PCEP Extensions for traffic steering support in Service Function Chaining
draft-wu-pce-traffic-steering-sfc-02

Abstract

   This document provides an overview of the usage of Path Computation
   Element (PCE) with Service Function Chaining (SFC); which is
   described as the definition and instantiation of an ordered set of
   such service functions (such as firewalls, load balancers), and the
   subsequent "steering" of traffic flows through those service
   functions.

   Further this document specifies extensions to the Path Computation
   Element Protocol (PCEP) that allow a stateful PCE to compute and
   instantiate Service Function Paths (SFP).

Status of This Memo

Copyright Notice

Table of Contents

1. Introduction

   Service chaining enables creation of composite services that consist
   of an ordered set of Service Functions (SF) that must be applied to
   packets and/or frames selected as a result of classification as
   described in [I-D.boucadair-sfc-framework][I-D.quinn-sfc-arch] and
   referred to as Service Function Chain (SFC). Service Function Path
   (SFP) is the instantiation of a SFC in the network. Packets follow a
   Service Function Path from a classifier through the requisite Service
   Functions (SF).

   [RFC5440] describes the Path Computation Element Protocol (PCEP) as
   the communication between a Path Computation Client (PCC) and a Path
   Control Element (PCE), or between PCE and PCE, enabling computation
   of Multiprotocol Label Switching (MPLS) for Traffic Engineering Label
   Switched Path (TE LSP).

   [I-D.ietf-pce-stateful-pce] specifies extensions to PCEP to enable
   stateful control of MPLS TE LSPs. [I-D.ietf-pce-pce-initiated-lsp]
   provides the fundamental extensions needed for stateful PCE-initiated
   LSP instantiation.

   This document specifies extensions to the PCEP that allow a stateful
   PCE to compute and instantiate Service Function Paths (SFP).

2. Conventions used in this document

   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 [RFC2119].

   The following terminologies are used in this document:

   PCC: Path Computation Client.

   PCE: Path Computation Element.

   PCEP: Path Computation Element Protocol.

   PDP: Policy Decision Point.

   SF: Service Function.

   SFC: Service Function Chain.

SFP: Service Function Path.

UNI: User-Network Interface.

3. Service Function Paths and PCE

Services are constructed as a sequence of SFs that represent an SFC,
where SF can be a virtual instance or be embedded in a physical
network element, and one or more SFs may be deployed within the same
physical network element. SFC creates an abstracted view of a
service and specifies the set of required SFs as well as the order in
which they must be executed.

When an SFC is instantiated into the network it is necessary to
select the specific instances of SFs that will be used, and to create
the service topology for that SFC using SF's network locator. Thus,
instantiation of the SFC results in the creation of a Service
Function Path (SFP) and is used for forwarding packets through the
SFC. In other words, an SFP is the instantiation of the defined SFC
as described in details in
[I-D.boucadair-sfc-framework][I-D.quinn-sfc-arch].

The selection of SFP can be based on a range of policy attributes,
ranging from simple to more elaborate criteria and stateful PCE with
extensions to PCEP are one such way to achieve this.

Stateful pce [I-D.ietf-pce-stateful-pce] specifies a set of
extensions to PCEP to enable stateful control of TE LSPs.
[I-D.ietf-pce-pce-initiated-lsp] provides the fundamental motivations
and extensions needed for stateful PCE-initiated LSP instantiation.
This document specifies extensions that allow a stateful PCE to
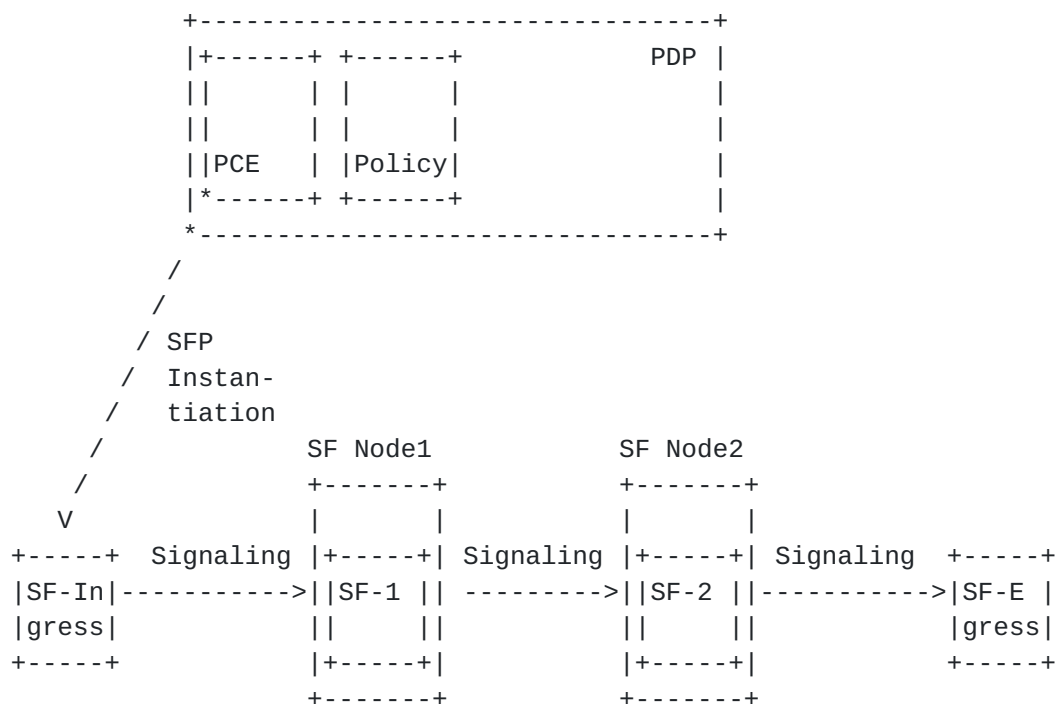compute and instantiate Service Function Paths (SFP) via PCEP.

```
          +--------------------------------+
          |+------+ +------+        PDP |
          ||      | |      |            |
          ||      | |      |            |
          ||PCE   | |Policy|            |
          |*------+ +------+            |
          *--------------------------------+
         /
        /
       / SFP
      /  Instan-
     /   tiation
    /             SF Node1          SF Node2
   /              +-------+         +-------+
  V               |       |         |       |
 +-----+  Signaling |+-----+| Signaling |+-----+| Signaling  +-----+
 |SF-In|----------->||SF-1 || --------->||SF-2 ||----------->|SF-E |
 |gress|            ||     ||          ||     ||            |gress|
 +-----+            |+-----+|          |+-----+|            +-----+
                    +-------+          +-------+
```

Figure 1: SFP instantiation vis PCE

A Policy Decision Point (PDP) [RFC2753] is the central entity which
is responsible for maintaining SFC Policy Tables and enforcing
appropriate policies in SF Nodes described in detail in
[I-D.boucadair-sfc-framework]. A PDP may further use stateful PCE
and its instantiation mechanism to compute and instantiate Service
Function Paths (SFP). The PCE maybe co-located with the PDP or an
external entity.

4. Overview of PCEP Operation in SFC enabled Networks

A PCEP speaker indicates its ability to support PCE initiated dynamic
SFP during the PCEP Initialization Phase via mechanism described in
Section 5.1.

As per section 5.1 of [I-D.ietf-pce-pce-initiated-lsp], the PCE sends
a Path Computation LSP Initiate Request (PCInitiate) message to the
PCC to instantiate or delete a LSP. This document makes no change to
the PCInitiate message format but extends LSP objects described in
Section 5.2.

4.1. SFP Instantiation

The Instantiation operation of SFP is same as defined in section 5.3
of [I-D.ietf-pce-pce-initiated-lsp]. Rules of processing and error
codes remains unchanged.

4.2. SFP Deletion

   The deletion operation of SFP is same as defined in section 5.4 of
   [I-D.ietf-pce-pce-initiated-lsp] by sending an LSP Initiate Message
   with an LSP object carrying the PLSP-ID of the SFP to be removed and
   an SRP object with the R flag set (LSP-REMOVE as per section 5.2 of
   [I-D.ietf-pce-pce-initiated-lsp]). Rules of processing and error
   codes remains unchanged.

4.3. SFP Delegation and Cleanup

   SFP delegation and cleanup operations are same as defined in section
   6 of [I-D.ietf-pce-pce-initiated-lsp]. Rules of processing and error
   codes remains unchanged.

4.4. SFP State Synchronization

   State Synchronization operations described in Section 5.4 of
   [I-D.ietf-pce-stateful-pce] and can be applied for SFPs as well.

4.5. SFP Update and Report

   PCE can make an SFP Update requests to a PCC to update one or more
   attributes of an SFP and to re-signal the SFP with updated
   attributes. PCC can make an SFP state report to a PCE to send SFP
   state. The mechanism are described in [I-D.ietf-pce-stateful-pce]
   and can be applied for SFPs as well.

5. Object Formats

5.1. The OPEN Object

   This document defines a new optional TLV for use in the OPEN Object
   to indicate the PCEP speaker's capability for Service function
   Chaining.

   The SFC-PCE-CAPABILITY TLV is an optional TLV for use in the OPEN
   Object to advertise the SFC capability on the PCEP session. The
   format of the SFC-PCE-CAPABILITY TLV is shown in the following
   figure:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|             Type=TBD          |           length=4            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|            Reserved           |             Flags             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   The code point for the TLV type is to be defined by IANA. The TLV
   length is 4 octets.

   The value is TBD.

   As per [I-D.ietf-pce-stateful-pce], PCEP speaker advertises
   capability for instantiation of PCE-initiated LSPs via Stateful PCE
   Capability TLV (LSP-INSTANTIATION-CAPABILITY bit) in open message.
   The inclusion of SFC-PCE-CAPABILITY TLV in an OPEN object indicates
   that the sender is SFC capable. These mechanism when used together
   indicates the instantiation capability for SFP by the PCEP speaker.

5.2. The LSP Object

   The LSP object is defined in [I-D.ietf-pce-pce-initiated-lsp] and
   included here for easy reference.

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                PLSP-ID                | Flags |F|C|  O|A|R|S|D|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//                        TLVs                                 //
|                                                              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   A new flag, the SFC (F) flag is introduced. The F Flag set to 1 to
   indicate that this an SFP. The C flag will also be set to indicate
   it was created via a PCInitiate message.

5.2.1. SFP Identifiers TLV

   The SFP Identifiers TLV MUST be included in the LSP object for
   Service Function Paths (SFP).

   The format and operations are TBD.

6. Backward Compatibility

   The PCEP protocol extensions described in this document for PCEP
   speaker with instantiation capability for SFPs MUST NOT be used if
   PCC or PCE has not advertised its stateful capability with
   Instantiation and SFC capability as per Section 5.1. If this is not
   the case and Stateful operations on SFPs are attempted, then a PCErr
   with error-type 19 (Invalid Operation) and error-value TBD needs to
   be generated.

   [Editor Note: more information on exact error value is needed]

7. Security Considerations

   The security considerations described in [RFC5440] and
   [I-D.ietf-pce-pce-initiated-lsp] are applicable to this
   specification. No additional security measure is required.

8. IANA Considerations

   TBD

9. References

9.1. Normative References

   [RFC2119]   Bradner, S., "Key words for use in
                                  RFCs to Indicate Requirement
                                  Levels", BCP 14, RFC 2119,
                                  March 1997.

   [I-D.ietf-pce-stateful-pce]   Crabbe, E., Medved, J., Minei, I.,
                                  and R. Varga, "PCEP Extensions for
                                  Stateful PCE",
                                  draft-ietf-pce-stateful-pce-07
                                  (work in progress), October 2013.

   [I-D.ietf-pce-pce-initiated-lsp] Crabbe, E., Minei, I., Sivabalan,
                                  S., and R. Varga, "PCEP Extensions
                                  for PCE-initiated LSP Setup in a
                                  Stateful PCE Model",
                                  draft-ietf-pce-pce-initiated-lsp-00
                                  (work in progress), December 2013.

9.2. Informative References

   [RFC2753]   Yavatkar, R., Pendarakis, D., and
                                  R. Guerin, "A Framework for Policy-

                                        based Admission Control", RFC 2753,
                                        January 2000.

   [RFC5440]   Vasseur, JP. and JL. Le Roux, "Path
                                        Computation Element (PCE)
                                        Communication Protocol (PCEP)",
                                        RFC 5440, March 2009.

   [I-D.quinn-sfc-arch]   Quinn, P. and A. Beliveau, "Service
                                        Function Chaining (SFC)
                                        Architecture",
                                        draft-quinn-sfc-arch-04 (work in
                                        progress), January 2014.

   [I-D.boucadair-sfc-framework]   Boucadair, M., Jacquenet, C.,
                                        Parker, R., Lopez, D., Guichard,
                                        J., and C. Pignataro, "Service
                                        Function Chaining: Framework &
                                        Architecture",
                                        draft-boucadair-sfc-framework-02
                                        (work in progress), February 2014.

Authors' Addresses

   Qin Wu
   Huawei
   101 Software Avenue, Yuhua District
   Nanjing, Jiangsu 210012
   China

   EMail: sunseawq@huawei.com

   Dhruv Dhody
   Huawei
   Leela Palace
   Bangalore, Karnataka 560008
   INDIA

   EMail: dhruv.ietf@gmail.com

    Mohamed Boucadair
    France Telecom
    Rennes 35000
    France

    EMail: mohamed.boucadair@orange.com

    Christian Jacquenet
    France Telecom
    Rennes 35000
    France

    EMail: christian.jacquenet@orange.com

    Jeff Tantsura
    Ericsson
    300 Holger Way
    San Jose, CA 95134
    US

    EMail: Jeff.Tantsura@ericsson.com