MPLS-TP Topology

Multi-Protocol Label Switching - Transport Profile (MPLS-TP) is a profile of the MPLS protocol that is used in packet switched transport networks and operated in a similar manner to other existing transport technologies (e.g., OTN), as described in [[RFC5921](#)].

Therefore YANG model defined in this document can also be applicable for MPLS-TP networks.

However, as described in [[RFC5921](#)], MPLS-TP networks support bidirectional LSPs and require no ECMP and no PHP. When reporting the topology for an MPLS-TP network, additional information is required to indicate whether the network support these MPLS-TP characteristics.

It is worth noting that [[RFC8795](#)] is already capable to model TE topologies supporting either unidirectional or bidirectional LSPs: all bidirectional TE links can support bidirectional LSPs and all the links can support unidirectional LSPs and it is always possible to associated unidirectional LSPs as long as they belong to the same tunnel.

When setting up bidirectional LSPs (e.g., MPLS-TP LSPs) only bidirectional TE Links are selected by path computation.

In order to allow reporting that ECMP is not affecting forwarding the packets of a given LSP, the load-balancing-type attribute reports whether a LAG or TE Bundled Link performs load-balancing on a per-flow or per-top-label:

```
augment /nw:networks/nw:network/nt:link/tet:te:
  +--rw load-balancing-type?  mte-types:load-balancing-type
```

When setting up LSPs which do not requires ECMP (e.g., MPLS-TP LSPs) only Links that are not part of a LAG or TE Bundle or that performs per-top-label load balancing are selected by path computation.

It is assumed that almost all the MPLS-TE nodes are capable to support Ultimate Hop Popping (UHP). However, if some interfaces are not able to support UHP, they can report it in the MPLS-TE topology:

```
augment /nw:networks/nw:network/nw:node/nt:termination-point
  /tet:te:
    +--ro uhp-incapable?  empty
```

When setting up LSPs which do not requires PHP (e.g., MPLS-TP LSPs) only the interfaces (LTPs) which are capable to support UHP in the destination node are selected by path computation.

[4.](#) YANG model for common MPLS-TE Types

```
<CODE BEGINS> file "ietf-mpls-te-types@2021-10-12.yang"
module ietf-mpls-te-types {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-mpls-te-types";

  prefix "mte-types";

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

  organization
    "Internet Engineering Task Force (IETF) TEAS WG";
  contact
    "WG Web:  <https://datatracker.ietf.org/wg/teas/>
     WG List: <mailto:teas@ietf.org>

    Editor:   Italo Busi
              <mailto:italo.busi@huawei.com>

    Editor:   Haomian Zheng
              <mailto:zhenghaomian@huawei.com>

    Editor:   Aihua Guo
              <mailto:aihuaguo.ietf@gmail.com>

    Editor:   Xufeng Liu
              <mailto:xufeng.liu.ietf@gmail.com>

    Editor:   Vishnu Pavan Beeram
```

Busi, et al.

Expires 30 October 2022

[Page 6]

Internet-Draft

MPLS-TE Topology YANG Model

April 2022

<<mailto:vbeeram@juniper.net>>

Editor: Tarek Saad
<<mailto:tsaad@juniper.net>>

Editor: Rakesh Gandhi
<<mailto:rgandhi@cisco.com>>

Editor: Igor Bryskin
<mailto:i_bryskin@yahoo.com>

Editor: Yanlei Zheng
<mailto:zhengyanlei@chinaunicom.cn>;

description

"This module defines technology-specific MPLS-TE types data model.

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 2021-10-12 {  
  description  
    "Initial Version";  
  reference  
    "draft-busizheng-teas-yang-te-mpls-topology-02";  
}
```

```
/*  
 * Typedefs  
 */
```

```
typedef load-balancing-type {  
  type enumeration {  
    enum per-flow {  
      description  
        "The load-balancing algorithm ensures that packets  
        characterized as the same flow (e.g. based on IP 5-tuple)
```

that egress on a LAG or a bundled TE link are forwarded


```

        on the same component link.

        Packets for different flows within the same LSP can be
        forwarded on different component links.";
    }
    enum per-top-label {
        description
            "The load-balancing algorithm ensures incoming MPLS
            packets with the same top MPLS label and that egress on
            on a LAG or bundled TE link are forwarded on the same
            component link.

            Packets for different flows within the same LSP are
            forwarded on the same component link.";
    }
}
description
    "The type of load balancing used on bundled links.";
} // typedef load-balancing-type

/*
 * Groupings
 */

grouping te-mpls-label-hop {
    description
        "MPLS-TE Label Hop.";

    leaf mpls-label {
        type rt-types:mpls-label;
        description
            "MPLS Label.";
    }
} // grouping te-mpls-label-hop
}
<CODE ENDS>

```

Figure 2: MPLS-TE Types YANG model

[5.](#) YANG model for MPLS-TE Topology

[5.1.](#) YANG Tree

Figure 3 below shows the tree diagram of the YANG model defined in module ietf-te-mpls-topology.yang.

```
module: ietf-te-mpls-topology

  augment /nw:networks/nw:network/nw:network-types/tet:te-topology
    /tet-pkt:packet:
      +--rw mpls-topology!
  augment /nw:networks/nw:network/nt:link/tet:te:
    +--rw load-balancing-type? mte-types:load-balancing-type
  augment /nw:networks/nw:network/nw:node/nt:termination-point
    /tet:te:
      +--ro uhp-incapable? empty
```

Figure 3: MPLS-TE topology YANG tree

5.2. YANG Code

```
<CODE BEGINS> file "ietf-te-mpls-topology@2021-07-12.yang"
module ietf-te-mpls-topology {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-te-mpls-topology";

  prefix "tet-mpls";

  import ietf-network {
    prefix "nw";
  }

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

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

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

  import ietf-mpls-te-types {
    prefix "mte-types";
  }

  organization
    "Internet Engineering Task Force (IETF) TEAS WG";
  contact
    "WG Web:  <https://datatracker.ietf.org/wg/teas/>
```

Internet-Draft

MPLS-TE Topology YANG Model

April 2022

Editor: Italo Busi
<mailto:italo.busi@huawei.com>

Editor: Haomian Zheng
<mailto:zhenghaomian@huawei.com>

Editor: Aihua Guo
<mailto:aihuaguo.ietf@gmail.com>

Editor: Xufeng Liu
<mailto:xufeng.liu.ietf@gmail.com>

Editor: Vishnu Pavan Beeram
<mailto:vbeeram@juniper.net>

Editor: Tarek Saad
<mailto:tsaad@juniper.net>

Editor: Rakesh Gandhi
<mailto:rgandhi@cisco.com>

Editor: Igor Bryskin
<mailto:i_bryskin@yahoo.com>

Editor: Yanlei Zheng
<mailto:zhengyanlei@chinaunicom.cn>";

description

"This module defines technology-specific MPLS-TE topology data model.

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 2021-10-12 {  
  description  
    "Initial Version";  
  reference
```

Busi, et al.

Expires 30 October 2022

[Page 10]

Internet-Draft

MPLS-TE Topology YANG Model

April 2022

```
    "draft-busizheng-teas-yang-te-mpls-topology-02";  
  }  
  
  /*  
   * Augmentations  
   */  
  
  augment "/nw:networks/nw:network/nw:network-types/"  
    + "tet:te-topology/tet-pkt:packet" {  
    description  
      "Augment network types to include MPLS-TE Topology Type";  
    container mpls-topology {  
      presence  
        "Indicates an MPLS-TE Topology Type.";  
      description  
        "Its presence indicates an MPLS-TE Topology";  
    }  
  }  
  
  augment "/nw:networks/nw:network/nt:link/tet:te" {  
    when "../nw:network-types/tet:te-topology/"  
      + "tet-pkt:packet/tet-mpls:mpls-topology" {  
      description  
        "Augment MPLS-TE Topology.";  
    }  
    description  
      "Augment TE Link.";  
  
    leaf load-balancing-type {  
      type mte-types:load-balancing-type;  
      default 'per-flow';  
      description
```

```

        "Indicates the type of load-balancing (per-flow or per-LSP)
        performed by the bundled TE Link.

        This leaf is not present when the TE Link is not bundled.";
    } // leaf load-balancing-type
}

augment "/nw:networks/nw:network/nw:node/nt:termination-point/"
    + "tet:te" {
    when "../..../nw:network-types/tet:te-topology/"
        + "tet-pkt:packet/tet-mpls:mpls-topology" {
        description "Augment MPLS-TE Topology.";
    }
    description "Augment LTP.";

    leaf uhp-incapable {

```

Busi, et al.

Expires 30 October 2022

[Page 11]

Internet-Draft

MPLS-TE Topology YANG Model

April 2022

```

        type empty;
        config false;
        description
            "When present, indicates that the LTP is not capable to
            support Ultimate Hop Popping (UHP).";
    } // leaf uhp-incapable
}
}
<CODE ENDS>

```

Figure 4: MPLS-TE topology YANG module

[6.](#) Security Considerations

To be added.

[7.](#) IANA Considerations

To be added.

[8.](#) References

[8.1.](#) Normative References

[I-D.ietf-teas-yang-l3-te-topo]

Liu, X., Bryskin, I., Beeram, V. P., Saad, T., Shah, H., and O. G. D. Dios, "YANG Data Model for Layer 3 TE Topologies", Work in Progress, Internet-Draft, [draft-ietf-teas-yang-l3-te-topo-12](#), 24 October 2021, <<https://www.ietf.org/archive/id/draft-ietf-teas-yang-l3-te-topo-12.txt>>.

- [RFC8294] Liu, X., Qu, Y., Lindem, A., Hopps, C., and L. Berger, "Common YANG Data Types for the Routing Area", [RFC 8294](#), DOI 10.17487/RFC8294, December 2017, <<https://www.rfc-editor.org/info/rfc8294>>.
- [RFC8340] Bjorklund, M. and L. Berger, Ed., "YANG Tree Diagrams", [BCP 215](#), [RFC 8340](#), DOI 10.17487/RFC8340, March 2018, <<https://www.rfc-editor.org/info/rfc8340>>.
- [RFC8795] Liu, X., Bryskin, I., Beeram, V., Saad, T., Shah, H., and O. Gonzalez de Dios, "YANG Data Model for Traffic Engineering (TE) Topologies", [RFC 8795](#), DOI 10.17487/RFC8795, August 2020, <<https://www.rfc-editor.org/info/rfc8795>>.

[8.2](#). Informative References

Busi, et al. Expires 30 October 2022 [Page 12]

Internet-Draft MPLS-TE Topology YANG Model April 2022

- [I-D.ietf-teas-yang-te-mpls]
Saad, T., Gandhi, R., Liu, X., Beeram, V. P., and I. Bryskin, "A YANG Data Model for MPLS Traffic Engineering Tunnels", Work in Progress, Internet-Draft, [draft-ietf-teas-yang-te-mpls-03](#), 9 March 2020, <<https://www.ietf.org/archive/id/draft-ietf-teas-yang-te-mpls-03.txt>>.
- [RFC5921] Bocci, M., Ed., Bryant, S., Ed., Frost, D., Ed., Levrau, L., and L. Berger, "A Framework for MPLS in Transport Networks", [RFC 5921](#), DOI 10.17487/RFC5921, July 2010, <<https://www.rfc-editor.org/info/rfc5921>>.

Acknowledgments

We thank Loa Andersson for providing useful suggestions for this draft.

This document was prepared using kramdown.

Previous versions of this document was prepared using 2-Word-v2.0.template.dot.

Contributors

Haomian Zheng
Huawei Technologies
Email: zhenghaomian@huawei.com

Vishnu Pavan Beeram
Juniper Networks
Email: vbeeram@juniper.net

Igor Bryskin
Individual
Email: i_bryskin@yahoo.com

Yanlei Zheng
China Unicom
Email: zhengyanlei@chinaunicom.cn

Authors' Addresses

Busi, et al.	Expires 30 October 2022	[Page 13]
--------------	-------------------------	-----------

Internet-Draft	MPLS-TE Topology YANG Model	April 2022
----------------	-----------------------------	------------

Italo Busi
Huawei Technologies
Email: italo.busi@huawei.com

Aihua Guo
Futurewei Inc.
Email: aihuaguo.ietf@gmail.com

Xufeng Liu

Volta Networks
Email: xufeng.liu.ietf@gmail.com

Tarek Saad
Juniper Networks
Email: tsaad@juniper.net

Rakesh Gandhi
Cisco Systems, Inc.
Email: rgandhi@cisco.com