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Path Computation Element Communication Protocol(PCEP) IPv6 Segment
Routing Extensions for Inter-Layer Network Programing
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Abstract

In some networks, the cross-layer planning and optimization is considered more efficient than independent planning and operation of the layer-3 and the underlying networks in terms of resource utilization and SLA assurance.

This document extends the PCEP SRv6 for inter-layer network, which enable the PCE to instantiate candidate paths comprising both the layer-3 network segments and underlay network segments.

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1. Introduction

[RFC5440] describes Path Computation Element Communication Protocol (PCEP) for communication between a Path Computation Client (PCC) and a PCE or between a pair of PCEs.

[RFC8231] specifies extensions to PCEP that allow a stateful PCE to compute and recommend network paths in compliance with [RFC4657] and defines objects and TLVs for MPLS-TE LSPs. Stateful PCEP extensions provide synchronization of LSP state between a PCC and a PCE or between a pair of PCEs, delegation of LSP control, reporting of LSP state from a PCC to a PCE, and controlling the setup and path routing of an LSP from a PCE to a PCC.

[RFC8281] further extends PCEP, providing a mechanism to dynamically initiate LSPs on a PCC based on the requests from a stateful PCE or a controller using stateful PCE.

[RFC8664] specifies PCEP extensions for supporting an SR-TE LSP for the MPLS data plane. [RFC9603] extends [RFC8664] to support SR for the IPv6 data plane.

As defined in [RFC8402], Segment Routing (SR) architecture allows the source node to steer a packet through a path indicated by an ordered list of instructions, called "segments". A segment can represent any instruction, topological or service based, and it can have a semantic local to an SR node or global within an SR domain.

Segment Routing over IPv6 (SRv6) [RFC8986] enables a network operator or an application to specify a packet processing program by encoding a sequence of instructions in the IPv6 packet header.

Based on [RFC8986], [I-D.ietf-spring-srv6-inter-layer-programming] defines a new SRv6 behavior, which can be used for steering packets to underlay network connections, so that the packet network layer can be integrated with the underlying layers efficiently to provide better SLA assurance.

This document extends the PCEP SRv6 for inter-layer network, which enable the PCE to instantiate candidate paths comprising both the layer-3 network segments and underlay network segments.

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. Object Extensions

2.1. The ERO Object

As specified in [RFC8664], an SR-TE path consists of one or more SIDs where each SID MAY be associated with the identifier that represents the node or adjacency corresponding to the SID. This identifier is referred to as the NAI. An NAI can be represented in various formats (e.g., IPv4 address, IPv6 address, etc).

However, when an SRv6-TE path includes the END.IL SID defined in [I-D.ietf-spring-srv6-inter-layer-programming], the existing layer-3 NAIs are not applicable to the END.IL SID. Therefore, a new kind of NAI is needed for the END.IL SID.

[RFC9603] defines the "SRv6-ERO" subobject in the ERO to carry the SRv6 SID, the format of it is shown as follows:

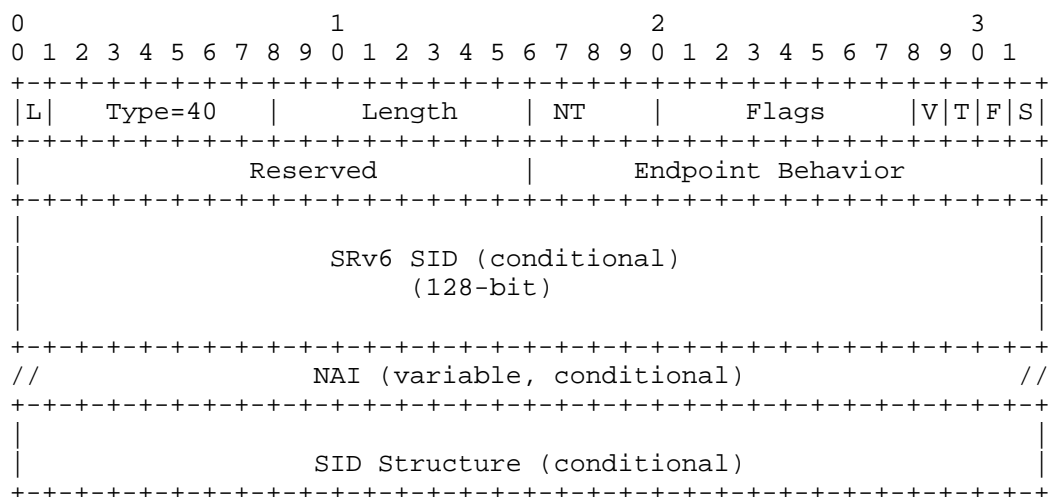


Figure 1: SRv6-ERO Subobject Format

The NT field in this subobject indicates the type and format of the NAI contained in the object body. The value 2, 4 and 6 have been allocated for indicating different kind of NAI.

This document request to allocate a new NT value for indicating the underlay network connection.

Value TBD1: the NAI consists of a local IPv6 address, a Remote IPv6 address, and a underlay tunnel ID. This is used to identify the underlay network tunnel and used with the SRv6 inter-layer SID.

The NAI associated with the new NT value is shown in the following figure:

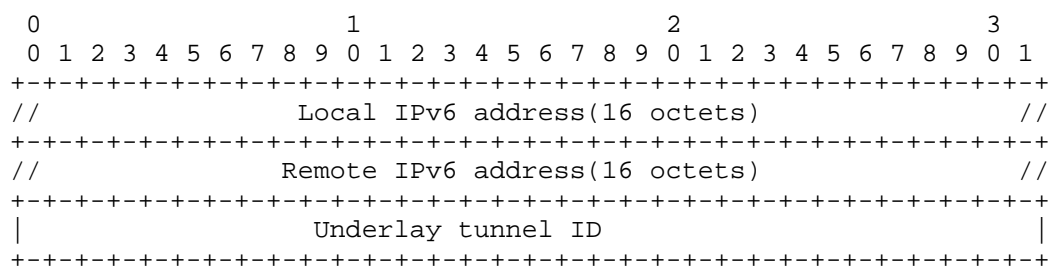


Figure 2: NAI for Underlay Interface Identifier

This NAI is specified as a pair of global IPv6 address and an Underlay tunnel ID. It is used to describe an underlay network tunnel between two nodes identified by global IPv6 address. Each global IPv6 address is configured on a specific router, so together they identify a pair of routers at the end of the tunnel. The underlay tunnel ID is configured by the management system and uniquely identifies a underlay network tunnel within the source node.

2.2. The RRO Object

A PCC reports an SRv6 path to a PCE by sending a PCRpt message, per [RFC8231]. The RRO on this message represents the SID list that was applied by the PCC, that is, the actual path taken. The procedures of [RFC8664] with respect to the RRO apply equally to this specification without change.

[RFC9603] defines the SRv6-RRO subobject to carry the SRv6 SID applied by the PCC. The format of the SRv6-RRO subobject is the same as that of the SRv6-ERO subobject but without the L flag.

The extension to the NT field of SRv6-ERO subobject is also applicable to the SRv6-RRO subobject.

3. Procedures

TBD

4. Security Considerations

TBD

5. IANA Considerations

This document requests IANA to make the following allocations from the PCEP SRv6-ERO NAI Types sub-registry.

Value	Description	Reference
TBD1	NAI is an underlay interface identifier	This document

Table 1

6. References

6.1. Normative References

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- [RFC8986] Filsfils, C., Ed., Camarillo, P., Ed., Leddy, J., Voyer, D., Matsushima, S., and Z. Li, "Segment Routing over IPv6 (SRv6) Network Programming", RFC 8986, DOI 10.17487/RFC8986, February 2021, <<https://www.rfc-editor.org/info/rfc8986>>.

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