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**Update to Include Route Object (IRO) specification in Path Computation
Element communication Protocol (PCEP)
draft-dhody-pce-iro-update-00**

Abstract

During discussions of a document to provide a standard representation and encoding of Domain-Sequence within the Path Computation Element (PCE) communication Protocol (PCEP) for communications between a Path Computation Client (PCC) and a PCE, or between two PCEs. It was determined that there was a need for clarification with respect to the ordered nature of the Include Route Object (IRO).

An informal survey was conducted to determine the state of current and planned implementation with respect to IRO ordering and handling of Loose bit.

This document updates the IRO specification based on the survey conclusion and recommendation.

Status of This Memo

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[1.](#) Introduction

The Path Computation Element Communication Protocol (PCEP) provides mechanisms for Path Computation Elements (PCEs) to perform path computations in response to Path Computation Clients (PCCs) requests.

[RFC5440] defines the Include Route Object (IRO) to specify that the computed path must traverse a set of specified network elements. The specification did not mention if IRO is an ordered or un-ordered list of sub-objects. It mentioned that the L bit (loose) has no meaning within an IRO.

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

During discussion of [[I-D.ietf-pce-pcep-domain-sequence](#)] it was proposed to have a new IRO type with ordered nature, as well as handling of L bit.

In order to discover the current state of affairs amongst implementations a survey of the existing and planned implementations was conducted. This survey [[I-D.dhody-pce-iro-survey](#)] was informal and conducted via email. Responses were collected and anonymized by the PCE working group chair.

This document updates the IRO specifications in [[RFC5440](#)] as per the conclusion and action points presented in [[I-D.dhody-pce-iro-survey](#)].

1.1. 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 [[RFC2119](#)].

2. Update in IRO specification

[[RFC5440](#)] describes IRO as an optional object used to specify that the computed path MUST traverse a set of specified network elements. It further state that the L bit of such sub-object has no meaning within an IRO. It did not mention if IRO is an ordered or un-ordered list of sub-objects.

A survey of the existing and planned implementations was conducted in order to discover the current state of affairs amongst implementations. [[I-D.dhody-pce-iro-survey](#)] describe the questionnaire, results and presents some conclusions and proposed action items. More details in [Appendix A](#).

The survey suggest that most implementations construct or interpret IRO in an ordered fashion and consider it to be an ordered list. More than half of implementation under survey consider the IRO sub-objects as strict hops, others consider loose or support both. The results shown in this survey seems to suggest that most implementations would be fine with updating [[RFC5440](#)] to specify IRO as an ordered list as well as to enable support for loose bit (L-bit) such that both strict and loose hops could be supported in the IRO.

This document thus updates [[RFC5440](#)] regarding the IRO specification making IRO as an ordered list as well as support for loose bit (L-bit).

The content of an IRO object is an ordered list of subobjects representing a series of abstract nodes. An abstract node may just be a simple abstract node comprising one node or a group of nodes for example an AS (comprising of multiple hops within the AS) (refer [[RFC3209](#)] for details). Further each subobject has an attribute

called 'L-bit', which is set if the subobject represents a loose hop. If the bit is not set, the subobject represents a strict hop.

3. Other Considerations

Based on the survey, it should be noted that most implementation already support the update in the IRO specification as per this document. The other implementation are expected to make an update to the IRO procedures.

4. Security Considerations

This update in IRO specification does not introduce any new security considerations, apart from those mentioned in [[RFC5440](#)]. Clarification in the supported IRO ordering or Loose 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](#)] while [[I-D.ietf-pce-pceps](#)] discusses an experimental approach to provide secure transport for PCEP.

5. IANA Considerations

This informational document makes no requests to IANA for action.

6. Acknowledgments

A special thanks to PCE chairs for guidance regarding this work.

7. References

7.1. Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.
- [RFC5440] Vasseur, JP. and JL. Le Roux, "Path Computation Element (PCE) Communication Protocol (PCEP)", [RFC 5440](#), March 2009.

7.2. Informative 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](#), December 2001.

- [RFC5441] Vasseur, JP., 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](#), April 2009.
- [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](#), May 2013.
- [I-D.ietf-pce-pcep-domain-sequence]
Dhody, D., Palle, U., and R. Casellas, "Standard Representation Of Domain-Sequence", [draft-ietf-pce-pcep-domain-sequence-05](#) (work in progress), July 2014.
- [I-D.ietf-pce-pceps]
Lopez, D., Dios, O., Wu, W., and D. Dhody, "Secure Transport for PCEP", [draft-ietf-pce-pceps-02](#) (work in progress), October 2014.
- [I-D.dhody-pce-iro-survey]
Dhody, D., "Informal Survey into Include Route Object (IRO) Implementations in Path Computation Element communication Protocol (PCEP)", [draft-dhody-pce-iro-survey-00](#) (work in progress), October 2014.

Appendix A. Details of IRO survey

During discussions of this document to provide a standard representation and encoding of Domain-Sequence within PCEP. It was determined that there was a need for clarification with respect to the ordered nature of the IRO.

Since there was a proposal to have a new IRO type with ordering, as well as handling of Loose bit, in an earlier version of this document (refer - [draft-ietf-pce-pcep-domain-sequence-05](#)), it was deemed necessary to conduct a survey of the existing and planned implementations. An informal survey was conducted via email. Responses were collected and anonymized by the PCE working group chairs.

[I-D.dhody-pce-iro-survey] summarizes the survey questions and captures the results. It further list some conclusions and action points.

This document was considered as one possible venue to handle the proposed action points.

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