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PCEP Extension for L2 Flow Specification

Abstract

The Path Computation Element (PCE) is a functional component capable of selecting paths through a traffic engineering network. These paths may be supplied in response to requests for computation, or may be unsolicited requests issued by the PCE to network elements. Both approaches use the PCE Communication Protocol (PCEP) to convey the details of the computed path.

Traffic flows may be categorized and described using "Flow Specifications". RFC 8955 defines the Flow Specification and describes how Flow Specification Components are used to describe traffic flows. RFC 8955 also defines how Flow Specifications may be distributed in BGP to allow specific traffic flows to be associated with routes.

RFC XXXX specifies a set of extensions to PCEP to support dissemination of Flow Specifications. This allows a PCE to indicate what traffic should be placed on each path that it is aware of.

The extensions defined in this document extends the support for Ethernet Layer 2 (L2) and Layer 2 Virtual Private Network (L2VPN) traffic filtering rules either by themselves or in conjunction with L3 flowspecs.

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Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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1. Introduction

RFC Editor Note: Please remove the below text before publication -

> The text in the document was earlier part of version 12 of draft-ietf-pce-pcep-flowspec which was approved by the IESG and was in the RFC Editor queue for a long time waiting for draft-ietf-idr-

flowspec-l2vpn to be ready. The pending specification for Flowspec V2 and implementation based on it will take time, it was decided to strip the L2 flowspec from the draft-ietf-pce-pcep-flowspec and move it an independent document (this one!).

[RFC4655] defines the Path Computation Element (PCE), a functional component capable of computing paths for use in traffic engineering networks. PCE was originally conceived for use in Multiprotocol Label Switching (MPLS) for Traffic Engineering (TE) networks to derive the routes of Label Switched Paths (LSPs). However, the scope of PCE was quickly extended to make it applicable to Generalized MPLS (GMPLS)-controlled networks, and more recent work has brought other traffic engineering technologies and planning applications into scope (for example, Segment Routing (SR) [RFC8664]).

[RFC5440] describes the Path Computation Element Communication Protocol (PCEP). PCEP defines the communication between a Path Computation Client (PCC) and a PCE, or between PCE and PCE, enabling computation of path for MPLS-TE LSPs.

Stateful PCE [RFC8231] specifies a set of extensions to PCEP to enable control of TE-LSPs by a PCE that retains state about the LSPs provisioned in the network (a stateful PCE). [RFC8281] describes the setup, maintenance, and teardown of LSPs initiated by a stateful PCE without the need for local configuration on the PCC, thus allowing for a dynamic network that is centrally controlled. [RFC8283] introduces the architecture for PCE as a central controller and describes how PCE can be viewed as a component that performs computation to place 'flows' within the network and decide how these flows are routed.

The description of traffic flows by the combination of multiple Flow Specification Components and their dissemination as traffic flow specifications (Flow Specifications) is described for BGP in [RFC8955]. In BGP, a Flow Specification is comprised of traffic filtering rules and is associated with actions to perform on the packets that match the Flow Specification. The BGP routers that receive a Flow Specification can classify received packets according to the traffic filtering rules and can direct packets based on the associated actions. [I-D.hares-idr-flowspec-v2] specify the version 2 of the BGP flow specification protocol that resolves some of issues with version 1.

When a PCE is used to initiate tunnels (such as TE-LSPs or SR paths) using PCEP, it is important that the head end of the tunnels understands what traffic to place on each tunnel. The data flows intended for a tunnel can be described using Flow Specification Components. When PCEP is in use for tunnel initiation it makes sense for that same protocol to be used to distribute the Flow

Specification Components that describe what data is to flow on those tunnels.

[I-D.ietf-pce-pcep-flowspec] specifies a set of extensions to PCEP to support dissemination of Flow Specification Components. It includes the creation, update, and withdrawal of Flow Specifications via PCEP, and can be applied to tunnels initiated by the PCE or to tunnels where control is delegated to the PCE by the PCC. Furthermore, a PCC requesting a new path can include Flow Specifications in the request to indicate the purpose of the tunnel allowing the PCE to factor this into the path computation.

[I-D.ietf-idr-flowspec-l2vpn] defines a BGP flowspec extension to disseminate Ethernet Layer 2 (L2) and Layer 2 Virtual Private Network (L2VPN) traffic filtering rules either by themselves or in conjunction with L3 flowspecs. This document extends the same support for PCEP by defining a new L2 Flow Filter TLV to be carried within the FLOWSPEC object. The context and the procedures for the use of Flow Specifications is as per [I-D.ietf-pce-pcep-flowspec].

2. Terminology

This document uses the following terms defined in [RFC5440]: PCC, PCE, PCEP Peer.

The following term from [RFC8955] is used frequently throughout this document:

> A Flow Specification is an n-tuple consisting of several matching criteria that can be applied to IP traffic. A given IP packet is said to match the defined Flow Specification if it matches all the specified criteria.

Its usage in PCEP is further clarified in [I-D.ietf-pce-pcep-flowspec].

This document uses the terms "stateful PCE" and "active PCE" as advocated in [RFC7399].

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.

3. L2 Flow Specifications

As per [I-D.ietf-pce-pcep-flowspec], to carry Flow Specifications in PCEP messages, a PCEP object called the PCEP FLOWSPEC object is defined. To describe a traffic flow, a PCEP TLV called the Flow

Filter TLV is aldo defined. This document extends the support for L2 flow specifications by creating a new PCEP TLV called L2 Flow Filter TLV and update the processing rules.

The PCEP FLOWSPEC object carries a FlowSpec filter rule encoded in a TLV. To describe a traffic flow based on both L3 and L2 fields a new L2 Flow Filter TLV is introduced by this document. The PCEP FLOWSPEC object could carries one of the following combinations of TLVs:

*no TLV

*one Flow Filter TLV

*one L2 Flow Filter TLV

*both a Flow Filter TLV and an L2 Flow Filter TLV

At most one L2 Flow Filter TLV MAY be include in the the PCEP FLOWSPEC object. The TLV is OPTIONAL when the R (remove) bit is set in the object. At least one Flow Filter TLV or one L2 Flow Filter TLV MUST be present when the R bit is clear. If both TLVs are missing when the R bit is clear, the PCEP peer MUST respond with a PCErr message with error-type TBD1 (FlowSpec Error) and error-value 2 (Malformed FlowSpec). A Flow Filter TLV and a L2 Flow Filter TLV MAY both be present when filtering is based on both L3 and L2 fields.

The TLV follow the format of all PCEP TLVs as defined in [RFC5440]. The Type field values come from the codepoint space for PCEP TLVs and has the value TBD2. The value field of L2 Flow Filter TLV contain one or more sub-TLVs (Section 3.1, and they represent the complete definition of a Flow Specification for traffic to be placed on the tunnel. The set of Flow Specification TLVs and L2 Flow Filter TLVs in a single instance of a Flow Filter TLV are combined to indicate the specific Flow Specification. Note that the PCEP FLOWSPEC object can include just one Flow Filter TLV, just one L2 Flow Filter TLV, or one of each TLV.

The rest of the procedures are same as [I-D.ietf-pce-pcep-flowspec].

3.1. L2 Flow Specification TLVs

The L2 Flow Filter TLV carries one or more L2 Flow Specification TLV. The L2 Flow Specification TLV follows the format of all PCEP TLVs as defined in [RFC5440]. However, the Type values are selected from a separate IANA registry (see Section 4.2) rather than from the common PCEP TLV registry.

Type values are chosen so that there can be commonality with L2 Flow Specifications defined for use with BGP [I-D.ietf-idr-flowspec-

l2vpn]. This is possible because the BGP Flow Spec encoding uses a single octet to encode the type where as PCEP uses two octets. Thus the space of values for the Type field is partitioned as shown in Figure 1.

Range	
0 .. 255	Per BGP registry defined by [I-D.ietf-idr-flowspec-l2vpn]. Not to be allocated in this registry.
256 .. 65535	New PCEP Flow Specifications allocated according to the registry defined in this document.

Figure 1: L2 Flow Specification TLV Type Ranges

[I-D.ietf-idr-flowspec-l2vpn] is the reference for the registry "L2 Flow Spec Component Types" and defines the allocations it contains.

The content of the Value field in each TLV is specific to the type and describes the parameters of the Flow Specification. The definition of the format of many of these Value fields is inherited from BGP specifications. Specifically, the inheritance is from [I-D.ietf-idr-flowspec-l2vpn], but may also be inherited from future BGP specifications.

When multiple L2 Flow Specification TLVs are present in a single L2 Flow Filter TLV they are combined to produce a more detailed specification of a flow. Similarly, when both Flow Filter TLV and L2 Flow Filter TLV are present, they are combined to produce a more detailed specification of a flow.

An implementation that receives a PCEP message carrying a L2 Flow Specification TLV with a type value that it does not recognize or does not support MUST respond with a PCErr message with error-type TBD1 (FlowSpec Error), error-value 1 (Unsupported FlowSpec) and MUST NOT install the Flow Specification.

All L2 Flow Specification TLVs with Types in the range 0 to 255 have their Values interpreted as defined for use in BGP (for example, in [I-D.ietf-idr-flowspec-l2vpn]) and are set using the BGP encoding, but without the type octet (the relevant information is in the Type field of the TLV). The Value field is padded with trailing zeros to achieve 4-byte alignment.

This document defines no new types.

4. IANA Considerations

IANA maintains the "Path Computation Element Protocol (PCEP) Numbers" registry. This document requests IANA actions to allocate code points for the protocol elements defined in this document.

4.1. PCEP TLV Type Indicators

IANA maintains a subregistry called "PCEP TLV Type Indicators". IANA is requested to make an assignment from this subregistry as follows:

Value	Meaning	Reference
TBD2	L2 FLOW FILTER TLV	[This.I-D]

4.2. L2 Flow Specification TLV Type Indicators

IANA is requested to create a new subregistry called the "PCEP L2 Flow Specification TLV Type Indicators" registry.

Allocations from this registry are to be made according to the following assignment policies [RFC8126]:

Range	Assignment policy
0 .. 255	Reserved - must not be allocated. Usage mirrors the BGP L2 FlowSpec registry [I-D.ietf-idr-flowspec-l2vpn].
256 .. 64506	Specification Required
64507 .. 65531	First Come First Served
65532 .. 65535	Experimental

5. Implementation Status

[NOTE TO RFC EDITOR : This whole section and the reference to RFC 7942 is to be removed before publication as an RFC]

This section records the status of known implementations of the protocol defined by this specification at the time of posting of this Internet-Draft, and is based on a proposal described in [RFC7942]. The description of implementations in this section is intended to assist the IETF in its decision processes in progressing drafts to RFCs. Please note that the listing of any individual

implementation here does not imply endorsement by the IETF. Furthermore, no effort has been spent to verify the information presented here that was supplied by IETF contributors. This is not intended as, and must not be construed to be, a catalog of available implementations or their features. Readers are advised to note that other implementations may exist.

According to [RFC7942], "this will allow reviewers and working groups to assign due consideration to documents that have the benefit of running code, which may serve as evidence of valuable experimentation and feedback that have made the implemented protocols more mature. It is up to the individual working groups to use this information as they see fit".

At the time of posting the -00 version of this document, there are no known implementations of this mechanism. It is believed that two vendors are considering prototype implementations, but these plans are too vague to make any further assertions.

6. Security Considerations

We may assume that a system that utilizes a remote PCE is subject to a number of vulnerabilities that could allow spurious LSPs or SR paths to be established or that could result in existing paths being modified or torn down. Such systems, therefore, apply security considerations as described in [RFC5440], Section 2.5 of [RFC6952], [RFC8253], and [RFC8955].

As per [I-D.ietf-pce-pcep-flowspec], the description of Flow Specifications associated with paths set up or controlled by a PCE add a further detail that could be attacked without tearing down LSPs or SR paths, but causing traffic to be misrouted within the network. Therefore, the use of the security mechanisms for PCEP referenced above is important. It further list the security considerations with respect to flow specifications which are applicable to L2 flowspec as well.

7. Acknowledgements

Thanks to Susan Hares for discussion related to BGP Flowspec V2.

8. References

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