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H. Zheng
I. Busi
Huawei Technologies

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A YANG Data Model for Layer 1 Types
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Abstract

This document defines a collection of common data types and groupings in YANG data modeling language for layer 1 networks. These derived common types and groupings are intended to be imported by modules that specifies the OTN networks, including the topology, tunnel, client signal adaptation and service.

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 May 4, 2020.

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1. Introduction

This document introduces a collection of common data types which would be used in Layer 1 networks. The derived types and groupings are designed to be the common types applicable for modeling Traffic Engineering (TE) features for Layer 1 optical networks.

Typical L1 network, the Optical Transport Networking, was specified in [RFC7062]. Corresponding routing and signaling protocol have been specified in [RFC7138] and [RFC7139]. The types and groupings defined in this document is consistent to these document, and will be imported in other Layer 1 data models, including but not restrictive to, [I-D.ietf-ccamp-otn-topo-yang], [I-D.ietf-ccamp-otn-tunnel-model] and [I-D.ietf-ccamp-l1csm-yang].

The data model in this draft has only types defined including groupings, typedef and identities. There is no need to include configuration and state data according to the new Network Management Datastore Architecture [RFC8342]. The content in this draft is in consistent with [MEF63].

2. Terminology and Notations

Refer to [RFC7062] for the key terms used in this document, and the terminology for describing YANG data models can be found in [RFC7950].

3. Prefix 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.

Prefix	YANG module	Reference
layer1-types	ietf-layer1-types	This Document

4. Layer 1 Types Overview

4.1. Relationship with other Modules

This document defines one YANG module for common Layer 1 types. The objective is to specifies common Layer 1 TE types that can be imported by layer 1 specific technology, for example OTN, in its technology-specific modules such as topology and tunnels. It is worth noting that the generic traffic-engineering (TE) types module is specified in [I-D.ietf-teas-yang-te-types] as ietf-te-types, and both the module ietf-te-types and ietf-layer1-types are needed to be imported when the OTN is configured.

4.2. Content in Layer 1 Type Module

The module ietf-layer1-types contains the following YANG reusable types and groupings:

tributary-slot-granularity:

This is to define the granularity of the server layer ODU Link (HO ODUk or ODUCn) supporting a client layer ODU LSP (LO ODUj or ODUk, respectively). Three granularities, 1.25G/2.5G/5G, have been specified.

odu-type:

This is to specify the type of ODUk LSP.

client-signal:

This is to specify the client signal types of OTN networks. The initial input was the G-PID specified in [RFC7139]. Identities about

a few categories of client signal types, including ETH, STM-n, OC and Fiber Channel have been specified.

otn-label-range-type:

The label range type of OTN has two different representations, tributary slots (TS) and tributary port number (TPN), according to [RFC7139]. Respective representation is specified under this same base type.

otn-link-bandwidth:

This grouping defines the link bandwidth information and could be used in OTN topology model for bandwidth representation. All the bandwidth related sections in generic topology module, ietf-te-topology, need to be augmented with this grouping for the usage of Layer 1.

otn-path-bandwidth:

This grouping defines the path bandwidth information and could be used in OTN topology model for bandwidth representation. All the bandwidth related sections in generic topology module, ietf-te-topology, need to be augmented with this grouping for the usage of Layer 1. This grouping is also applicable to set up the OTN tunnel.

otn-label-restriction and otn-label-step:

These groupings are used for the augmentation of OTN label in a specific way.

otn-label-start-end and otn-label-hop:

These groupings are used for the augmentation of label for OTN link and path respectively.

optical-interface-func:

The optical interface function is specified in [MEF63]. This grouping describes the functionality which encodes bits for transmission and the corresponding decode upon reception.

service-performance-metric:

The service performance metric is a quantitative characterization of Layer 1 characteristic information delivery quality experienced by the Layer 1 subscriber.

4.3. Usage of groupings in Layer1-types

As described in [RFC7139], the OTN label usually represents the Tributary Port Number (TPN) and the related set of Tributary Slots (TS) assigned to a client layer ODU LSP (LO ODUj or ODUk) on a given server layer ODU (HO-ODU or ODUCn, respectively) Link (e.g., ODU2 LSP over ODU3 Link). Some special OTN label values are also defined for an ODUk LSP being setup over an OTUk Link.

The same OTN label shall be assigned to the same ODUk LSP at the two ends of an OTN Link.

As described in [RFC7139], TPN can be a number from 1 to 4095 and TS are numbered from 1 to 4095, although the actual maximum values depend on the type of server layer ODU. For example, a server layer ODU4 provides 80 time slots (numbered from 1 to 80) and the TPN values can be any number from 1 to 80.

The OTN Label Range represents the values for the TPN and TS that are available for ODUk LSPs to be setup over a given OTN Link.

The OTN Label Range is defined by the label-restriction list, defined in [I-D.ietf-teas-yang-te-types], which, for OTN, should be augmented using the otn-label-restriction grouping.

Each entry in the label-restriction list represents either the range of the available TPN values or the range of the available TS values: the range-type attribute defines the type of range for each entry of the list.

Each entry of the label-restriction list, as defined in [I-D.ietf-teas-yang-te-types], defines a label-start, a label-end, a label-step and a range-bitmap. The label-start and label-end definitions for OTN should be augmented using the otn-link-label grouping. The label-step definition for OTN should be augmented using the otn-label-step grouping. It is expected that the otn-label-step will always be equal to its default value (i.e., 1).

As described in [RFC7139], in some cases, the TPN assignment rules is flexible (e.g., ODU4 Link) while in other cases the TPN assignment rules are fixed (e.g., ODU1 Link). In the latter case, only the TS range is reported: not reporting the TPN range means that the TPN shall be set equal to the TS number assigned to the ODUk LSP.

As described in [RFC7139], in some cases, the TPN assignment rules depends on the TS Granularity (e.g., ODU2 or ODU3 Links). Different entries in the label-restriction list will report different TPN

ranges for each TS granularity supported by the link, as indicated by the tsg attribute.

As described in [RFC7139], in some cases, the TPN ranges are different for different types of ODUk LSPs. For example, on an ODU2 Link with 1,25G TS granularity, there is TPN range 1-4 for ODU1 and another TPN range 1-8 in common for ODU0 and ODUflex. Different entries in the label-restriction list will report different TPN ranges for different set of ODUk types, as indicated by the odu-type-list .

5. YANG Code for Layer1 Types

```
<CODE BEGINS>file "ietf-layer1-types@2019-11-01.yang"
module ietf-layer1-types {
  namespace "urn:ietf:params:xml:ns:yang:ietf-layer1-types";
  prefix "layer1-types";

  organization
    "IETF CCAMP Working Group";
  contact
    "WG Web: <http://tools.ietf.org/wg/ccamp/>
     WG List: <mailto:ccamp@ietf.org>

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

     Editor: Italo Busi
       <mailto:Italo.Busi@huawei.com>";

  description
    "This module defines Layer 1 types. The model fully conforms
     to the Network Management Datastore Architecture (NMDA).

     Copyright (c) 2018 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
     (https://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 "2019-11-01" {
```

```
    description
      "Initial Version";
    reference
      "RFC XXXX: A YANG Data Model for Layer 1 Types";
    // RFC Ed.: replace XXXX with actual RFC number, update date
    // information and remove this note
  }

  identity tributary-slot-granularity {
    description
      "Tributary slot granularity";
    reference
      "G.709/Y.1331, February 2016: Interfaces for the Optical
       Transport Network (OTN)";
  }

  identity tsg-1.25G {
    base tributary-slot-granularity;
    description
      "1.25G tributary slot granularity";
  }

  identity tsg-2.5G {
    base tributary-slot-granularity;
    description
      "2.5G tributary slot granularity";
  }

  identity tsg-5G {
    base tributary-slot-granularity;
    description
      "5G tributary slot granularity";
  }

  identity odu-type {
    description
      "Base identity for protocol framing used by tributary signals.";
  }

  identity ODU0 {
    base odu-type;
    description
      "ODU0 protocol (1.24G), RFC7139/ITU-T G.709, as standard track.";
  }

  identity ODU1 {
    base odu-type;
    description
```

```
      "ODU1 protocol (2.49G), RFC7139/ITU-T G.709, as standard track.";
  }

  identity ODU1e {
    base odu-type;
    description
      "ODU1e protocol (10.35G), RFC7963/ITU-T G.sup43, as informational.";
  }

  identity ODU2 {
    base odu-type;
    description
      "ODU2 protocol (10.03G), RFC7139/ITU-T G.709, as standard track.";
  }

  identity ODU2e {
    base odu-type;
    description
      "ODU2e protocol (10.39G), RFC7139/ITU-T G.709, as standard track.";
  }

  identity ODU3 {
    base odu-type;
    description
      "ODU3 protocol (40.31G), RFC7139/ITU-T G.709, as standard track.";
  }

  identity ODU3e1 {
    base odu-type;
    description
      "ODU3e1 protocol (41.77G), RFC7963/ITU-T G.sup43, as informational.";
  }

  identity ODU3e2 {
    base odu-type;
    description
      "ODU3e2 protocol (41.78G), RFC7963/ITU-T G.sup43, as informational.";
  }

  identity ODU4 {
    base odu-type;
    description
      "ODU4 protocol (104.79G), RFC7139/ITU-T G.709, as standard track.";
  }

  identity ODUFlex-cbr {
    base odu-type;
    description
```

```
      "ODU Flex CBR protocol for transporting constant bit rate
       signal";
  }

  identity ODUFlex-gfp {
    base odu-type;
    description
      "ODU Flex GFP protocol for transporting stream of packets
       using Generic Framing Procedure";
  }

  identity client-signal {
    description
      "Base identity from which specific client signals for the
       tunnel are derived";
  }

  identity ETH-1Gb {
    base client-signal;
    description
      "Client signal type of 1GbE";
  }

  identity ETH-10Gb-LAN {
    base client-signal;
    description
      "Client signal type of 10GbE LAN";
  }

  identity ETH-10Gb-WAN {
    base client-signal;
    description
      "Client signal type of 10GbE WAN";
  }

  identity ETH-40Gb {
    base client-signal;
    description
      "Client signal type of 40GbE";
  }

  identity ETH-100Gb {
    base client-signal;
    description
      "Client signal type of 100GbE";
  }

  identity STM-1 {
```

```
    base client-signal;
    description
      "Client signal type of STM-1";
  }

  identity STM-4 {
    base client-signal;
    description
      "Client signal type of STM-4";
  }

  identity STM-16 {
    base client-signal;
    description
      "Client signal type of STM-16";
  }

  identity STM-64 {
    base client-signal;
    description
      "Client signal type of STM-64";
  }

  identity STM-256 {
    base client-signal;
    description
      "Client signal type of STM-256";
  }
  identity OC-3 {
    base client-signal;
    description
      "Client signal type of OC3";
  }

  identity OC-12 {
    base client-signal;
    description
      "Client signal type of OC12";
  }

  identity OC-48 {
    base client-signal;
    description
      "Client signal type of OC48";
  }

  identity OC-192 {
    base client-signal;
```

```
    description
      "Client signal type of OC192";
  }

  identity OC-768 {
    base client-signal;
    description
      "Client signal type of OC768";
  }

  identity FC-100 {
    base client-signal;
    description
      "Client signal type of Fibre Channel FC-100";
  }

  identity FC-200 {
    base client-signal;
    description
      "Client signal type of Fibre Channel FC-200";
  }

  identity FC-400 {
    base client-signal;
    description
      "Client signal type of Fibre Channel FC-400";
  }

  identity FC-800 {
    base client-signal;
    description
      "Client signal type of Fibre Channel FC-800";
  }

  identity FC-1200 {
    base client-signal;
    description
      "Client signal type of Fibre Channel FC-1200";
  }

  identity FC-1600 {
    base client-signal;
    description
      "Client signal type of Fibre Channel FC-1600";
  }

  identity FC-3200 {
    base client-signal;
```

```
    description
      "Client signal type of Fibre Channel FC-3200";
  }

  identity FICON-4G {
    base client-signal;
    description
      "Client signal type of Fibre Connection 4G";
  }

  identity FICON-8G {
    base client-signal;
    description
      "Client signal type of Fibre Connection 8G";
  }

  identity otn-label-range-type {
    description
      "Base identity from which specific OTN label
           range types derived";
  }

  identity label-range-trib-slot {
    base otn-label-range-type;
    description
      "Defines a range of OTN tributary slots";
  }

  identity label-range-trib-port {
    base otn-label-range-type;
    description
      "Defines a range of OTN tributary ports";
  }

  grouping otn-link-bandwidth {
    description "link bandwidth attributes for OTN";
    list odulist {
      key "odu-type";
      description
        "OTN bandwidth definition";
      leaf odu-type {
        type identityref {
          base layer1-types:odu-type;
        }
        description "ODU type";
      }
      leaf number {
        type uint16;
```

```
        description "Number of ODUs";
      }
    }
  }

  grouping otn-path-bandwidth {
    description
          "path bandwidth attributes for OTN";
    leaf odu-type {
      type identityref {
        base layer1-types:odu-type;
      }
      description "ODU type";
    }
  }

  grouping otn-label-range-info {
    description "label range information for OTN";
    leaf range-type {
      type identityref {
        base layer1-types:otn-label-range-type;
      }
      description "type for range";
    }
    leaf tsg {
      type identityref {
        base layer1-types:tributary-slot-granularity;
      }
      description
            "Tributary slot granularity.";
      reference
        "G.709/Y.1331, February 2016: Interfaces for the
         Optical Transport Network (OTN)";
    }
        leaf-list odu-type-list {
      type identityref {
        base odu-type;
      }
      description
            "List of ODU types to which the label range applies.
                Empty odu-type-list means all the ODU types are applicable
                per label range. ";
    }
    leaf priority {
      type uint8;
      description "priority.";
    }
  }
```

```
  grouping otn-label-start-end {
    description
          "The OTN label-start or label-end used to specify an OTN label
range.";
    choice otn-label-type {
      description
        "OTN label range type, either TPN range or TS range";
      case tributary-port {
        leaf tpn {
          type uint16 {
            range "1..4095";
          }
          description
            "Tributary Port Number. Applicable in case of mux services.";
          reference
            "RFC7139: GMPLS Signaling Extensions for Control of Evolving
             G.709 Optical Transport Networks.";
        }
      }
      case tributary-slot {
        leaf ts {
          type uint16 {
            range "1..4095";
          }
          description
            "Tributary Slot Number. Applicable in case of mux services.";
          reference
            "RFC7139: GMPLS Signaling Extensions for Control of Evolving
             G.709 Optical Transport Networks.";
        }
      }
    }
  }

  grouping otn-label-hop {
    description "label information for OTN, for label-hop";
    leaf tpn {
      type uint16 {
        range "1..4095";
      }
      description
        "Tributary Port Number. Applicable in case of mux services.";
      reference
        "RFC7139: GMPLS Signaling Extensions for Control of Evolving
         G.709 Optical Transport Networks.";
    }
    leaf tsg {
      type identityref {
```

```
        base layer1-types:tributary-slot-granularity;
```

```
      }
      description "Tributary slot granularity.";
      reference
        "G.709/Y.1331, February 2016: Interfaces for the
         Optical Transport Network (OTN)";
    }
    leaf ts-list {
      type string {
          pattern "([1-9][0-9]{0,3}(-[1-9][0-9]{0,3})?"
                + "(,[1-9][0-9]{0,3}(-[1-9][0-9]{0,3})?)*)";
        }
        description
          "A list of available tributary slots ranging
           between 1 and 4095.
           For example 1-20,25,50-1000";
        reference "RFC 7139: GMPLS Signaling Extensions for Control
                   of Evolving G.709 Optical Transport Networks";
    }
  }

  grouping otn-label-step {
    description "Label step for OTN";
    choice otn-label-type {
      description
        "OTN label range type, either TPN range or TS range";
      case tributary-port {
        leaf tpn {
          type uint16 {
            range "1..4095";
          }
          default 1;
          description
            "Label step which represents possible increments for
             Tributary Port Number.";
          reference
            "RFC7139: GMPLS Signaling Extensions for Control of Evolving
             G.709 Optical Transport Networks.";
        }
      }
      case tributary-slot {
        leaf ts {
          type uint16 {
            range "1..4095";
          }
          default 1;
          description
            "Label step which represents possible increments for
             Tributary Slot Number.";
```

```
          reference
            "RFC7139: GMPLS Signaling Extensions for Control of Evolving
             G.709 Optical Transport Networks.";
        }
      }
    }
  }

  identity coding-func {
      description
      "base identity from which coding func is derived.";
     }

      identity ETH-1000X-PCS-36 {
         base "coding-func";
         description
            "PCS clause 36 coding function that corresponds to
             1000BASE-X";
         reference "MEF63 & IEEE802.3";
      }

      identity ETH-10GW-PCS-49-WIS-50 {
         base "coding-func";
         description
            "PCS clause 49 and WIS clause 50 coding func that
             corresponds to 10GBASE-W (WAN PHY)";
         reference "MEF63 & IEEE802.3";
      }

      identity ETH-10GR-PCS-49 {
         base "coding-func";
         description
            "PCS clause 49 coding function that corresponds to
             10GBASE-R (LAN PHY)";
         reference "MEF63 & IEEE802.3";
      }

      identity ETH-40GR-PCS-82 {
         base "coding-func";
         description
            "PCS clause 82 coding function that corresponds to
             40GBASE-R";
         reference "MEF63 & IEEE802.3";
      }

      identity ETH-100GR-PCS-82 {
         base "coding-func";
         description
```

```
            "PCS clause 82 coding function that corresponds to
             100GBASE-R";
          reference "MEF63 & IEEE802.3";
       }

  identity optical-interface-func {
      description
        "base identity from which optical-interface-function is
         derived.";
     }

      identity SX-PMD-clause-38 {
         base "optical-interface-func";
         description
            "SX-PMD-clause-38 Optical Interface function for
            1000BASE-X PCS-36";
         reference "MEF63 & IEEE802.3";
      }

      identity LX-PMD-clause-38 {
         base "optical-interface-func";
         description
            "LX-PMD-clause-38 Optical Interface function for
            1000BASE-X PCS-36";
         reference "MEF63 & IEEE802.3";
      }

      identity LX10-PMD-clause-59 {
         base "optical-interface-func";
         description
            "LX10-PMD-clause-59 Optical Interface function for
            1000BASE-X PCS-36";
         reference "MEF63 & IEEE802.3";
      }

      identity BX10-PMD-clause-59 {
         base "optical-interface-func";
         description
            "BX10-PMD-clause-59 Optical Interface function for
            1000BASE-X PCS-36";
         reference "MEF63 & IEEE802.3";
      }

      identity LW-PMD-clause-52 {
         base "optical-interface-func";
         description
            "LW-PMD-clause-52 Optical Interface function for
            10GBASE-W PCS-49-WIS-50";
```

```
         reference "MEF63 & IEEE802.3";
      }

      identity EW-PMD-clause-52 {
         base "optical-interface-func";
         description
            "EW-PMD-clause-52 Optical Interface function for
            10GBASE-W PCS-49-WIS-50";
         reference "MEF63 & IEEE802.3";
      }

      identity LR-PMD-clause-52 {
         base "optical-interface-func";
         description
            "LR-PMD-clause-52 Optical Interface function for
            10GBASE-R PCS-49";
         reference "MEF63 & IEEE802.3";
      }

      identity ER-PMD-clause-52 {
         base "optical-interface-func";
         description
            "ER-PMD-clause-52 Optical Interface function for
            10GBASE-R PCS-49";
         reference "MEF63 & IEEE802.3";
      }

      identity LR4-PMD-clause-87 {
         base "optical-interface-func";
         description
            "LR4-PMD-clause-87 Optical Interface function for
            40GBASE-R PCS-82";
         reference "MEF63 & IEEE802.3";
      }

      identity ER4-PMD-clause-87 {
         base "optical-interface-func";
         description
            "ER4-PMD-clause-87 Optical Interface function for
            40GBASE-R PCS-82";
         reference "MEF63 & IEEE802.3";
      }

      identity FR-PMD-clause-89 {
         base "optical-interface-func";
         description
            "FR-PMD-clause-89 Optical Interface function for
            40GBASE-R PCS-82";
```

```
         reference "MEF63 & IEEE802.3";
      }

      identity LR4-PMD-clause-88 {
         base "optical-interface-func";
         description
            "LR4-PMD-clause-88 Optical Interface function for
            100GBASE-R PCS-82";
         reference "MEF63 & IEEE802.3";
      }

      identity ER4-PMD-clause-88 {
         base "optical-interface-func";
         description
            "ER4-PMD-clause-88 Optical Interface function for
            100GBASE-R PCS-82";
         reference "MEF63 & IEEE802.3";
      }

   identity service-performance-metric {
      description
            "list of service-specific performance metric";
     }

      identity One-way-Delay {
         base "service-performance-metric";
         description "one-way-delay";
      }

      identity One-way-Errored-Second {
         base "service-performance-metric";
         description "one-way-errored-second";
      }

      identity One-way-Severely-Errored-Second {
         base "service-performance-metric";
         description "one-way-severely-errored-second";
      }

      identity One-way-Unavailable-Second {
         base "service-performance-metric";
         description "one-way-unavailable-second";
      }

      identity One-way-Availability {
         base "service-performance-metric";
         description "one-way-availability";
      }
```

```
      identity network-performance-metric {
        description "list of network-specific performance metric";
      }


}
<CODE ENDS>
```

6. 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 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.

The YANG module in this document defines layer 1 type definitions (i.e., typedef, identity and grouping statements) in YANG data modeling language to be imported and used by other layer 1 technology-specific modules. When imported and used, the resultant schema will have data nodes that can be writable, or readable. The access to such data nodes may be onsidered 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.

The security considerations spelled out in the YANG 1.1 specification [RFC7950] apply for this document as well.

7. IANA Considerations

It is proposed that IANA should assign new URIs from the "IETF XML Registry" [RFC3688] as follows:

```
      URI: urn:ietf:params:xml:ns:yang:ietf-layer1-types
      Registrant Contact: The IESG
      XML: N/A; the requested URI is an XML namespace.
```

This document registers following YANG modules in the YANG Module Names registry [RFC7950].

```
name:         ietf-layer1-types
namespace:    urn:ietf:params:xml:ns:yang:ietf-otn-types
prefix:       layer1-types
reference:    RFC XXXX
```

8. Acknowledgements

TBD.

9. Contributors

Dieter Beller
Nokia
Email: dieter.beller@nokia.com

Sergio Belotti
Nokia
Email: sergio.belotti@nokia.com

Yanlei Zheng
China Unicom
Email: zhengyl@dimpt.com

Aihua Guo
Huawei Technologies
Email: aihuaguo@huawei.com

Young Lee
Huawei Technologies
Email: leeyoung@huawei.com

Lei Wang
China Mobile
Email: wangleiyj@chinamobile.com

Oscar Gonzalez de Dios
Telefonica
Email: oscar.gonzalezdedios@telefonica.com

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

Yunbin Xu
CAICT
Email: xuyunbin@ritt.com

Anurag Sharma
Google
Email: ansha@google.com

Rajan Rao
Infinera
Email: rrao@infinera.com

Victor Lopez
Telefonica
Email: victor.lopezalvarez@telefonica.com

Yunbo Li
China Mobile
Email: liyunbo@chinamobile.com

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Authors' Addresses

Haomian Zheng
Huawei Technologies
H1-1-A043S Huawei Industrial Base, Songshanhu
Dongguan, Guangdong 523808
China

Email: zhenghaomian@huawei.com

Italo Busi
Huawei Technologies
Milan
Italy

Email: Italo.Busi@huawei.com