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PCEP LS Extensions for Fine Granularity Metro Transport Network (fgMTN) Topology Resource Information Reporting

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Abstract

This document extends PCEP-LS by defining several new sub-TLVs for the LS object to report the fgMTN topology resource information, which includes timeslot occupation status of links and the relationship between the FGU client and the occupied timeslots.

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1. Introduction

MTN(Metro Transport Network) [ITU-T_G.8310] is a new generation of transport network technology system defined by ITU-T. MTN integrates packet and TDM technologies, enabling compatibility with Ethernet protocol stacks while meeting differentiated requirements of the 5G era, such as hard isolation, low latency, and high reliability, thus further enhancing the bearer capability of 5G networks. On this basis, the fgMTN technology [ITU-T_G.8312.20]incorporates fine-grained slicing into the MTN architecture, providing a low-cost, refined, hard-isolated, and fine-grained bearer channels. The fgMTN technology further refines the granularity of hard slicing from 5 Gbit/s to 10 Mbit/s, meeting the differentiated service bearer requirements of vertical industry applications and private line services, such as small bandwidth, high isolation, and high security. The fgMTN technology is one of the means to realize network resource partitions(NRP) [RFC9543].

fgMTN uses the management and control system to perform centralized path computation. However, the current MTN management and control standard [ITU-T_G.8350] only defines the functions of topology and resource collection and does not specify specific protocols.

[RFC5440] describes the Path Computation Element Communication Protocol (PCEP). PCEP defines the communication between a Path Computation Client (PCC) and a Path Computation Element (PCE), or between PCEs. PCEP-LS [I-D.ietf-pce-pcep-ls] extends PCEP to enable the collection of link-state and TE information from networks and sharing with PCE by extending a new LS Report message. Therefore, the PCEP-LS can be extended to support the reporting of fgMTN topology resources.

This document extends PCEP-LS by defining several new sub-TLVs for the LS object to report the fgMTN topology resource information, which includes timeslot ccupation status of links and the relationship between the FGU client and the occupied timeslots.

1.1. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

2. Protocol Extensions

2.1. OPEN Object

2.1.1. LS Capability TLV

[I-D.ietf-pce-pcep-ls] defines LS-CAPABILITY TLV for use in the OPEN Object for link-state (and TE) distribution via PCEP capability advertisement.

This document defines a new flag in the flags field of the LS-CAPABILITY TLV to indicate the support of fgMTN resource information reporting.

Bit M (fgMTN state collection, 1-bit): if set to 1 by a PCC, the M Flag indicates that the PCC allows the reporting of fgMTN resource information learned via other means like LLDP; if set to 1 by a PCE, the M Flag indicates that the PCE is capable of receiving fgMTN resource information.

2.2. LS Object

The LS (link-state) object is defined by [I-D.ietf-pce-pcep-ls], it MUST be carried within LSRpt messages. The LS object contains a set of TLVs used to specify the target node’s or link’s information.

[I-D.ietf-pce-pcep-ls] also defines the Link Descriptors TLV, it contains Link Descriptors for each link. The value of it contains one or more Link Descriptor Sub-TLVs.

This document defines four kind of Link Descriptor Sub-TLVs to describe the fgMTN resource information.

2.2.1. Parent NRP ID Sub-TLV

The Parent NRP ID sub-TLV indicates the NRP ID that the link belongs to. This sub-TLV is an optional sub-TLV MAY be included in the Link Descriptors TLV.

At most one instance of this sub-TLV can be included in the Link Descriptors TLV. The format of this sub-TLV is shown in Figure 1.

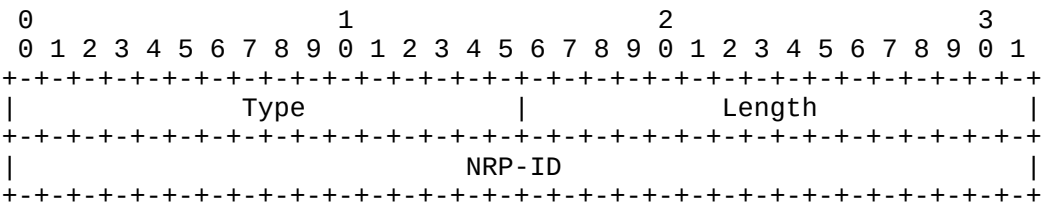

Figure 1: Parent NRP ID Sub-TLV

where:

Type: TBD1, needs to be allocated by IANA.

Length: the length of NRP-ID, equals to 4.

NRP-ID: 4-bit length, the value of NRP-ID is the slice ID of the service-layer interface (MTN client or GE/10GE interface) of a fine-grained interface. If t the information does not exist on the device, the default value 0xFFFFFFFF SHOULD be filled.

2.2.2. Sub-Slot BitMap Sub-TLV

The sub-slot bitmap sub-TLV indicates the timeslot’s occupation status of all FGU clients in the link. This sub-TLV is an optional sub-TLV MAY be included in the Link Descriptors TLV. At most one instance of this sub-TLV can be included in the Link Descriptors TLV. The format of this sub-TLV is shown in Figure 2.

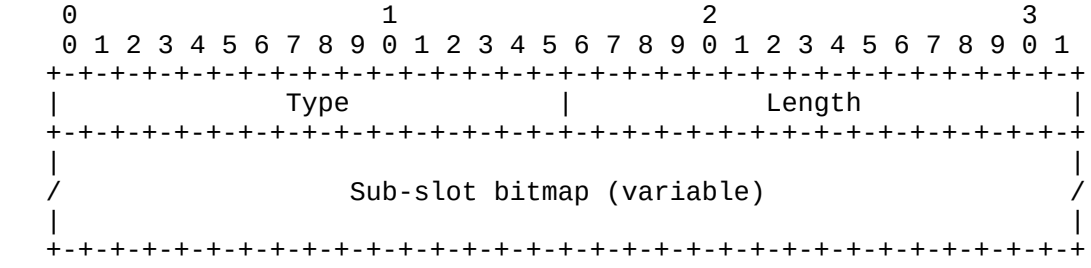

Figure 2: Parent NRP ID Sub-TLV

where:

Type: TBD2, needs to be allocated by IANA.

Length: the length of sub-slot bitmap, variable.

Sub-slot bitmap: variable, indicates the occupation state of all the timeslots of the link, each bit represents a timeslot. If the last bits are all zeros, the padding can be omitted.

2.2.3. FGU Client Sub-Slot Bitmap Relationship Sub-TLV

The FGU Client Sub-Slot Bitmap Relationship sub-TLV indicates the relationship between the occupied timeslots(expressed by bitmap) and corresponding FGU Client.

This sub-TLV is an optional sub-TLV MAY be included in the Link Descriptors TLV. More than one instance of this sub-TLV can be included in the Link Descriptors TLV. The format of this sub-TLV is shown in Figure 3.

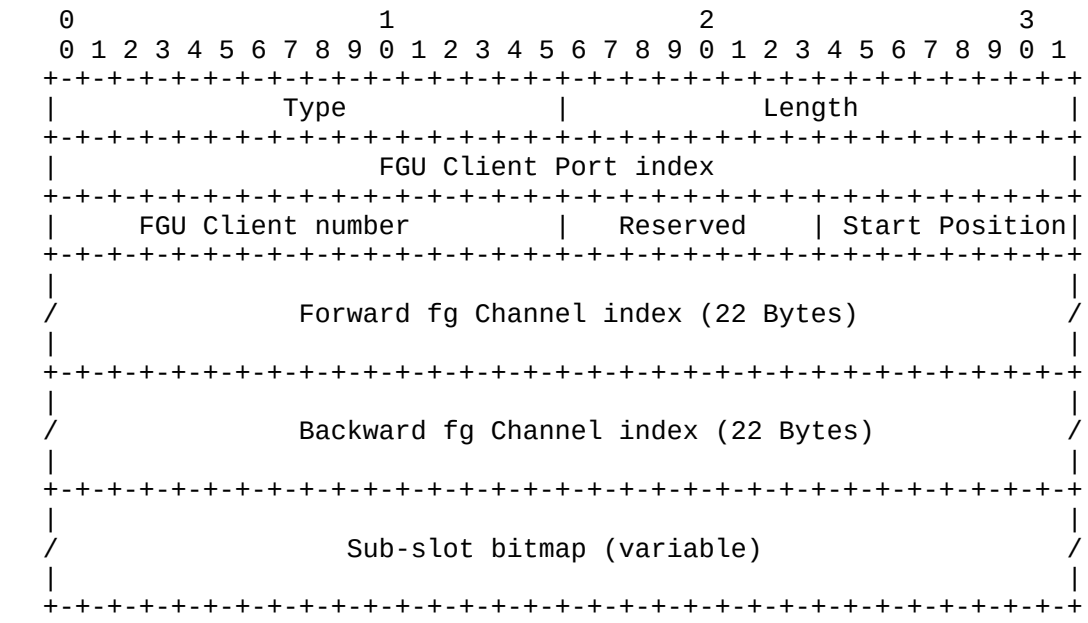

Figure 3: FGU Client Sub-Slot BitMap RelationShip Sub-TLV

where:

Type: TBD3, needs to be allocated by IANA.

Length: the length of value field, variable.

FGU Client Port index: 4-byte length, the local FGU client port identifier allocated by the device itself, which is unique within a network device. The value ranges from 1 to 0xFFFFFFFF. The value 0 indicates an invalid value.

FGU Client number: 2-byte length, the FGU client identifier negotiated by the source and destination device, which is unique within a MTN client. The value ranges from 1 to 1022. The value 0 indicates not used, and the value 1023 is reserved.

Start Position: 1-byte length, the start position of the timeslots occupied by the current FGU client. It is expressed in bytes. The timeslots are arranged in the order of timeslots 0 to 959. The value of this field ranges from 0 to 119.

Forward fg Channel index: 22-byte length, forward fg channel identifier. It is a unique channel ID on the entire network, which is identified by the combination of the source device’s MPLS LSR ID

(16 bytes, device IPv4 or IPv6 address), fg Channel ID (4 bytes, allocated by the management and control system, unique within the source node), and LSP ID (2 bytes, allocated by the management and control system, used to distinguish the original path from the rerouting path).

Backward fg Channel index: 22-byte length, backward fg channel identifier. It is a unique channel ID on the entire network, which is identified by the combination of the following information: MPLS LSR ID (16 bytes, IPv4 or IPv6 address of the device) of the reverse source, fg Channel ID (4 bytes, allocated by the management and control system, unique within the source node), and LSP ID (2 bytes, allocated by management and control system, used to distinguish the original path from the rerouting path).

Sub-slot bitmap: variable, indicates the occupation state of all the sub-slots of the FGU. It starts from the start position. If the last bits are all zeros, the padding can be omitted.

2.2.4. FGU Client Sub-Slot Relationship Sub-TLV

The FGU Client Sub-Slot Bitmap Relationship sub-TLV indicates the relationship between the occupied timeslots(expressed by enumeration value) and FGU Client. This sub-TLV is an optional sub-TLV MAY be included in the Link Descriptors TLV. More than one instance of this sub-TLV can be included in the Link Descriptors TLV. The format of this sub-TLV is shown in Figure 4:

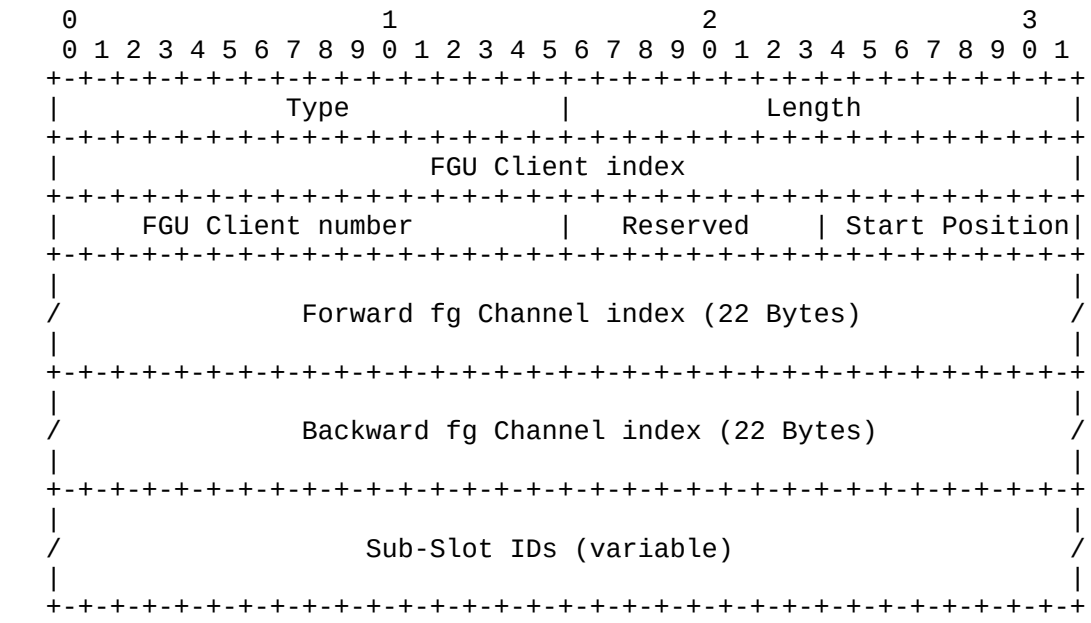

Figure 4: FGU Client Sub-Slot Relationship Sub-TLV

where:

Type: TBD4, needs to be allocated by IANA.

Length: the length of value field, variable.

FGU Client Port index: 4-byte length, the local FGU client port identifier allocated by the device itself, which is unique within a network device. The value ranges from 1 to 0xFFFFFFFF. The value 0 indicates an invalid value.

FGU Client number: 2-byte length, the FGU client identifier negotiated by the source and destination device, which is unique within a MTN client. The value ranges from 1 to 1022. The value 0 indicates not used, and the value 1023 is reserved.

Start Position: 1-byte length, the start position of the timeslots occupied by the current FGU client. It is expressed in bytes. The timeslots are arranged in the order of timeslots 0 to 959. The value of this field ranges from 0 to 119.

Forward fg Channel index: 22-byte length, forward fg channel identifier. It is a unique channel ID on the entire network, which is identified by the combination of the source device’s MPLS LSR ID

(16 bytes, device IPv4 or IPv6 address), fg Channel ID (4 bytes, allocated by the management and control system, unique within the source node), and LSP ID (2 bytes, allocated by the management and control system, used to distinguish the original path from the rerouting path).

Backward fg Channel index: 22-byte length, backward fg channel identifier. It is a unique channel ID on the entire network, which is identified by the combination of the following information: MPLS LSR ID (16 bytes, IPv4 or IPv6 address of the device) of the reverse source, fg Channel ID (4 bytes, allocated by the management and control system, unique within the source node), and LSP ID (2 bytes, allocated by management and control system, used to distinguish the original path from the rerouting path).

Sub-slot IDs: Variable length, indicates the enumerated value of the sub-slots occupied by the current FGU client. Each sub-slot ID is represented by 2 bytes. The number of sub-slot ID ranges from 0 to 959.

3. Procedures

TBD.

4. Security Considerations

TBD.

5. IANA Considerations

[I-D.ietf-pce-pcep-ls] requests IANA to create a "PCEP-LS Sub-TLV Types" sub-registry for the sub-TLVs carried in the PCEP-LS TLV. This document requests IANA to make the following allocations from this sub-registry.

Value	Description	Reference
TBD1	Parent NRP ID Sub-TLV	This document
TBD2	Sub-Slot Bitmap Sub-TLV	This document
TBD3	FGU Client Sub-Slot Bitmap Relationship Sub-TLV	This document
TBD4	FGU Client Sub-Slot Relationship Sub-TLV	This document

Table 1: IANA Considerations

6. Acknowledgments

TBD.

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