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MPLS Transport Profile (MPLS-TP) Identifiers  
Following ITU-T Conventions

Abstract

This document specifies an extension to the identifiers to be used in the Transport Profile of Multiprotocol Label Switching (MPLS-TP). Identifiers that follow IP/MPLS conventions have already been defined. This memo augments that set of identifiers for MPLS-TP management and Operations, Administration, and Maintenance (OAM) functions to include identifier information in a format typically used by the International Telecommunication Union Telecommunication Standardization Sector (ITU-T).

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## 1. Introduction

This document augments the initial set of identifiers to be used in the Transport Profile of Multiprotocol Label Switching (MPLS-TP) defined in [RFC6370] by adding new identifiers based on ITU-T conventions. It is not intended that both types of identifiers will be used at the same time in the same domain.

[RFC6370] defines a set of MPLS-TP transport and management entity identifiers to support bidirectional (co-routed and associated) point-to-point MPLS-TP Label Switched Paths (LSPs), including Pseudowires (PWs) and Sections that follow the IP/MPLS conventions.

This document specifies an alternative way to generate unambiguous identifiers for operators/service providers based on ITU-T conventions and specifies how these operator/service provider identifiers can be used to generate unambiguous identifiers for the existing set of identifiable MPLS-TP entities described in [RFC6370].

This document solely defines those identifiers. Their use and possible protocol extensions to carry them are out of the scope of this document.

In this document, we follow the notational convention laid out in [RFC6370], which is included in this document for convenience in Section 1.3.

### 1.1. Terminology

CC: Country Code

ICC: ITU Carrier Code

ISO: International Organization for Standardization

ITU: International Telecommunication Union

ITU-T: ITU Telecommunication Standardization Sector

LSP: Label Switched Path

MEG: Maintenance Entity Group

MEP: Maintenance Entity Group End Point

MIP: Maintenance Entity Group Intermediate Point

MPLS: Multiprotocol Label Switching

PW: Pseudowire

TSB: (ITU-T) Telecommunication Standardization Bureau

UMC: Unique MEG ID Code

## 1.2. Requirements Notation

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].

## 1.3. Notational Conventions

This document uses the notational conventions laid out in [RFC6370]:

All multiple-word atomic identifiers use underscores (\_) between the words to join the words. Many of the identifiers are composed of a set of other identifiers. These are expressed by listing the latter identifiers joined with double-colon "::" notation.

Where the same identifier type is used multiple times in a concatenation, they are qualified by a prefix joined to the identifier by a dash (-). For example, A1-Node\_ID is the Node\_ID of a node referred to as A1.

The notation defines a preferred ordering of the fields. Specifically, the designation A1 is used to indicate the lower sort order of a field or set of fields and Z9 is used to indicate the higher sort order of the same. The sort is either alphanumeric or numeric depending on the field's definition. Where the sort applies to a group of fields, those fields are grouped with {...}.

Note, however, that the uniqueness of an identifier does not depend on the ordering, but rather, upon the uniqueness and scoping of the fields that compose the identifier. Further, the preferred ordering is not intended to constrain protocol designs by dictating a particular field sequence ... or even what fields appear in which objects.

## 2. Named Entities

This document provides additional identifiers supplementing those defined in [RFC6370]. The identifiers in [RFC6370] are composed of a set of atomic identifiers, and this document defines some new atomic identifiers that can be substituted for some of those that have already been defined, to create new identifiers. The set of identifiers defined in [RFC6370] is:

- o Global\_ID
- o Node

- o Interface
- o Tunnel
- o LSP
- o PW
- o MEG
- o MEP
- o MIP

The following sections go through this list of identifiers one by one. The structure of this document is loosely aligned with the structure of [RFC6370].

### 3. Uniquely Identifying an Operator -- the ICC\_Operator\_ID

In [RFC6370], an operator is uniquely identified by the Global\_ID, which is based on the Autonomous System (AS) number of the operator. The ITU-T, however, traditionally identifies operators and service providers based on the ITU Carrier Code (ICC) as specified in [M1400].

The ITU-T Telecommunication Standardization Bureau (TSB) maintains a list of assigned ICCs [ICC-list]. Note that ICCs, all of which are referenced at [ICC-list], can be assigned to ITU-T members as well as non-members. The national regulatory authorities act as an intermediary between the ITU/TSB and operators/service providers. One of the things that the national authorities are responsible for in the process of assigning an ICC is to ensure that the Carrier Codes are unique within their country. This uniqueness assumption is the basis for creating a globally unique ICC-based operator ID.

The ICC itself is a string of one to six characters, each character being either alphabetic (i.e., A-Z) or numeric (i.e., 0-9). Alphabetic characters in the ICC SHOULD be represented with uppercase letters.

Global uniqueness is assured by concatenating the ICC with a Country Code (CC). The Country Code (alpha-2) is a string of two alphabetic characters represented with uppercase letters (i.e., A-Z).

The International Organization for Standardization (ISO) establishes internationally recognized codes for the representation of names of countries, territories or areas of geographical interest, and their subdivisions, published as a list of CCs [CC-list] in ISO Standard 3166-1 [ISO3166-1].

The ICC and CC characters are coded according to ITU-T Recommendation T.50 [T.50].

Together, the CC and the ICC form the ICC\_Operator\_ID as:

CC::ICC

### 3.1. Use of the ICC\_Operator\_ID

The ICC\_Operator\_ID is used as a replacement for the Global\_ID as specified in [RFC6370], i.e., its purpose is to provide a globally unique context for other MPLS-TP identifiers.

As an example, an Interface Identifier (IF\_ID) in [RFC6370] is specified as the concatenation of the Node\_ID (a unique 32-bit value assigned by the operator) and the Interface Number (IF\_Num, a 32-bit unsigned integer assigned by the operator that is unique within the scope of a Node\_ID). To make this IF\_ID globally unique, the Global\_ID is prefixed. This memo specifies the ICC\_Operator\_ID as an alternative format that, just like the Global\_ID, is prefixed to the IF\_ID. Using the notation from RFC 6370 [RFC6370]:

Global\_ID::Node\_ID::IF\_Num

is functionally equivalent to:

ICC\_Operator\_ID::Node\_ID::IF\_Num

The same substitution procedure applies to all identifiers specified in [RFC6370] with the exception of the MEG ID, MEP ID, and MIP ID. MEG, MEP, and MIP Identifiers are redefined in this document (see Sections 7.1, 7.2, and 7.3, respectively).

#### 4. Node and Interface Identifiers

The format of the Node and Interface Identifiers are not changed by this memo except for the case when global uniqueness is required.

[RFC6370] defines the Node Identifier (Node\_ID) as a unique 32-bit value assigned by the operator within the scope of a Global\_ID. The structure of the Node\_ID itself is not defined as it is left to the operator to choose an appropriate value. The value zero, however, is reserved and MUST NOT be used.

This document does not change the above definition. However, in case global uniqueness is required, the Node\_ID is prefixed with the ICC\_Operator\_ID as defined in Section 3.

[RFC6370] further defines interface numbers (IF\_Num) as 32-bit unsigned integers that can be freely assigned by the operator and must be unique in the scope of the respective Node\_ID. The IF\_Num value 0 has a special meaning, and therefore, it MUST NOT be used to identify an MPLS-TP interface.

An Interface Identifier (IF\_ID) identifies an interface uniquely within the context of an ICC\_Operator\_ID. It is formed by concatenating the Node\_ID with the IF\_Num to result in a 64-bit identifier formed as Node\_ID::IF\_Num.

Global uniqueness of the IF\_ID, if needed, can be assured by prefixing the identifier with the ICC\_Operator\_ID.

#### 5. MPLS-TP Tunnel and LSP Identifiers

This document does not change the definition for local Tunnel and LSP IDs. When global uniqueness is needed, the format of these identifiers is as described in Sections 5.1 and 5.2.

##### 5.1. MPLS-TP Point-to-Point Tunnel Identifiers

Tunnel IDs (Tunnel\_ID) are based on the end points' Node\_IDs and locally assigned tunnel numbers (Tunnel\_Num), which identify the tunnel at each end point. The tunnel number is a 16-bit unsigned integer unique within the context of the Node\_ID. A full Tunnel ID is represented by the concatenation of these two end-point-specific identifiers. Using the A1/Z9 convention, the format of a Tunnel\_ID is:

$$A1-\{Node\_ID::Tunnel\_Num\}::Z9-\{Node\_ID::Tunnel\_Num\}$$

Where global uniqueness is required, using ITU-T conventions, the ICC\_Operator\_ID is prefixed to the Tunnel\_ID. Thus, a globally unique Tunnel\_ID becomes:

```
A1-{ICC_Operator_ID::Node_ID::Tunnel_Num}::
Z9-{ICC_Operator_ID::Node_ID::Tunnel_Num}
```

As per [RFC6370], when an MPLS-TP tunnel is configured, it MUST be assigned a unique IF\_ID at each end point as defined in Section 4.

## 5.2. MPLS-TP LSP Identifiers

The following subsections define identifiers for MPLS-TP co-routed bidirectional and associated bidirectional LSPs. Since MPLS-TP Sub-Path Maintenance Entities (SPMEs) are also LSPs, they use the same form of IDs.

### 5.2.1. MPLS-TP Co-Routed Bidirectional LSP Identifiers

The LSP Identifier (LSP\_ID) for a co-routed bidirectional LSP is formed by adding a 16-bit unsigned integer LSP number (LSP\_Num) to the Tunnel ID. Consequently, the format of an MPLS-TP co-routed bidirectional LSP\_ID is:

```
A1-{Node_ID::Tunnel_Num}::Z9-{Node_ID::Tunnel_Num}::LSP_Num
```

[RFC6370] notes that the "uniqueness of identifiers does not depend on the A1/Z9 sort ordering".

A co-routed bidirectional LSP is provisioned or signaled as a single entity, and therefore, a single LSP\_Num is used for both unidirectional LSPs. These can be referenced by the following identifiers:

```
A1-Node_ID::A1-Tunnel_Num::LSP_Num::Z9-Node_ID and
```

```
Z9-Node_ID::Z9-Tunnel_Num::LSP_Num::A1-Node_ID, respectively.
```

Global uniqueness is accomplished by using globally unique Node\_IDs. A globally unique LSP\_ID consequently becomes:

```
A1-{ICC_Operator_ID::Node_ID::Tunnel_Num}::
Z9-{ICC_Operator_ID::Node_ID::Tunnel_Num}::LSP_Num
```



### 5.2.2. MPLS-TP Associated Bidirectional LSP Identifiers

An associated bidirectional LSP needs a separate LSP\_Num for both of its unidirectional LSPs. The LSP number is again a 16-bit unsigned integer that needs to be unique within the scope of the ingress's Tunnel\_Num. Consequently, the format of an MPLS-TP associated bidirectional LSP\_ID is:

```
A1- {Node_ID::Tunnel_Num::LSP_Num}::
Z9- {Node_ID::Tunnel_Num::LSP_Num}
```

Each of the unidirectional LSPs of which the associated bidirectional LSP is composed may be referenced by one of the following identifiers:

```
A1-Node_ID::A1-Tunnel_Num::A1-LSP_Num::Z9-Node_ID and
Z9-Node_ID::Z9-Tunnel_Num::Z9-LSP_Num::A1-Node_ID, respectively.
```

A globally unique LSP\_ID is constructed using the globally unique Node\_IDs as defined before. Consequently, a globally unique LSP\_ID is formulated as:

```
A1- {ICC_Operator_ID::Node_ID::Tunnel_Num::LSP_Num}::
Z9- {ICC_Operator_ID::Node_ID::Tunnel_Num::LSP_Num}
```

## 6. Pseudowire Path Identifiers

The PW Path Identifier (PW\_Path\_ID) is structured in a similar manner as the PW\_Path\_ID described in Section 6 of [RFC6370]. Instead of the Global\_ID used in [RFC6370], this document uses the ICC\_Operator\_ID to make the PW\_Path\_ID globally unique. In this document, the Attachment Individual Identifier (AII) is composed of three fields. These are the ICC\_Operator\_ID, the Node\_ID, and the AC\_ID. The AC\_ID is as defined in [RFC5003]. The complete globally unique PW\_Path\_ID is formulated as:

```
A1- {ICC_Operator_ID::Node_ID::AC_ID}::
Z9- {ICC_Operator_ID::Node_ID::AC_ID}
```

## 7. Maintenance Identifiers

The following subsections define the identifiers for the various maintenance-related groups and entities as defined in [RFC6371]. In contrast to the IDs defined in [RFC6370], this document does not define separate maintenance identifiers for Sections, PWs, and LSPs.

### 7.1. MEG Identifiers

MEG\_IDs for MPLS-TP Sections, LSPs, and PWs following ITU-T conventions are based on the globally unique ICC\_Operator\_ID. In this case, the MEG\_ID is a string of up to 15 characters and consists of three subfields: the Country Code (as described in Section 3) and the ICC (as described in Section 3) -- which together form the ICC\_Operator\_ID -- followed by a Unique MEG ID Code (UMC) as defined in [Y.1731\_cor1].

The resulting MEG\_ID is:

```
CC::ICC::UMC
```

To avoid the potential for the concatenation of a short (i.e., less than 6 characters) ICC with a UMC not being unique, the UMC MUST start with the "/" character, which is not allowed in the ICC itself. This way, the MEG\_ID can also be easily decomposed into its individual components by a receiver.

The UMC MUST be unique within the organization identified by the combination of CC and ICC.

The ICC\_Operator\_ID-based MEG\_ID may be applied equally to a single MPLS-TP Section, LSP, or Pseudowire.

### 7.2. MEP Identifiers

ICC\_Operator\_ID-based MEP\_IDs for MPLS-TP Sections, LSPs, and Pseudowires are formed by appending a 16-bit index to the MEG\_ID defined in Section 7.1. Within the context of a particular MEG, we call the identifier associated with a MEP the MEP Index (MEP\_Index). The MEP\_Index is administratively assigned. It is encoded as a 16-bit unsigned integer and MUST be unique within the MEG. An ICC\_Operator\_ID-based MEP\_ID is structured as:

```
MEG_ID::MEP_Index
```

An ICC\_Operator\_ID-based MEP ID is globally unique by construction given the ICC\_Operator\_ID-based MEG\_ID's global uniqueness.

### 7.3. MIP Identifiers

ICC\_Operator\_ID-based MIP\_IDs for MPLS-TP Sections, LSPs, and Pseudowires are formed by a global IF\_ID that is obtained by prefixing the identifier of the interface on which the MIP resides

with the ICC\_Operator\_ID as described in Section 3.1. This allows MIPs to be independently identified in nodes where a per-interface MIP model is used.

If only a per-node MIP model is used, one MIP is configured. In this case, the MIP\_ID is formed by using the Node\_ID and an IF\_Num of 0.

## 8. Security Considerations

This document extends an existing naming scheme and does not introduce new security concerns. However, as mentioned in the Security Considerations section of [RFC6370], protocol specifications that describe the use of this naming scheme may introduce security risks and concerns about authentication of participants. For this reason, these protocol specifications need to describe security and authentication concerns that may be raised by the particular mechanisms defined and how those concerns may be addressed.

## 9. References

### 9.1. Normative References

- [ISO3166-1] "Codes for the representation of names of countries and their subdivisions -- Part 1: Country codes", ISO 3166-1, 2006.
- [M1400] "Designations for interconnections among operators' networks", ITU-T Recommendation M.1400, July 2006.
- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.
- [RFC5003] Metz, C., Martini, L., Balus, F., and J. Sugimoto, "Attachment Individual Identifier (AII) Types for Aggregation", RFC 5003, September 2007.
- [RFC6370] Bocci, M., Swallow, G., and E. Gray, "MPLS Transport Profile (MPLS-TP) Identifiers", RFC 6370, September 2011.
- [T.50] "International Reference Alphabet (IRA) (Formerly International Alphabet No. 5 or IA5) - Information technology - 7-bit coded character set for information exchange", ITU-T Recommendation T.50, September 1992.
- [Y.1731\_cor1] "OAM functions and mechanisms for Ethernet based networks - Corrigendum 1", ITU-T Recommendation G.8013/Y.1731 Corrigendum 1, October 2011.

## 9.2. Informative References

- [CC-list] "List of Country Codes - ISO 3166 (CCs)",  
<[http://www.iso.org/iso/country\\_codes.htm](http://www.iso.org/iso/country_codes.htm)>.
- [ICC-list] "List of ITU Carrier Codes (ICCs)",  
<<http://www.itu.int/oth/T0201>>.
- [RFC6371] Busi, I., Ed., and D. Allan, Ed., "Operations,  
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