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MPLS-TP Identifiers  
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Abstract

This document specifies identifiers for MPLS-TP objects. Included are identifiers conformant to existing ITU conventions and identifiers which are compatible with existing IP, MPLS, GMPLS, and Pseudowire definitions.

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## 1. Introduction

This document specifies identifiers to be used in within the Transport Profile of Multiprotocol Label Switching (MPLS-TP). The MPLS-TP requirements [12] require that the elements and objects in an MPLS-TP environment are able to be configured and managed without a control plane. In such an environment many conventions for defining identifiers are possible. This document defines identifiers for MPLS-TP management and OAM functions suitable to ITU conventions and to IP/MPLS conventions. Applicability of the different identifier schemas to different applications are outside the scope of this document.

### 1.1. Terminology

AII: Attachment Interface Identifier

ASN: Autonomous System Number

FEC: Forwarding Equivalence Class

GMPLS: Generalized Multi-Protocol Label Switching

ICC: ITU Carrier Code

LSP: Label Switched Path

LSR: Label Switching Router

ME: Maintenance Entity

MEG: Maintenance Entity Group

MEP: Maintenance Entity Group End Point

MIP: Maintenance Entity Group Intermediate Point

MPLS: Multi-Protocol Label Switching

OAM: Operations, Administration and Maintenance

P2MP: Point to Multi-Point

P2P: Point to Point

~~PSC: Protection State Coordination~~

PW: Pseudowire

**Comment [M1]:** Not used in this draft. Also use of this acronym is current under review.

RSVP: Resource Reservation Protocol

RSVP-TE: RSVP Traffic Engineering

S-PE: Switching Provider Edge

T-PE: Terminating Provider Edge

#### Requirements Language

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 RFC 2119 [1].

## 2. Named Entities

In order to configure, operate and manage a transport network based on the MPLS Transport Profile, a number of entities require identification. Identifiers for the follow entities are defined in this document:

- o Operator
  - \* ICC
  - \* Global\_ID
- o LSR
- o LSP
- o PW
- o Interface
- o MEG
- o MEP
- o MIP
- o Tunnel

Note that we have borrowed the term tunnel from RSVP-TE (RFC 3209) [2] where it is used to describe an entity that provides an LSP connection between a source and destination LSR which in turn is instantiated by one or more LSPs, where the additional LSPs are used

for protection or re-grooming of the tunnel.

### 3. Uniquely Identifying an Operator

Two forms of identification are defined, one that is compatible with IP operational practice called a Global\_ID and one compatible with ITU practice, the ICC. An Operator MAY be identified either by its Global\_ID or by its ICC.

#### 3.1. The Global ID

RFC 5003 [3] defines a globally unique Attachment Interface Identifier (AII). That AII is composed of three parts, a Global ID which uniquely identifies a operator, a prefix, and finally and attachment circuit identifier. We have chosen to use that Global ID for MPLS-TP. Quoting from RFC 5003, section 3.2, "The global ID can contain the 2-octet or 4-octet value of the operator's Autonomous System Number (ASN). It is expected that the global ID will be derived from the globally unique ASN of the autonomous system hosting the PEs containing the actual AIIs. The presence of a global ID based on the operator's ASN ensures that the AII will be globally unique."

When the Global\_ID is derived from a 2-octet AS number, the two high-order octets of this 4-octet identifier MUST be set to zero.

Note that this Global\_ID is used solely to provide a globally unique context for other MPLS-TP identifiers. It has nothing to do with the use of the ASN in protocols such as BGP.

#### 3.2. ITU Carrier Code

M.1400 defines the ITU Carrier Code (ICC) assigned to a network operator/service provider and maintained by the ITU-T Telecommunication Standardization Bureau (TSB): [www.itu.int/ITU-T/inr/icc/index.html](http://www.itu.int/ITU-T/inr/icc/index.html).

ICCs can be assigned both to ITU-T and non-ITU-T members and the referenced local ICC website may contain ICCs of operators of both kinds.

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

#### 4. Node and Interface Identifiers

An LSR requires identification of the node itself and of its interfaces. We call the identifier associated with a node a Node Identifier (Node\_ID). Within the context of a particular node, we call the identifier associated with an interface an Logical Interface Handle or LIH. The combination of Node\_ID::LIH we call an Network Interface ID or IF\_ID.

In existing MPLS deployments Node\_IDs are IPv4 addresses. Therefore we have chosen the Node\_ID to be a 32-bit value assigned by the operator. Where IPv4 addresses are in use the Node\_ID can be automatically mapped to the LSR's /32 IPv4 loopback address. Note that, when IP reachability is not needed, the 32-bit Node\_ID is not required to have any association with the IPv4 address space used in the operator's IGP or BGP, other ~~that than~~ that they be uniquely chosen within the scope of that operator.

GMPLS signaling [4] requires interface identification. We have chosen to adopt the conventions of that RFC. GMPLS allows three formats for the Interface\_ID. For IP numbered links, it is simply the IPv4 or IPv6 address associated with the interface. The third format consists of an IPv4 Address plus a 32-bit unsigned integer for the specific interface.

For MPLS-TP, we have adopted a format consistent with the third format above. In MPLS-TP, each interface is assigned a 32-bit identifier which we call a Logical Interface Handle (LIH). The LIH MUST be unique within the context of the Node\_ID. We map the Node\_ID to the field ~~the field~~ which carries the IP address. That is, an IF\_ID is a 64-bit identifier consisting of the Node\_ID followed by the LIH. The LIH in turn is a 32-bit unsigned integer unique to the node. The LIH value 0 has special meaning (see section Section 7.3 and must not be used as the LIH in an MPLS-TP IF\_ID.

In situations where a Node\_ID or an IF\_ID needs to be globally unique, this is accomplished by prefixing the identifier with the operator's Global\_ID. The combination of Global\_ID::Node\_ID we call an Global Node ID or Global\_Node\_ID. Likewise, the combination of Global\_ID::Node\_ID::LIH we call an Global Interface ID or Global\_IF\_ID.

MPLS-TP Tunnels (see section Section 5.1) also need interface identifiers. A procedure for automatically generating these is contained in that section.

**Comment [M2]:** The scope of an "interface" should be defined. Is it a physical port, a logical port (e.g. a TDM timeslot or an outer label).

**Comment [M3]:** Please clarify, is the Node\_ID set to the IPv4 loopback address?

**Comment [M4]:** Scope of Node\_IDs or all IPv4 addresses?

**Comment [M5]:** In an environment that does not support IP forwarding this may not be a routable address. Please clarify this point.

5. MPLS-TP Tunnel and LSP Identifiers

A important construct within MPLS TP is a connection which is provided across a working and a protection LSP. Within this document we will use the term MPLS-TP Tunnel or simply tunnel for the connection provided by the working and protect LSPs. This section defines an MPLS-TP Tunnel\_ID to uniquely identify a tunnel and MPLS-TP LSP\_IDs within the context of a tunnel.

**Comment [M6]:** Does a bi-directional tunnel or LSP have one or two tunnel/LSP identifiers. If one how would that identifier be constructed. If two how are they automatically associated.

**Comment [M7]:** What is the relationship between the term "tunnel" in this draft and the term "Path Segment Tunnel (PST)" used in the framework draft? It appears that a PST described in the framework draft is NOT a tunnel as defined in this draft. It also appears that a hierarchical LSP is also NOT a tunnel. Please clarify the definition of "tunnel" as used in this draft.

5.1. MPLS-TP Tunnel Identifiers

At each endpoint a tunnel is uniquely identified by the Source Node\_ID and a locally assigned tunnel number. Specifically a Tunnel\_Num is a 16-bit unsigned integer unique to the node. The concatenation of the two endpoint identifier servers as the full identifier. Thus the format of a Tunnel\_ID is:

Src-Node\_ID::Src-Tunnel\_Num::Dst-Node\_ID::Dst-Tunnel\_Num

**Comment [M8]:** Is a tunnel number only assigned at the source node or at both the source and destination. If a bi-directional tunnel only has one identifier how is the "source" selected?

**Comment [M9]:** Why is a Dst-Tunnel\_num required?

Where the Tunnel\_ID needs to be globally unique, this is accomplished by using globally unique Node\_IDs as defined above. Thus a globally unique Tunnel\_ID becomes:

Src-Global\_ID::Src-Node\_ID::Src-Tunnel\_Num:: Dst-Global ID::Dst-Node\_ID::Dst-Tunnel\_Num

**Comment [M10]:** What is Src-Global\_ID, above this is defined as "Global\_ID::Node\_ID" so why is the Src-Node\_ID required.

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When an MPLS-TP Tunnel is configured, it MUST be assigned a unique IF\_ID at both the source and destination endpoints. As usual, the IF\_ID is composed of the local NODE\_ID concatenated with a 32-bit LIH. It is RECOMMENDED that the LIH be auto-generated by adding 2^31 to the local Tunnel\_Num.

**Comment [M11]:** Which LIH is used if the Tunnel has both a working and protect LSP?

5.2. MPLS-TP LSP Identifiers

Within the scope of an MPLS-TP Tunnel\_ID an LSP can be uniquely identified by a single LSP number. Specifically an LSP\_Num is a 16-bit unsigned integer unique within the Tunnel\_ID. Thus the format of a Tunnel\_ID is:

Src-Node\_ID::Src-Tunnel\_Num::Dst-Node\_ID::Dst-Tunnel\_Num:: LSP\_Num

Where the LSP\_ID needs to be globally unique, this is accomplished by using globally unique Node\_IDs as defined above. Thus a globally unique Tunnel\_ID becomes:

Src-Global\_ID::Src-Node\_ID::Src-Tunnel\_Num:: Dst-Global ID::Dst-Node\_ID::Dst-Tunnel\_Num::LSP\_Num

**Comment [M12]:** What is Src-Global\_ID, above this is defined as "Global\_ID::Node\_ID" so why is the Src-Node\_ID required.

### 5.3. Mapping to GMPLS Signalling

This section defines the mapping from an MPLS-TP LSP\_ID to GMPLS. At this time, GMPLS has yet to be extended to accommodate Global\_IDs. Thus a mapping is only made for the network unique form of the LSP\_ID.

GMPLS signaling [5] uses a 5-tuple to uniquely identify an LSP within a operator's network. This tuple is composed of a Tunnel Endpoint Address, Tunnel\_ID, Extended Tunnel ID, and Tunnel Sender Address and (GMPLS) LSP\_ID.

In situations where a mapping to the GMPLS 5-tuple is required, the following mapping is used.

- o Tunnel Endpoint Address = Dst-Node\_ID
- o Tunnel\_ID = Src-Tunnel\_Num
- o Extended Tunnel\_ID = Src-Node\_ID
- o Tunnel Sender Address = Src-Node\_ID
- o LSP\_ID = LSP\_Num

## 6. Pseudowire Path Identifiers

Pseudowire signaling (RFC 4447 [6]) defines two FECs used to signal pseudowires. Of these, FEC Type 129 along with AII Type 2 as defined in RFC 5003 [3] fits the identification requirements of MPLS-TP.

In an MPLS-TP environment, a PW is identified by a set of identifiers which can be mapped directly to the elements required by FEC 129 and AII Type 2. To distinguish this identifier from other Pseudowire Identifiers, we call this a Pseudowire Path Identifier or PW\_Path\_Id.

The AII Type 2 is composed of three fields. These are the Global\_ID, the Prefix, and the AC\_ID. The Global\_ID used in this document is identical to the Global\_ID defined in RFC 5003. The Node\_ID is used as the Prefix. The AC\_ID is as defined in RFC 5003.

To complete the FEC 129, all that is required is a Attachment Group Identifier (AGI). That field is exactly as specified in RFC 4447. FEC 129 has a notion of Source AII (SAII) and Target AII (TAII). These terms are used relative to the direction of the signaling. In a purely configured environment when referring to the entire PW, this distinction is not critical. That is a FEC 129 of AGIa::AIIb::AIIc

**Comment [M13]:** How would an ICC based identifier be constructed for a PW.

is equivalent to AGIa::AIIC::AIIB. We note that in a signaled environment, the required convention in RFC 4447 is that at a particular endpoint, the AII associated with that endpoint comes first. The complete PW\_Path\_Id is:

```
AGI:Src-Global_ID::Src-Node_ID::Src-AC_ID:: Dst-Global_ID::Dst-Node_ID::Dst-AC_ID.
```

## 7. Maintenance Identifiers

[Note this section needs to be reconciled with the MPLS-TP OAM Framework]

In MPLS-TP a Maintenance Entity Group (MEG) represents an Entity that requires management and defines a relationship between a set of maintenance points. A maintenance point is either Maintenance Entity Group End-point (MEP) or a Maintenance Entity Group Intermediate Point (MIP). Maintenance points are uniquely associated with a MEG. Within the context of a MEG, MEPs and MIPs must be uniquely identified. This section defines a means of uniquely identifying Maintenance Entity Groups, Maintenance Entities and uniquely defining MEPs and MIPs within the context of a Maintenance Entity Group.

Note that depending on the requirements of a particular OAM interaction, the MPLS-TP maintenance entity context may be provided either explicitly using the MEG\_IDs described above or implicitly by the label of the received OAM message.

### 7.1. Maintenance Entity Group Identifiers

Maintenance Entity Group Identifiers (MEG\_IDs) are required for MPLS-TP ~~Paths-LSPs~~ and Pseudowires. Two classes of MEG\_IDs are defined, one that follows the IP compatible identifier defined above as well as the ICC-format.

#### 7.1.1. ICC based MEG\_IDs

MEG\_ID for MPLS-TP LSPs and Pseudowires MAY use the globally unique ICC-based format.

In this case, the MEG\_ID is a string of up to thirteen characters, each character being either alphabetic (i.e. A-Z) or numeric (i.e. 0-9) characters. It consists of two subfields: the ICC (as defined in section 3) followed by a unique MEG code (UMC).

The UMC MUST be unique within the organization identified by the ICC.

**Comment [M14]:** How is the case of a PW, LSP or tunnel that transits two domains, where one uses ICC format and the other uses IP format addressed.

**Comment [M15]:** This alignment must be completed before approval

The ICC MEG\_ID may be applied equally to MPLS-TP tunnels, a single MPLS-TP LSP, groups of MPLS-TP LSPs, Pseudowires, and groups of Pseudowires.

**Comment [M16]:** In the framework draft and the OAM framework OAM is run in the context of a PST which is a LSP so why do we need an identifier for a tunnel MEG.

Note that when encoded in a protocol such as in a TLV, a different type needs to be defined for LSP and PWs as the OAM capabilities may be different.

**Comment [M17]:** A MEG cannot contain an arbitrary collection of LSPs – please reference the OAM framework

7.1.2. IP Compatible MEG\_IDs

**Comment [M18]:** A MEG cannot contain an arbitrary collection of PWs – please reference the OAM framework

7.1.2.1. MPLS-TP Tunnel MEG\_IDs

**Comment [M19]:** In the framework draft and the OAM framework OAM is run in the context of a PST which is a LSP so why do we need an identifier for a tunnel MEG.

Since a MEG pertains to a single MPLS-TP Tunnel, IP compatible MEG\_IDs for MPLS-TP Tunnels are simply the corresponding Tunnel\_IDs. We note that while the two identifiers are syntactically identical, they have different semantics. This semantic difference needs to be made clear. For instance if both a MPLS-TP Tunnel\_ID and MPLS-TP Tunnel MEG\_IDs are to be encoded in TLVs different types need to be assigned for these two identifiers.

7.1.2.2. MPLS-TP LSP MEG\_IDs

MEG\_IDs for MPLS-TP LSPs may pertain to one or more LSPs. Therefore the direct mapping used for tunnels is not possible. However an indirect mapping which keeps the formats aligned is possible. This is done by replacing the LSP\_Num with a LSP\_MEG\_Num. Thus the format of a MPLS-TP LSP MEG\_ID is:

Src-Global\_ID::Src-Node\_ID::Src-Tunnel\_Num:: Dst-Global\_ID::Dst-Node\_ID::Dst-Tunnel\_Num::LSP\_MEG\_Num

When a MEG\_ID is assigned to a single MPLS-TP LSP it is RECOMMENDED that the LSP\_MEG\_Num be assigned equal to the LSP\_Num. When a MEG\_ID is assigned to a group of MPLS-TP LSPs within a single MPLS-TP Tunnel, it is recommended that the MEG\_ID be assigned equal to the LSP\_Num of one member of the group of MPLS-TP LSPs. In this situation if the chosen LSP is later deconfigured it is RECOMMENDED that this LSP\_Num not be reused unless the new LSP in question will become a member of the same MEG.

**Comment [M20]:** The LSP\_Num is only unique within the tunnel, do you mean reuse within the same tunnel?

7.1.2.3. Pseudowire MEG\_IDs

For Pseudowires a MEG pertains to a single PW. The IP compatible MEG\_ID for a PW is simply the corresponding PW\_Path\_ID. We note that while the two identifiers are syntactically identical, they have different semantics. This semantic difference needs to be made clear. For instance if both a PW\_Path\_ID and a PW\_MEG\_ID is to be encoded in TLVs different types need to be assigned for these two

identifiers.

## 7.2. MEP\_IDs

### 7.2.1. ICC based MEP\_IDs

ICC-based MEP\_IDs for MPLS-TP LSPs and Pseudowires ~~MAY~~ **MUST** be formed by appending a unique number to the MEG\_ID defined in section Section 7.1.1 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 ~~and-it~~ is encoded as a 16-bit unsigned integer **and must be unique within the MEG**. An ICC-based MEP\_ID is:

MEG\_ID::MEP\_Index

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

### 7.2.2. IP based MEP\_IDs

#### 7.2.2.1. MEP\_IDs for MPLS-TP LSPs and Tunnels

In order to automatically generate MEP\_IDs for MPLS-TP Tunnels and LSPs, we use the elements of identification that are unique to an endpoint. This ensures that MEP\_IDs are unique for all Tunnels and LSPs within a operator. When Tunnels or LSPs cross operator boundaries, these are made unique by pre-pending them with the operator's Global\_ID.

##### 7.2.2.1.1. MPLS-TP Tunnel\_MEP\_ID

A MPLS-TP Tunnel\_MEP\_ID is:

Src-Node\_ID::Src-Tunnel\_Num

In situations where global uniqueness is required this becomes:

Src-Global\_ID::Src-Node\_ID::Src-Tunnel\_Num

##### 7.2.2.1.2. MPLS-TP LSP\_MEP\_ID

A MPLS-TP LSP\_MEP\_ID is:

Src-Node\_ID::Src-Tunnel\_Num::LSP\_Num

In situations where global uniqueness is required this becomes:

**Comment [M21]:** Is the intent to allow other options if so please document them.

**Comment [M22]:** How are the source and sink parts identified when a bi-direction entity is being monitored.

**Comment [M23]:** How is this related to the MEG identifier. Since this is syntactically identical to the LSP/Tunnel identifiers do we need the equivalent text that provides TLV encoding guidelines for the PW.

Src-Global\_ID::Src-Node\_ID::Src-Tunnel\_Num::LSP\_Num

7.2.2.2. MEP\_IDs for Pseudowires

Comment [M24]: How is this related to the MEG ID:

Like MPLS-TP LSPs, Pseudowire endpoints (T-PEs) require MEP\_IDs. In order to automatically generate MEP\_IDs for PWs, we simply use the AGI plus the AII associated with that end of the PW. Thus a MEP\_ID used in end-to-end for an Pseudowire T-PE takes the form:

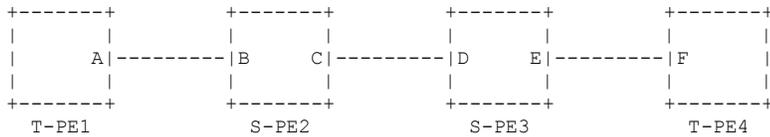
AGI:Src-Global\_ID::Src-Node\_ID::Src-AC\_ID

7.2.2.3. MEP\_IDs for Pseudowire Segments

Comment [M25]: Please check with the OAM framework - S-PE can only support a MIP.

In some OAM communications, messages are originated at one end of a PW segment and relayed to the other end by setting the TTL of the PW label to one.

The MEP\_ID Is Formed by a combination of a PW MEP\_ID and the identification of the local node. At an S-PE, there are two PW segments. We distinguish the segments by using the MEP\_ID which is upstream of the PW segment in question. To complete the identification we suffix this with the identification of the local node.



Pseudowire Maintenance Points

For example, suppose that in the above figure all of the nodes have Global\_ID GID1; the node are represented as named in the figure; and The identification for the Pseudowire is:

- AGI = AGI1
- Src-Global\_ID = GID1
- Src-Node\_ID = T-PE1
- Src-AC\_ID = AII1
- Dst-Global\_ID = GID1
- Dst-Node\_ID = T-PE1
- Dst-AC\_ID = AII4

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The MEP\_ID at point A would be AGI1::GID1:T-PE1::AII1. The MP\_ID at

point C would be AGI1::GID1:T-PE1::AII1::GID1:S-PE2.

For interaction where the T-PE is acting as the segment endpoint, it too may use the Pseudowire Segment MEP\_ID.

### 7.3. MIP\_IDs

At a cross connect point, in order to automatically generate MIP\_IDs for MPLS-TP, we simply use the IF\_IDs of the two interfaces which are cross connected via the label bindings of the MPLS-TP LSP. If only one MIP is configured, then the MIP\_ID is formed using the Node\_ID and an LIH of 0. In some contexts, such as LSP Ping[13], the Node\_ID alone may be used as the MEP\_ID.

## 8. Open issues

1. MEPs and MIPs need to be aligned with MPLS-TP OAM Framework.
2. Identifiers for P2MP entities.

## 9. References

### 9.1. Normative References

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- [2] Awduche, D., Berger, L., Gan, D., Li, T., Srinivasan, V., and G. Swallow, "RSVP-TE: Extensions to RSVP for LSP Tunnels", RFC 3209, December 2001.
- [3] Metz, C., Martini, L., Balus, F., and J. Sugimoto, "Attachment Individual Identifier (AII) Types for Aggregation", RFC 5003, September 2007.
- [4] Berger, L., "Generalized Multi-Protocol Label Switching (GMPLS) Signaling Functional Description", RFC 3471, January 2003.
- [5] Berger, L., "Generalized Multi-Protocol Label Switching (GMPLS) Signaling Resource ReserVation Protocol-Traffic Engineering (RSVP-TE) Extensions", RFC 3473, January 2003.
- [6] Martini, L., Rosen, E., El-Aawar, N., Smith, T., and G. Heron, "Pseudowire Setup and Maintenance Using the Label Distribution Protocol (LDP)", RFC 4447, April 2006.

**Comment [M26]:** This is not sufficient :  
 - Should have MIP id per LSP not per interface (which may support multiple LSPs).  
 - How are ingress and egress interface MIPs identified  
 - How are PW MIPs identified.

**Comment [M27]:** Must be completed before approval

**Comment [M28]:** Should be out of scope otherwise we will not be able to approve before the p2mp framework is completed.

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