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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.

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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)
   specified 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:

   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-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 unsigend 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 LSP IDs described before. It uses the concept of a group ID
   (Group_ID) as described in RFC 4447 together with a PW number
   (PW_Num). Both are 16 bit quantaties. In a statically configure
   environment, both the group ID and the PW number need to be equal on
   both ends of the PW. Together with the node ID these values form the
   PW_Path_ID as follows:

      A1-{Node_ID::Group_ID::PW_Num}::Z9-{Node_ID::Group_ID::PW_Num}

   A globally unique PW_Path_ID is constructed using the globally unique
   Node_IDs as defined earlier in this document. A globally unique
   PW_Path_ID is formulated as:

      A1-{ICC_Operator_ID::Node_ID::Group_ID::PW_Num}::
      Z9-{ICC_Operator_ID::Node_ID::Group_ID::PW_Num}

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 LSPs and Pseudowires are
formed by appending a 32-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 32-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 are formed the same way MEP_IDs are
constructed, i.e. by appending a 32-bit MIP Index (MIP_Index) to the
MEG_ID. The MIP_Index is administratively assigned and encoded as a
32-bit unsigned integer. It MUST be unique within the MEG. An
ICC_Operator_ID-based MIP_ID is structured as:

    MEG_ID::MIP_Index

An ICC_Operator_ID-based MIP ID is globally unique by construction
given the ICC_Operator_ID-based MEG_ID's global uniqueness.

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'
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    [RFC6370] Bocci, M., Swallow, G., and E. Gray, "MPLS Transport
              Profile (MPLS-TP) Identifiers", RFC 6370, September 2011.

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

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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

    [ICC-list]
              "List of ITU Carrier Codes (ICCs)",
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