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A YANG Data Model for Multipath Traffic Engineering Directed Acyclic Graph (MPTED) Tunnels and Junctions
draft-beeram-teas-yang-mpted-03

Abstract

This document defines a YANG data model for representing, retrieving, and manipulating Multipath Traffic Engineering Directed Acyclic Graph (MPTED) Tunnels and Junctions. The model includes two YANG modules, one for managing MPTED Tunnels on an MPTED tunnel originator node and the other for managing MPTED Junctions on an MPTED junction node.

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This Internet-Draft will expire on 3 September 2026.

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1. Introduction

The notions of a Multipath Traffic Engineering Directed Acyclic Graph (MPTED) tunnel and an MPTED junction are introduced in [I-D.draft-kompella-teas-mpte]. An MPTED tunnel is a Traffic Engineering (TE) construct that contains a constrained set of paths representing an optimized Directed Acyclic Graph (DAG) from one or more ingresses to one or more egresses. The paths that make up an MPTED tunnel traverse a set of junction nodes. An MPTED junction refers to the construct associated with the MPTED tunnel at each junction node and constitutes a set of previous-hops and a set of next-hops over which traffic is load-balanced in a weighted fashion. Provisioning an MPTED tunnel in a TE network involves provisioning MPTED junction state at each junction node.

An MPTED tunnel is instantiated and managed on a tunnel originator node, while an MPTED junction is instantiated and managed on a junction node. A tunnel originator node MAY also be a junction node.

This document defines a YANG data model for representing, retrieving, and manipulating Multipath Traffic Engineering Directed Acyclic Graph (MPTED) Tunnels and Junctions. The model includes two YANG modules, one for managing MPTED Tunnels on a tunnel originator node and the other for managing MPTED Junctions on a junction node.

The YANG modules discussed in this version of the document are scoped to MPLS MPTED tunnels and junctions with signaled label switching. The coverage for other types of MPTED tunnels and junctions will be added in later versions.

1.1. Requirements Language

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.

1.2. Terminology

The terminology for describing YANG data models is found in [RFC7950].

The reader is expected to be familiar with the terminology used in [I-D.draft-kompella-teas-mpte].

1.3. Tree Diagram

A simplified graphical representation of the data model is used in Appendix A and Appendix B of this document. The meaning of the symbols in these diagrams is defined in [RFC8340].

2. MPTED YANG Module

2.1. Model Structure

The high-level model structure for MPTED tunnels defined by this document is as shown below:

```
module: ietf-mpted

  augment /te:te:
    +--rw mpted-tunnels
       +--rw tunnel* [originator identifier]
          +--rw originator                        inet:ip-address
          +--rw identifier                        uint32
          +  ..
          +--ro instances
             +--ro instance* [version]
                +--ro version      uint32
                +  ..
                +--ro junctions
                   +--ro junction* [node-id]
                      +--ro node-id                inet:ip-address
                      +  ..
                      +--ro phops
                      |  +--ro phop*
                      |           [hop-address hop-index hop-version]
                      |     +--ro hop-address    inet:ip-address
                      |     +--ro hop-index      uint32
                      |     +--ro hop-version    uint32
                      +  ..
                      +--ro nhops
                         +--ro nhop*
                                 [hop-address hop-index hop-version]
                            +--ro hop-address
                            |       inet:ip-address
                            +--ro hop-index             uint32
                            +--ro hop-version           uint32
                            +  ..
```

Figure 1: MPTED YANG Structure

The top-level 'te' container is [I-D.draft-ietf-teas-yang-te] is augmented with a set of MPTED tunnels. The 'mpted-tunnels' container carries a list of tunnel entries. Each tunnel entry includes the set of parameters required to produce a list of junctions that need to programmed in the network. Each tunnel entry may have more than one instance associated with it, where a unique version identifies each instance. Each tunnel instance has a list of junctions associated with it. Each junction entry consists of the set of previous-hops ('phops' container) and next-hops ('nhops' container).

2.2. YANG Code

```
<CODE BEGINS> file "ietf-mpted@2026-03-02.yang"
module ietf-mpted {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-mpted";
  prefix mpted;

  import ietf-te {
    prefix te;
    reference
      "draft-ietf-teas-yang-te: A YANG Data Model for Traffic
       Engineering Tunnels and Interfaces";
  }
  import ietf-routing-types {
    prefix rt-types;
    reference
      "RFC8294: Common YANG Data Types for the Routing Area";
  }
  import ietf-inet-types {
    prefix inet;
    reference
      "RFC6991: Common YANG Data Types";
  }

  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:   Vishnu Pavan Beeram
               <mailto:vishnupavan.ietf@gmail.com>

     Editor:   Kireeti Kompella
               <mailto:kireeti.ietf@gmail.com>";
  description
    "This module defines a YANG data model for Multipath Traffic
     Engineering Directed Acyclic Graph (MPTED) Tunnels. It is
     intended to be used as part of the IETF TEAS framework to
     enable the configuration and management of MPTED Tunnels on
     an MPTED Tunnel Originator.

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     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 Revised 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 the module is part of RFC XXXX
        (https://www.rfc-editor.org/info/rfcXXXX); see the RFC
        itself for full legal notices.";

    revision 2026-03-02 {
      description
        "Initial revision.
         This revision introduces the YANG data model for
         Multipath Traffic Engineering Directed Acyclic Graph
         (MPTED) Tunnels.";
      reference
        "RFC XXXX: A YANG Data Model for Multipath Traffic
         Engineering Directed Acyclic Graph (MPTED) Tunnels and
         Junctions";
    }

    identity mpted-tunnel-type {
      description
        "Base identity of MPTED tunnel type.";
    }

    identity mpted-tunnel-type-mpls-siglab {
      base mpted-tunnel-type;
      description
        "MPLS MPTED Tunnel with signaled label switching.";
    }

    identity mpted-signaling-type {
      description
        "Base identity for MPTED signaling type.";
    }

    identity mpted-signaling-rsvp {
      base mpted-signaling-type;
      description
        "MPTED RSVP signaling.";
    }

    identity mpted-signaling-pcep {
      base mpted-signaling-type;
      description
        "MPTED PCEP signaling.";
    }
```

```
identity mpted-signaling-bgp {
  base mpted-signaling-type;
  description
    "MPTED BGP signaling.";
}

identity mpted-signaling-grpc {
  base mpted-signaling-type;
  description
    "MPTED gRPC signaling.";
}

identity mpted-tunnel-status {
  description
    "Base identity for MPTED Tunnel status.";
}

identity mpted-tunnel-up {
  base mpted-tunnel-status;
  description
    "MPTED Tunnel Up.";
}

identity mpted-tunnel-down {
  base mpted-tunnel-status;
  description
    "MPTED Tunnel Down.";
}

identity mpted-tunnel-degraded {
  base mpted-tunnel-status;
  description
    "MPTED Tunnel Degraded.";
}

identity mpted-junction-status {
  description
    "Base identity for MPTED JUNCTION status.";
}

identity mpted-junction-up {
  base mpted-junction-status;
  description
    "MPTED JUNCTION Up.";
}

identity mpted-junction-down {
  base mpted-junction-status;
```

```
    description
      "MPTED JUNCTION Down.";
  }

  identity mpted-junction-degraded {
    base mpted-junction-status;
    description
      "MPTED JUNCTION Degraded.";
  }

  identity mpted-jct-phop-status {
    description
      "Base identity for MPTED JCT-PHOP status.";
  }

  identity mpted-jct-phop-up {
    base mpted-jct-phop-status;
    description
      "MPTED JCT-PHOP Up.";
  }

  identity mpted-jct-phop-down {
    base mpted-jct-phop-status;
    description
      "MPTED JCT-PHOP Down.";
  }

  identity mpted-jct-nhop-status {
    description
      "Base identity for MPTED JCT-NHOP status.";
  }

  identity mpted-jct-nhop-up {
    base mpted-jct-nhop-status;
    description
      "MPTED JCT-NHOP Up.";
  }

  identity mpted-jct-nhop-down {
    base mpted-jct-nhop-status;
    description
      "MPTED JCT-NHOP Down.";
  }

  identity mpted-jct-nhop-degraded {
    base mpted-jct-nhop-status;
    description
      "MPTED JCT-NHOP Degraded.";
```

```
  }

  identity mpted-opt-metric-type {
    description
      "Base identity of MPTED optimization metric type.";
  }

  identity mpted-opt-metric-te {
    base mpted-opt-metric-type;
    description
      "TE Metric.";
  }

  identity mpted-opt-metric-igp {
    base mpted-opt-metric-type;
    description
      "IGP Metric.";
  }

  identity mpted-opt-metric-delay {
    base mpted-opt-metric-type;
    description
      "Delay Metric.";
  }

  identity mpted-bw-spec-type {
    description
      "Base identity for MPTED bandwidth specification type.";
  }

  identity mpted-bw-spec-explicit {
    base mpted-bw-spec-type;
    description
      "Explicit MPTED bandwidth specification type.";
  }

  identity mpted-bw-spec-auto {
    base mpted-bw-spec-type;
    description
      "Automatic MPTED bandwidth specification type.";
  }

  grouping mpted-ingress {
    description
      "Grouping for MPTED ingress information.";
    leaf ingress-id {
      type inet:ip-address;
      description
```

```
            "IP-address of the ingress node.";
        }
        leaf set-bandwidth {
          when "/te:te/mpted-tunnels/tunnel/bandwidth-spec-type = "
             + "'mpted-bw-spec-explicit'" {
            description
              "Applicable only when bandwidth specification
               type is explicit.";
          }
          type uint64;
          description
            "Explicitly specified bandwidth at the ingress of
             the MPTED tunnel.";
        }
        container auto-bandwidth {
          when "/te:te/mpted-tunnels/tunnel/bandwidth-spec-type = "
             + "'mpted-bw-spec-auto'" {
            description
              "Applicable only when bandwidth specification
               type is automatic.";
          }
          description
            "Container for auto-bandwidth parameters.";
          uses mpted-ingress-autobw-config;
          container overflow {
            description
              "Autobandwidth overflow parameters.";
            uses mpted-autobw-overflow-config;
          }
          container underflow {
            description
              "Autobandwidth underflow parameters.";
            uses mpted-autobw-underflow-config;
          }
        }
      }

      grouping mpted-ingress-autobw-config {
        description
          "MPTED tunnel ingress autobandwidth parameters";
        leaf min-bw {
          type uint64;
          description
            "Minimum bandwidth at the ingress of the
             autobandwidth enabled MPTED tunnel.";
        }
        leaf max-bw {
          type uint64;
```

```
        description
          "Maximum bandwidth at the ingress of the
           autobandwidth enabled MPTED tunnel";
      }
      leaf adjust-threshold {
        type rt-types:percentage;
        description
          "Bandwidth demand at the ingress for the current
           bandwidth adjustment interval is compared to the
           current bandwidth allocation for the ingress of
           the MPTED tunnel. If the percentage difference
           in bandwidth is greater than or equal to the percentage
           specified by this leaf, the bandwidth allocation
           for the ingress is adjusted to the current bandwidth
           demand.";
      }
    }

    grouping mpted-autobw-overflow-config {
      description
        "MPTED Tunnel ingress autobandwidth overflow parameters.";
      leaf enabled {
        type boolean;
        default "false";
        description
          "Enables autobandwidth overflow adjustment on the
           MPTED tunnel ingress";
      }
      leaf overflow-threshold {
        type rt-types:percentage;
        description
          "Bandwidth percentage change to trigger
           an overflow event";
      }
      leaf trigger-event-count {
        type uint16;
        description
          "Number of consecutive overflow sample
           events needed to trigger an overflow adjustment";
      }
    }

    grouping mpted-autobw-underflow-config {
      description
        "MPTED Tunnel ingress autobandwidth underflow parameters.";
      leaf enabled {
        type boolean;
        default "false";
```

```
        description
          "Enables autobandwidth underflow adjustment on the
           MPTED tunnel ingress";
      }
      leaf underflow-threshold {
        type rt-types:percentage;
        description
          "Bandwidth percentage change to trigger
           and underflow event";
      }
      leaf trigger-event-count {
        type uint16;
        description
          "Number of consecutive underflow sample
           events needed to trigger an underflow adjustment";
      }
    }

    grouping tunnel-status-info {
      description
        "Grouping for tunnel status information.";
      leaf current-version {
        type uint32;
        config false;
        description
          "Current version of the MPTED tunnel.";
      }
      leaf status {
        type identityref {
          base mpted-tunnel-status;
        }
        config false;
        description
          "Status of the MPTED tunnel";
      }
    }

    grouping tunnel-instance-status-info {
      description
        "Grouping for tunnel instance status information.";
      leaf version {
        type uint32;
        config false;
        description
          "Identifier of the MPTED tunnel instance.";
      }
      leaf status {
        type identityref {
```

```
          base mpted-tunnel-status;
        }
        config false;
        description
          "Status of the MPTED tunnel instance";
      }
    }

    grouping junction-info {
      description
        "Grouping for junction information.";
      leaf node-id {
        type inet:ip-address;
        description
          "IP-address of the junction node.";
      }
      leaf current_jct_version {
        type uint32;
        description
          "Current instance identifier of the MPTED tunnel
           junction.";
      }
      leaf bandwidth-requested {
        type uint64;
        description
          "Amount of bandwidth requested for the junction.";
      }
    }

    grouping junction-status-info {
      description
        "Grouping for junction status information.";
      uses junction-info;
      leaf mtu {
        type uint16;
        description
          "MTU at the junction node. This is the smallest MTU value
           among the MTUs received from all JCT-NHOPs.";
      }
      leaf status {
        type identityref {
          base mpted-junction-status;
        }
        description
          "Status of the JUNCTION.";
      }
    }
```

```
    grouping mpted-jct-hop-info {
      description
        "Grouping for junction hop information.";
      leaf hop-address {
        type inet:ip-address;
        description
          "IP-address of the peer.";
      }
      leaf hop-index {
        type uint32;
        description
          "Index of the peer interface.";
      }
      leaf hop-version {
        type uint32;
        description
          "Version of the Hop.";
      }
    }

    grouping mpted-jct-phop-status-info {
      description
        "Grouping for junction phop status information.";
      uses mpted-jct-hop-info;
      leaf in-label {
        type rt-types:mpls-label;
        description
          "Label used by incoming packets on the JCT-PHOP.";
      }
      leaf status {
        type identityref {
          base mpted-jct-phop-status;
        }
        description
          "Status of the JCT-PHOP.";
      }
    }

    grouping mpted-jct-nhop-info {
      description
        "Grouping for junction nhop information.";
      uses mpted-jct-hop-info;
      leaf load-share {
        type uint16;
        description
          "Relative load share.";
      }
      leaf bandwidth-requested {
```

```
        type uint64;
        description
          "Amount of bandwidth requested for the hop.";
      }
    }

    grouping mpted-jct-nhop-status-info {
      description
        "Grouping for junction nhop status information.";
      uses mpted-jct-nhop-info;
      leaf bandwidth-reserved {
        type uint64;
        description
          "Amount of bandwidth reserved on the TE link associated
           with the JCT-NHOP.";
      }
      leaf out-label {
        type rt-types:mpls-label;
        description
          "Label used by outgoing packets on the JCT-NHOP.";
      }
      leaf status {
        type identityref {
          base mpted-jct-nhop-status;
        }
        description
          "Status of the JCT-NHOP.";
      }
    }

    augment "/te:te" {
      description
        "Augmentation for MPTED tunnels.";
      container mpted-tunnels {
        description
          "Container for MPTED tunnels.";
        list tunnel {
          key "originator identifier";
          unique "name";
          description
            "MPTED tunnel entry.";
          leaf originator {
            type inet:ip-address;
            description
              "IP address of the MPTED tunnel originator.";
          }
          leaf identifier {
            type uint32;
```

```
        description
          "Identifier of the MPTED tunnel.";
      }
      leaf name {
        type string;
        description
          "Name of the MPTED tunnel.";
      }
      container ingresses {
        description
          "Container for list of MPTED ingresses.";
        list ingress {
          key "ingress-id";
          description
            "MPTED ingress entry.";
          uses mpted-ingress;
        }
      }
      leaf-list egress {
        type inet:ip-address;
        description
          "List of egress nodes associated with the MPTED
           tunnel.";
      }
      leaf type {
        type identityref {
          base mpted-tunnel-type;
        }
        description
          "Type of tunnel.";
      }
      leaf setup-priority {
        type uint8 {
          range "0..7";
        }
        default "7";
        description
          "The priority of the MPTED tunnel with respect to
           taking resources, in the range of 0 to 7.  The
           value 0 is the highest priority.";
      }
      leaf hold-priority {
        type uint8 {
          range "0..7";
        }
        default "7";
        description
          "The priority of the MPTED tunnel with respect to
```

```
            holding resources, in the range of 0 to 7.  The
            value 0 is the highest priority.";
        }
        leaf optimization-metric {
          type identityref {
            base mpted-opt-metric-type;
          }
          description
            "Metric type for which the DAG is optimized.";
        }
        container resource-affinities {
          description
            "Resource-affinity constraints.";
          leaf-list exclude-any {
            type string;
            description
              "Exclude the link if it has any of these
               affinities.";
          }
          leaf-list include-any {
            type string;
            description
              "Include the link if it has any of these
               affinities";
          }
          leaf-list include-all {
            type string;
            description
              "Include the link if it has all these affinities";
          }
        }
        leaf bandwidth-spec-type {
          type identityref {
            base mpted-bw-spec-type;
          }
          description
            "The method used for setting the bandwidth on the
             tunnel, either explicitly specified or automatically
             derived.";
        }
        leaf auto-bandwidth-adjust-interval {
          when "../bandwidth-spec-type = "
             + "'mpted-bw-spec-auto'" {
            description
              "Applicable only when bandwidth specification
               type is automatic.";
          }
          type uint32;
```

```
        description
          "Time in seconds between autobandwidth adjustments.";
      }
      leaf mpted-computer {
        type inet:ip-address;
        description
          "IP-address of the MPTED computer.";
      }
      leaf signaling-type {
        type identityref {
          base mpted-signaling-type;
        }
        description
          "MPTED tunnel signaling type.";
      }
      leaf signaling-source {
        type inet:ip-address;
        description
          "IP-address of the MPTED tunnel signaling source.";
      }
      uses tunnel-status-info;
      container instances {
        config false;
        description
          "Container for list of instances of the MPTED tunnel.";
        list instance {
          key "version";
          description
            "MPTED tunnel instance entry.";
          uses tunnel-instance-status-info;
          container junctions {
            description
              "Container for list of JUNCTIONs associated
               with the MPTED tunnel instance.";
            list junction {
              key "node-id";
              description
                "JUNCTION entry.";
              uses junction-status-info;
              container phops {
                description
                  "Container for associated JCT-PHOPs.";
                list phop {
                  key "hop-address hop-index hop-version";
                  description
                    "JCT-PHOP entry.";
                  uses mpted-jct-phop-status-info;
                }
```

```
                    }
                    container nhops {
                      description
                        "Container for associated JCT-NHOPs.";
                      list nhop {
                        key "hop-address hop-index hop-version";
                        description
                          "JCT-NHOP entry.";
                        uses mpted-jct-nhop-status-info;
                      }
                    }
                  }
                }
              }
            }
          }
        }
      }
    }
  }
  <CODE ENDS>
```

Figure 2: MPTED YANG module

3. MPTED-JCT YANG Module

3.1. Model Structure

The high-level model structure for MPTED junctions defined by this document is as shown below:

```
module: ietf-mpted-jct

  augment /te:te:
    +--rw mpted-junctions
       +--rw junction* [node-id originator tnl-id tnl-vers sig-src]
          +--rw node-id                inet:ip-address
          +--rw originator             inet:ip-address
          +--rw tnl-id                 uint32
          +--rw tnl-vers               uint32
          +--rw sig-src                inet:ip-address
          +  ..
          +--rw phops
          |  +--rw phop* [hop-address hop-index hop-version]
          |     +--rw hop-address    inet:ip-address
          |     +--rw hop-index      uint32
          |     +--rw hop-version    uint32
          |     +  ..
          +--rw nhops
             +--rw nhop* [hop-address hop-index hop-version]
                +--rw hop-address            inet:ip-address
                +--rw hop-index              uint32
                +--rw hop-version?           uint32
                +  ..
```

Figure 3: MPTED-JCT YANG Structure

The top-level 'te' container is [I-D.draft-ietf-teas-yang-te] is augmented with a set of MPTED junctions. The 'mpted-junctions' container carries a list of junction entries. Each junction entry includes information about the associated set of previous-hops ('phops' container) and next-hops ('nhops' container).

3.2. YANG Code

```
<CODE BEGINS> file "ietf-mpted-jct@2026-03-02.yang"
module ietf-mpted-jct {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-mpted-jct";
  prefix mpted-jct;

  import ietf-te {
    prefix te;
    reference
      "draft-ietf-teas-yang-te: A YANG Data Model for Traffic
       Engineering Tunnels and Interfaces";
  }
  import ietf-inet-types {
    prefix inet;
```

```
      reference
        "RFC6991: Common YANG Data Types";
    }
    import ietf-routing-types {
      prefix rt-types;
      reference
        "RFC8294: Common YANG Data Types for the Routing Area";
    }

    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:   Vishnu Pavan Beeram
                 <mailto:vishnupavan.ietf@gmail.com>

                 Kireeti Kompella
                 <mailto:kireeti.ietf@gmail.com>";
    description
      "This module defines a YANG data model for Multipath Traffic
       Engineering Directed Acyclic Graph (MPTED) Junctions. It is
       intended to be used as part of the IETF TEAS framework to
       enable the configuration and management of MPTED Junctions on
       an MPTED junction node.

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       without modification, is permitted pursuant to, and subject
       to the license terms contained in, the Revised 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 the module is part of RFC XXXX
       (https://www.rfc-editor.org/info/rfcXXXX); see the RFC
       itself for full legal notices.";

    revision 2026-03-02 {
      description
        "Initial revision.
         This revision introduces the YANG data model for
         Multipath Traffic Engineering Directed Acyclic Graph
         (MPTED) Junctions.";
```

```
    reference
      "RFC XXXX: A YANG Data Model for Multipath Traffic
       Engineering Directed Acyclic Graph (MPTED) Tunnels and
       Junctions";
  }

  identity mpted-tunnel-type {
    description
      "Base identity of MPTED tunnel type.";
  }

  identity mpted-tunnel-type-mpls-siglab {
    base mpted-tunnel-type;
    description
      "MPLS MPTED Tunnel with signaled label switching.";
  }

  identity mpted-signaling-type {
    description
      "Base identity for MPTED signaling type.";
  }

  identity mpted-signaling-rsvp {
    base mpted-signaling-type;
    description
      "MPTED RSVP signaling.";
  }

  identity mpted-signaling-pcep {
    base mpted-signaling-type;
    description
      "MPTED PCEP signaling.";
  }

  identity mpted-signaling-bgp {
    base mpted-signaling-type;
    description
      "MPTED BGP signaling.";
  }

  identity mpted-signaling-grpc {
    base mpted-signaling-type;
    description
      "MPTED gRPC signaling.";
  }

  identity mpted-junction-status {
    description
```

```
        "Base identity for MPTED JUNCTION status.";
    }

    identity mpted-junction-up {
      base mpted-junction-status;
      description
        "MPTED JUNCTION Up.";
    }

    identity mpted-junction-down {
      base mpted-junction-status;
      description
        "MPTED JUNCTION Down.";
    }

    identity mpted-junction-degraded {
      base mpted-junction-status;
      description
        "MPTED JUNCTION Degraded.";
    }

    identity mpted-jct-phop-status {
      description
        "Base identity for MPTED JCT-PHOP status.";
    }

    identity mpted-jct-phop-up {
      base mpted-jct-phop-status;
      description
        "MPTED JCT-PHOP Up.";
    }

    identity mpted-jct-phop-down {
      base mpted-jct-phop-status;
      description
        "MPTED JCT-PHOP Down.";
    }

    identity mpted-jct-nhop-status {
      description
        "Base identity for MPTED JCT-NHOP status.";
    }

    identity mpted-jct-nhop-up {
      base mpted-jct-nhop-status;
      description
        "MPTED JCT-NHOP Up.";
    }
```

```
identity mpted-jct-nhop-down {
  base mpted-jct-nhop-status;
  description
    "MPTED JCT-NHOP Down.";
}

identity mpted-jct-nhop-degraded {
  base mpted-jct-nhop-status;
  description
    "MPTED JCT-NHOP Degraded.";
}

grouping mpted-jct-info {
  description
    "Grouping for junction information.";
  leaf current_jct_version {
    type uint32;
    description
      "Current instance identifier of the MPTED tunnel
       junction.";
  }
  leaf bandwidth-requested {
    type uint64;
    description
      "Amount of bandwidth requested for the junction.";
  }
}

grouping mpted-jct-status-info {
  description
    "Grouping for junction status information.";
  uses mpted-jct-info;
  leaf mtu {
    type uint16;
    config false;
    description
      "MTU at the junction node. This is the smallest MTU value
       among the MTUs received from all JCT-NHOPs.";
  }
  leaf status {
    type identityref {
      base mpted-junction-status;
    }
    config false;
    description
      "Status of the JUNCTION.";
  }
}
```

```
    grouping mpted-jct-hop-info {
      description
        "Grouping for MPTED junction hop information.";
      leaf hop-address {
        type inet:ip-address;
        description
          "IP-address of the peer.";
      }
      leaf hop-index {
        type uint32;
        description
          "Index of the peer interface.";
      }
      leaf hop-version {
        type uint32;
        description
          "Version of the Hop.";
      }
    }

    grouping mpted-jct-nhop-info {
      description
        "Grouping for MPTED junction next-hop information.";
      uses mpted-jct-hop-info;
      leaf load-share {
        type uint16;
        description
          "Relative load share.";
      }
      leaf bandwidth-requested {
        type uint64;
        description
          "Amount of bandwidth requested for the hop.";
      }
    }

    augment "/te:te" {
      description
        "Augmentation for MPTED junctions.";
      container mpted-junctions {
        description
          "Container for MPTED junctions.";
        list junction {
          key "node-id originator tnl-id tnl-vers sig-src";
          unique "name";
          description
            "MPTED junction entry.";
          leaf node-id {
```

```
            type inet:ip-address;
            description
              "IP-address of the junction node.";
          }
          leaf originator {
            type inet:ip-address;
            description
              "IP address of the associated MPTED tunnel
               originator.";
          }
          leaf tnl-id {
            type uint32;
            description
              "Identifier of the associated MPTED tunnel.";
          }
          leaf tnl-vers {
            type uint32;
            description
              "Version of the MPTED tunnel.";
          }
          leaf sig-src {
            type inet:ip-address;
            description
              "IP-address of the MPTED tunnel signaling source.";
          }
          leaf name {
            type string;
            description
              "Name of the associated MPTED tunnel.";
          }
          leaf-list ingress {
            type inet:ip-address;
            description
              "List of ingress nodes of the associated MPTED
               tunnel.";
          }
          leaf-list egress {
            type inet:ip-address;
            description
              "List of egress nodes of the associated MPTED
               tunnel.";
          }
          leaf type {
            type identityref {
              base mpted-tunnel-type;
            }
            description
              "Type of associated tunnel.";
```

```
            }
            leaf setup-priority {
              type uint8 {
                range "0..7";
              }
              default "7";
              description
                "The priority of the associated MPTED tunnel with
                 respect to taking resources, in the range of 0 to 7.
                 The value 0 is the highest priority.";
            }
            leaf hold-priority {
              type uint8 {
                range "0..7";
              }
              default "7";
              description
                "The priority of the associated MPTED tunnel with
                 respect to holding resources, in the range of 0 to 7.
                 The value 0 is the highest priority.";
            }
            uses mpted-jct-status-info;
            container phops {
              description
                "Container for associated JCT-PHOPs.";
              list phop {
                key "hop-address hop-index hop-version";
                uses mpted-jct-hop-info;
                description
                  "JCT-PHOP entry.";
                leaf in-label {
                  type rt-types:mpls-label;
                  config false;
                  description
                    "Label used by incoming packets
                     on the JCT-PHOP.";
                }
                leaf status {
                  type identityref {
                    base mpted-jct-phop-status;
                  }
                  config false;
                  description
                    "Status of the JCT-PHOP.";
                }
              }
            }
            container nhops {
```

```
            description
              "Container for associated JCT-NHOPs.";
            list nhop {
              key "hop-address hop-index hop-version";
              description
                "JCT-NHOP entry.";
              uses mpted-jct-nhop-info;
              leaf bandwidth-reserved {
                type uint64;
                config false;
                description
                  "Amount of bandwidth reserved on the TE link
                   associated with the JCT-NHOP.";
              }
              leaf out-label {
                type rt-types:mpls-label;
                config false;
                description
                  "Label used by outgoing packets
                   on the JCT-NHOP.";
              }
              leaf status {
                type identityref {
                  base mpted-jct-nhop-status;
                }
                config false;
                description
                  "Status of the JCT-NHOP.";
              }
            }
          }
        }
      }
    }
  }
  <CODE ENDS>
```

Figure 4: MPTED JCT YANG module

4. 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]. 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 Network Configuration Access Control Model (NACM) [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.

The data nodes defined in these YANG modules that are writable/creatable/deletable (i.e., config true, which is the default) 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:

"/te/mpted-tunnels": Unauthorized access to this list could influence how traffic is forwarded through the network.

"/te/mpted-junctions": Unauthorized access to this list could influence how traffic is forwarded on a junction node.

The readable data nodes in these 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:

"/te/mpted-tunnels/tunnel/junctions": Unauthorized read access to this list can disclose how traffic is load-balanced on each junction node.

5. IANA Considerations

This document requests IANA to register the following URIs in the "ns" subregistry within the "IETF XML Registry" [RFC3688].

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

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

This document requests IANA to register the following YANG modules in the "YANG Module Names" subregistry [RFC6020] within the "YANG Parameters" registry.

```
        name:      ietf-mpted
        namespace: urn:ietf:params:xml:ns:yang:ietf-mpted
        prefix:    mpted
        reference: RFC XXXX

        name:      ietf-mpted-jct
        namespace: urn:ietf:params:xml:ns:yang:ietf-mpted-jct
        prefix:    mpted-jct
        reference: RFC XXXX
```

RFC Editor: Please replace XXXX with the RFC number assigned to this document.

6. References

6.1. Normative References

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

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[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/rfc/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/rfc/rfc8446>.

6.2. Informative References

[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/rfc/rfc8340>.

Appendix A. MPTED YANG Module - Complete Tree Structure

```
module: ietf-mpted

  augment /te:te:
    +--rw mpted-tunnels
       +--rw tunnel* [originator identifier]
          +--rw originator                        inet:ip-address
          +--rw identifier                        uint32
          +--rw name?                             string
          +--rw ingresses
          |  +--rw ingress* [ingress-id]
```

```
|     +--rw ingress-id        inet:ip-address
|     +--rw set-bandwidth?    uint64
|     +--rw auto-bandwidth
|        +--rw min-bw?             uint64
|        +--rw max-bw?             uint64
|        +--rw adjust-threshold?   rt-types:percentage
|        +--rw overflow
|        |  +--rw enabled?               boolean
|        |  +--rw overflow-threshold?
|        |  |       rt-types:percentage
|        |  +--rw trigger-event-count?   uint16
|        +--rw underflow
|           +--rw enabled?               boolean
|           +--rw underflow-threshold?
|           |       rt-types:percentage
|           +--rw trigger-event-count?   uint16
+--rw egress*                            inet:ip-address
+--rw type?                              identityref
+--rw setup-priority?                    uint8
+--rw hold-priority?                     uint8
+--rw optimization-metric?               identityref
+--rw resource-affinities
|  +--rw exclude-any*   string
|  +--rw include-any*   string
|  +--rw include-all*   string
+--rw bandwidth-spec-type?               identityref
+--rw auto-bandwidth-adjust-interval?   uint32
+--rw mpted-computer?                    inet:ip-address
+--rw signaling-type?                    identityref
+--rw signaling-source?                  inet:ip-address
+--ro current-version?                   uint32
+--ro status?                            identityref
+--ro instances
   +--ro instance* [version]
      +--ro version      uint32
      +--ro status?      identityref
      +--ro junctions
         +--ro junction* [node-id]
            +--ro node-id                 inet:ip-address
            +--ro current_jct_version?   uint32
            +--ro bandwidth-requested?   uint64
            +--ro mtu?                    uint16
            +--ro status?                 identityref
            +--ro phops
            |  +--ro phop*
            |          [hop-address hop-index hop-version]
            |     +--ro hop-address    inet:ip-address
            |     +--ro hop-index      uint32
```

```
|     +--ro hop-version    uint32
|     +--ro in-label?      rt-types:mpls-label
|     +--ro status?        identityref
+--ro nhops
   +--ro nhop*
            [hop-address hop-index hop-version]
      +--ro hop-address
      |       inet:ip-address
      +--ro hop-index              uint32
      +--ro hop-version            uint32
      +--ro load-share?            uint16
      +--ro bandwidth-requested?   uint64
      +--ro bandwidth-reserved?    uint64
      +--ro out-label?
      |       rt-types:mpls-label
      +--ro status?                identityref
```

Figure 5: MPTED YANG tree

Appendix B. MPTED-JCT YANG Module - Complete Tree Structure

```
   module: ietf-mpted-jct

     augment /te:te:
       +--rw mpted-junctions
          +--rw junction* [node-id originator tnl-id tnl-vers sig-src]
             +--rw node-id                inet:ip-address
             +--rw originator             inet:ip-address
             +--rw tnl-id                 uint32
             +--rw tnl-vers               uint32
             +--rw sig-src                inet:ip-address
             +--rw name?                  string
             +--rw ingress*               inet:ip-address
             +--rw egress*                inet:ip-address
             +--rw type?                  identityref
             +--rw setup-priority?        uint8
             +--rw hold-priority?         uint8
             +--rw current_jct_version?   uint32
             +--rw bandwidth-requested?   uint64
             +--ro mtu?                   uint16
             +--ro status?                identityref
             +--rw phops
             |  +--rw phop* [hop-address hop-index hop-version]
             |     +--rw hop-address    inet:ip-address
             |     +--rw hop-index      uint32
             |     +--rw hop-version    uint32
             |     +--ro in-label?      rt-types:mpls-label
             |     +--ro status?        identityref
             +--rw nhops
                +--rw nhop* [hop-address hop-index hop-version]
                   +--rw hop-address            inet:ip-address
                   +--rw hop-index              uint32
                   +--rw hop-version?           uint32
                   +--rw load-share?            uint16
                   +--rw bandwidth-requested?   uint64
                   +--ro bandwidth-reserved?    uint64
                   +--ro out-label?             rt-types:mpls-label
                   +--ro status?                identityref
```

Figure 6: MPTED-JCT YANG tree

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This document was prepared using kramdown.

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