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Update to the Include Route Object (IRO) Specification in the Path Computation Element Communication Protocol (PCEP)

Abstract

The Path Computation Element Communication Protocol (PCEP) enables communications between a Path Computation Client (PCC) and a PCE, or between two PCEs. RFC 5440 defines the Include Route Object (IRO) to specify network elements to be traversed in the computed path. The specification does not specify if the IRO contains an ordered or unordered list of subobjects. During recent discussions, it was determined that there was a need to define a standard representation to ensure interoperability. It was also noted that there is a benefit in the handling of an attribute of the IRO's subobject, the L bit.

This document updates RFC 5440 regarding the IRO specification.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 7841.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at http://www.rfc-editor.org/info/rfc7896.

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1. Introduction

The Path Computation Element Communication Protocol (PCEP) enables communications between a Path Computation Client (PCC) and a PCE, or between two PCEs. [RFC5440] defines the Include Route Object (IRO) to specify network elements to be traversed in the computed path. The specification does not specify if the IRO is an ordered or unordered list of subobjects. In addition, it defines the L bit as having no meaning within an IRO.

[RFC5441] describes the use of an IRO to indicate the sequence of domains to be traversed during inter-domain path computation.

During recent discussions, it was determined that there was a need to define a standard representation to ensure interoperability.

This document updates the IRO specifications in Section 7.12 of [RFC5440].

2. Update in the IRO Specification

Section 7.12 of [RFC5440] describes the IRO as an optional object used to specify a set of network elements to be traversed in the computed path. It states that the L bit in the subobject has no meaning within an IRO. It does not mention if the IRO contains an ordered or unordered list of subobjects.

2.1. Update to RFC 5440

The IRO specification is updated to remove the last line in the Section 7.12 of [RFC5440], which states:

> "The L bit of such sub-object has no meaning within an IRO."

Further, Section 7.12 of [RFC5440] is updated to add the following two statements at the end of the first paragraph.

- The content of an IRO is an ordered list of subobjects representing a series of abstract nodes (refer to Section 4.3.2 of [RFC3209]).

- The L bit of an IRO subobject is set based on the loose or strict hop property of the subobject; it is set if the subobject represents a loose hop. If the bit is not set, the subobject represents a strict hop. The interpretation of the L bit is as per Section 4.3.3.1 of [RFC3209].

3. Operational Considerations

Because of the lack of clarity in [RFC5440], it is possible to encounter implementations that always interpret the IRO subobjects as loose. When these implementations interwork with an implementation conforming to this document, the following impact might be seen:

- If a non-conforming (to this document) PCC sends an IRO to a conforming (to this document) PCE, then the PCE may unexpectedly fail to find a path (since the PCC may think of the IRO subobjects as loose hops, but the PCE interprets them as strict hops).

- If a conforming PCC sends an IRO containing strict hops to a non-conforming PCE, then the PCE may erroneously return a path that does not comply with the requested strict hops (since the PCE interprets them all as loose hops). The PCC may check the returned path and find the issue, or it may end up using an incorrect path.

4. Security Considerations

This update in the IRO specification does not introduce any new security considerations, apart from those mentioned in [RFC5440]. Clarification in the supported IRO ordering or Loose hop bit handling will not have any negative security impact.

It is worth noting that PCEP operates over TCP. An analysis of the security issues for routing protocols that use TCP (including PCEP) is provided in [RFC6952].

5. References

5.1. Normative References

[RFC3209] Awduche, D., Berger, L., Gan, D., Li, T., Srinivasan, V., and G. Swallow, "RSVP-TE: Extensions to RSVP for LSP Tunnels", RFC 3209, DOI 10.17487/RFC3209, December 2001, <http://www.rfc-editor.org/info/rfc3209>.

[RFC5440] Vasseur, JP., Ed. and JL. Le Roux, Ed., "Path Computation Element (PCE) Communication Protocol (PCEP)", RFC 5440, DOI 10.17487/RFC5440, March 2009, <http://www.rfc-editor.org/info/rfc5440>.

5.2. Informative References

[RFC5441] Vasseur, JP., Ed., Zhang, R., Bitar, N., and JL. Le Roux, "A Backward-Recursive PCE-Based Computation (BRPC) Procedure to Compute Shortest Constrained Inter-Domain Traffic Engineering Label Switched Paths", RFC 5441, DOI 10.17487/RFC5441, April 2009, <http://www.rfc-editor.org/info/rfc5441>.

[RFC6952] Jethanandani, M., Patel, K., and L. Zheng, "Analysis of BGP, LDP, PCEP, and MSDP Issues According to the Keying and Authentication for Routing Protocols (KARP) Design Guide", RFC 6952, DOI 10.17487/RFC6952, May 2013, <http://www.rfc-editor.org/info/rfc6952>.

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