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MPLS-TP Identifiers Following ITU-T Conventions
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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 OAM functions to include identifier information in a format typically used by the ITU-T.

Status of this Memo

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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].

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

This document specifies an alternative way to uniquely identify an operator/service provider based on ITU-T conventions and specifies how this operator/service provider identifier can be used to make the existing set of MPLS-TP transport and management entity identifiers, defined by [RFC6370], globally unique.

This document solely defines those identifiers. Their use and possible protocols extensions to carry them is out of scope in 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

ITU-T: International Telecommunication Union Telecommunication Standardization Sector

LSP: Label Switched Path

MEG: Maintenance Entity Group

MEP: Maintenance Entity Group End Point

MIP: Maintenance Entity Group Intermediate Point

MPLS: Multi-Protocol 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

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 makes modest changes to the set of identifiers defined in [RFC6370]. Most changes replace certain parts in the already defined identifiers that are themselves composed of a set of atomic identifiers. The set of identifiers defined in [RFC6370] are:

- Global_ID

- Node

- 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 AS number of the operator. The ITU-T however traditionally identifies operators/service providers based on the ITU-T 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 can be assigned to both, ITU-T members as well as non-members, all of which are referenced at [ICC-list]. The national regulatory authorities act as an intermediary between the ITU/TSB and operators/service providers. Amongst 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.

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 upper case 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 upper case letters (i.e., A-Z). The Country Code format is defined in ISO 3166-1 [ISO3166-1]. 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 which, 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 Section 7.1, Section 7.2 and Section 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 draft 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 which 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 Section 5.1 and Section 5.2 below.

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_IDs. 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 sub-sections 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

Associated bidirectional LSPs need an LSP_Num for each unidirectional LSP it consists of. The LSP number is again a 16-bit unsigned integer which needs to be unique within the scope of the ingress' 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 consists of 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]. In stead 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

A Maintenance Entity Group (MEG) as defined by [RFC6371] is a collection of one or more maintenance enties that belong to the same transport path. These maintenance entities can be e.g. Maintenance Entity Group End Points (MEPs) or Maintenance Entity Group Intermediate Points (MIPs). The following sub-sections define the identifiers for the various maintenance-related groups and entities. 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 Pseudowires 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), 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 Character) 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 above. 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 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 information model and does not introduce new security concerns. But, as mentioned in the security considerations section of [RFC6370] protocol specifications that describe use of this information model 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. IANA Considerations

There are no IANA actions resulting from this document.

10. References

10.1. Normative References

[ISO3166-1]
"Codes for the representation of names of countries and their subdivisions -- Part 1: Country codes", ISO 3166-1.

[M1400] "Designations for interconnections among operators' networks", ITU-T Recommendation M.1400, July 2006, <http://www.itu.int/rec/T-REC-M.1400-200607-I/en>.

[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.

[Y.1731_cor1]
"OAM functions and mechanisms for Ethernet based networks - Corrigendum 1", ITU-T Recommendation ITU-T G.8013/Y.1731 (2011) Corrigendum 1.

10.2. Informative References

[ICC-list]
"List of ITU Carrier Codes (ICCs)", <http://www.itu.int/oth/T0201>.

[RFC6371] Busi, I. and D. Allan, "Operations, Administration, and Maintenance Framework for MPLS-Based Transport Networks", RFC 6371, September 2011.

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