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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 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).

Status of this Memo

   This Internet-Draft is submitted in full conformance with the
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   material or to cite them other than as "work in progress."

   This Internet-Draft will expire on August 29, 2013.

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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 identifier 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
   Pseudowire (PWs) and Sections which 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 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

   ISO: International Organization for Standardization

   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:

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 AS number of the operator.  The ITU-T however traditionally identifies operators/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 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.  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 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 International Organization for Standardization (ISO) establishes
internationally recognised 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 standard ISO
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 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].  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 sub-sections 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 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 naming scheme and does not
   introduce new security concerns.  But, as mentioned in the security
   considerations section of [RFC6370] protocol specifications that
   describe 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.  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.

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           networks", ITU-T Recommendation M.1400, July 2006,
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[RFC5003]  Metz, C., Martini, L., Balus, F., and J. Sugimoto,
           "Attachment Individual Identifier (AII) Types for
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           "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

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[ICC-list]

                  "List of ITU Carrier Codes (ICCs)",
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   [RFC6371]  Busi, I. and D. Allan, "Operations, Administration, and
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