    PCEP Extensions for PCE-initiated LSP Setup in a Stateful PCE Model
                  draft-ietf-pce-pce-initiated-lsp-02

Abstract

   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.

   The extensions for stateful PCE provide stateful control of
   Multiprotocol Label Switching (MPLS) Traffic Engineering Label
   Switched Paths (TE LSP) via PCEP, for a model where the PCC delegates
   control over one or more locally configured LSPs to the PCE. This
   document describes the creation and deletion of PCE-initiated LSPs
   under the stateful PCE model.

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].

Status of This Memo

   This Internet-Draft will expire on April 28, 2015.

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1. Introduction

[RFC5440] describes the Path Computation Element Protocol PCEP. PCEP
defines 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) characteristics.

Stateful pce [I-D.ietf-pce-stateful-pce] specifies a set of
extensions to PCEP to enable stateful control of TE LSPs between and
across PCEP sessions in compliance with [RFC4657]. It includes
mechanisms to effect LSP state synchronization between PCCs and PCEs,
delegation of control of LSPs to PCEs, and PCE control of timing and
sequence of path computations within and across PCEP sessions and
focuses on a model where LSPs are configured on the PCC and control
over them is delegated to the PCE.

This document describes the setup, maintenance and teardown of PCE-
initiated LSPs under the stateful PCE model, without the need for
local configuration on the PCC, thus allowing for a dynamic network
that is centrally controlled and deployed.

2. Terminology

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

This document uses the following terms defined in
[I-D.ietf-pce-stateful-pce]: Stateful PCE, Delegation, Redelegation
Timeout, State Timeout Interval LSP State Report, LSP Update Request.

The following terms are defined in this document:

PCE-initiated LSP: LSP that is instantiated as a result of a request
   from the PCE.

The message formats in this document are specified using Routing
Backus-Naur Format (RBNF) encoding as specified in [RFC5511].

3. Architectural Overview

3.1. Motivation

[I-D.ietf-pce-stateful-pce] provides stateful control over LSPs that
are locally configured on the PCC. This model relies on the LER
taking an active role in delegating locally configured LSPs to the
PCE, and is well suited in environments where the LSP placement is
fairly static. However, in environments where the LSP placement

needs to change in response to application demands, it is useful to
support dynamic creation and tear down of LSPs. The ability for a
PCE to trigger the creation of LSPs on demand can make possible agile
software-driven network operation, and can be seamlessly integrated
into a controller-based network architecture, where intelligence in
the controller can determine when and where to set up paths.

A possible use case is one of a software-driven network, where
applications request network resources and paths from the network
infrastructure. For example, an application can request a path with
certain constraints between two LSRs by contacting the PCE. The PCE
can compute a path satisfying the constraints, and instruct the head
end LSR to instantiate and signal it. When the path is no longer
required by the application, the PCE can request its teardown.

Another use case is one of dynamically adjusting aggregate bandwidth
between two points in the network using multiple LSPs. This
functionality is very similar to auto-bandwidth, but allows for
providing the desired capacity through multiple LSPs. This approach
overcomes two of the limitations auto-bandwidth can experience: 1)
growing the capacity between the endpoints beyond the capacity of
individual links in the path and 2) achieving good bin-packing
through use of several small LSPs instead of a single large one. The
number of LSPs varies based on the demand, and LSPs are created and
deleted dynamically to satisfy the bandwidth requirements.

Another use case is that of demand engineering, where a PCE with
visibility into both the network state and the demand matrix can
anticipate and optimize how traffic is distributed across the
infrastructure. Such optimizations may require creating new paths
across the infrastructure.

3.2. Operation overview

A PCC or PCE indicates its ability to support PCE provisioned dynamic
LSPs during the PCEP Initialization Phase via a new flag in the
STATEFUL-PCE-CAPABILITY TLV (see details in Section 4.1).

The decision when to instantiate or delete a PCE-initiated LSP is out
of the scope of this document. To instantiate or delete an LSP, the
PCE sends a new message, the Path Computation LSP Initiate Request
(PCInitiate) message to the PCC. The LSP Initiate Request MUST
include the SRP and LSP objects, and the LSP object MUST include the
Symbolic Path Name TLV and MUST have a PLSP-ID of 0.

For an instantiation operation, the PCE MUST include the ERO and END-
POINTS object and may include various attributes as per [RFC5440].
The PCC creates the LSP using the attributes communicated by the PCE,

and local values for the unspecified parameters. It assigns a unique
PLSP-ID for the LSP and automatically delegates the LSP to the PCE.
It also generates an LSP State Report (PCRpt) for the LSP, carrying
the newly assigned PLSP-ID and indicating the delegation via the
Delegate flag in the LSP object. In addition to the Delegate flag,
the PCC also sets the Create flag in the LSP object (see
Section 5.3.1), to indicate that the LSP was created as a result of a
PCinitiate message and SHOULD include the optional SPEAKER-IDENTITY-
ID TLV defined in [I-D.ietf-pce-stateful-sync-optimizations]
identifying the PCE that requested the LSP creation. This PCRpt
message MUST include the SRP object, with the SRP-id-number used in
the SRP object of the PCInitate message. The PCE may update the
attributes of the LSP via subsequent PCUpd messages. Subsequent LSP
State Report and LSP Update Request for the LSP will carry the PCC-
assigned PLSP-ID, which uniquely identifies the LSP. See details in
Section 5.3.

Once instantiated, the delegation procedures for PCE-initiated LSPs
are the same as for PCC initiated LSPs as described in
[I-D.ietf-pce-stateful-pce]. This applies to the case of a PCE
failure as well. In order to allow for network cleanup without
manual intervention, the PCC SHOULD support removal of PCE-initiated
LSPs as one of the behaviors applied on expiration of the State
Timeout Interval [I-D.ietf-pce-stateful-pce]. The behavior SHOULD be
picked based on local policy, and can result either in LSP removal,
or into reverting to operator-defined default parameters. See
details in Section 6. A PCE may return a delegation to the PCC in
order to facilitate re-delegation of its LSPs to an alternate PCE.

To indicate a delete operation, the PCE MUST use the R flag in the
SRP object in a PCUpd message. As a result of the deletion request,
the PCC MUST remove all state related to the LSP, and send a PCRpt
with the R flag set in the LSP object for the removed state. See
details in Section 5.4.

4. Support of PCE-initiated LSPs

A PCC indicates its ability to support PCE provisioned dynamic LSPs
during the PCEP Initialization phase. The Open Object in the Open
message contains the "Stateful PCE Capability" TLV, defined in
[I-D.ietf-pce-stateful-pce]. A new flag, the I (LSP-INSTANTIATION-
CAPABILITY) flag is introduced to indicate support for instantiation
of PCE-initiated LSPs. A PCE can initiate LSPs only for PCCs that
advertised this capability and a PCC will follow the procedures
described in this document only on sessions where the PCE advertised
the I flag.

4.1. Stateful PCE Capability TLV

The format of the STATEFUL-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=16          |            Length=4           |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |             Flags                                     |I|S|U|
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-++-+-+-+-+-+-+-+-+-+-+-++-+-+-+-+-+
```

Figure 1: STATEFUL-PCE-CAPABILITY TLV format

The type of the TLV is defined in [I-D.ietf-pce-stateful-pce] and it
has a fixed length of 4 octets.

The value comprises a single field - Flags (32 bits). The U and S
bits are defined in [I-D.ietf-pce-stateful-pce] and
[I-D.ietf-pce-stateful-sync-optimizations] respectively.

I (LSP-INSTANTIATION-CAPABILITY - 1 bit): If set to 1 by a PCC, the
   I Flag indicates that the PCC allows instantiation of an LSP by a
   PCE. If set to 1 by a PCE, the I flag indicates that the PCE will
   attempt to instantiate LSPs. The LSP-INSTANTIATION-CAPABILITY
   flag must be set by both PCC and PCE in order to support PCE-
   initiated LSP instantiation.

Unassigned bits are considered reserved. They MUST be set to 0 on
transmission and MUST be ignored on receipt.

5. PCE-initiated LSP instantiation and deletion

To initiate an LSP, a PCE sends a PCInitiate message to a PCC. The
message format, objects and TLVs are discussed separately below for
the creation and the deletion cases.

5.1. The LSP Initiate Message

A Path Computation LSP Initiate Message (also referred to as
PCInitiate message) is a PCEP message sent by a PCE to a PCC to
trigger LSP instantiation or deletion. The Message-Type field of the
PCEP common header for the PCInitiate message is set to 12 (suggested
value, to be assigned by IANA). The PCInitiate message MUST include
the SRP and the LSP objects, and may contain other objects, as
discussed later in this section. If either the SRP or the LSP object
is missing, the PCC MUST send a PCErr as described in

[I-D.ietf-pce-stateful-pce]. LSP instantiation is done by sending an
LSP Initiate Message with an LSP object with the reserved PLSP-ID 0.
LSP deletion is done by sending an LSP Initiate Message with an LSP
object carrying the PLSP-ID of the LSP to be removed and an SRP
object with the R flag set (see Section 5.2).

The format of a PCInitiate message for LSP instantiation is as
follows:

    <PCInitiate Message> ::= <Common Header>
                             <PCE-initiated-lsp-list>
Where:

    <PCE-initiated-lsp-list> ::= <PCE-initiated-lsp-request>[<PCE-initiated-lsp-
list>]

    <PCE-initiated-lsp-request> ::= (<PCE-initiated-lsp-instantiation>|<PCE-
initiated-lsp-deletion>)

    <PCE-initiated-lsp-instantiation> ::= <SRP>
                                          <LSP>
                                          <END-POINTS>
                                          <ERO>
                                          [<attribute-list>]

    <PCE-initiated-lsp-deletion> ::= <SRP>
                                     <LSP>

Where:
    <attribute-list> is defined in [RFC5440] and extended by PCEP extensions.

The SRP object is used to correlate between initiation requests sent
by the PCE and the error reports and state reports sent by the PCC.
Every request from the PCE receives a new SRP-ID-number. This number
is unique per PCEP session and is incremented each time an operation
(initiation, update, etc) is requested from the PCE. The value of
the SRP-ID-number MUST be echoed back by the PCC in PCErr and PCRpt
messages to allow for correlation between requests made by the PCE
and errors or state reports generated by the PCC. Details of the SRP
object and its use can be found in [I-D.ietf-pce-stateful-pce].

5.2. The R flag in the SRP Object

The format of the SRP object is shown Figure 2:

```
      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
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     |                            Flags                            |R|
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     |                         SRP-ID-number                         |
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     |                                                               |
     //                       Optional TLVs                        //
     |                                                               |
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
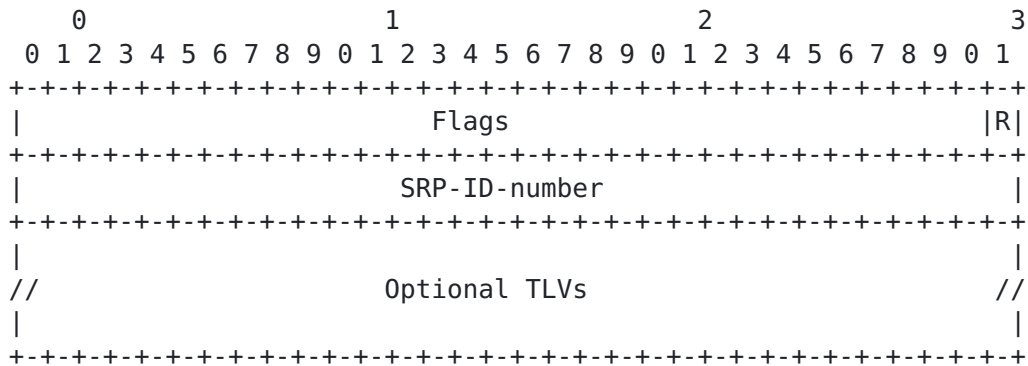
Figure 2: The SRP Object format

The type object is defined in [I-D.ietf-pce-stateful-pce].

A new flag is defined to indicate a delete operation initiated by the PCE:

R (LSP-REMOVE - 1 bit): If set to 1, it indicates a removal request initiated by the PCE.

5.3. LSP instantiation

LSP instantiation is done by sending an LSP Initiate Message with an LSP object with the reserved PLSP-ID 0. The LSP is set up using RSVP-TE, extensions for other setup methods are outside the scope of this draft.

Receipt of a PCInitiate Message with a non-zero PLSP-ID and the R flag in the SRP object set to zero results in a PCErr message of type 19 (Invalid Operation) and value 8 (non-zero PLSP-ID in LSP initiation request).

The END-POINTS Object is mandatory for an instantiation request of an RSVP-signaled LSP. It contains the source and destination addresses for provisioning the LSP. If the END-POINTS Object is missing, the PCC MUST send a PCErr message with Error-type=6 (Mandatory Object missing) and Error-value=3 (END-POINTS Object missing).

The ERO Object is mandatory for an instantiation request. It contains the ERO for the LSP. If the ERO Object is missing, the PCC MUST send a PCErr message with Error-type=6 (Mandatory Object missing) and Error-value=9 (ERO Object missing).

The LSP Object MUST include the SYMBOLIC-PATH-NAME TLV, which will be used to correlate between the PCC-assigned PLSP-ID and the LSP. If

the TLV is missing, the PCC MUST send a PCErr message with Error-type=6(Mandatory object missing) and Error-value=14 (SYMBOLIC-PATH-NAME TLV missing). The symbolic name used for provisioning PCE-initiated LSPs must not have conflict with the LSP name of any existing LSP in the PCC. (Existing LSPs may be either statically configured, or initiated by another PCE). If there is conflict with the LSP name, the PCC MUST send a PCErr message with Error-type=23 (Bad Parameter value) and Error-value=1 (SYMBOLIC-PATH-NAME in use). The only exception to this rule is for LSPs for which the State timeout timer is running (see Section 6).

The PCE MAY include various attributes as per [RFC5440]. The PCC MUST use these values in the LSP instantiation, and local values for unspecified parameters. After the LSP setup, the PCC MUST send a PCRpt to the PCE, reflecting these values. The SRP object in the PCRpt message MUST echo the value of the PCInitiate message that triggered the setup. LSPs that were instantiated as a result of a PCInitiate message MUST have the C flag set in the LSP object.

If the PCC determines that the LSP parameters proposed in the PCInitiate message are unacceptable, it MUST trigger a PCErr with error-type=TBD (PCE instantiation error) and error-value=1 (Unacceptable instantiation parameters). If the PCC encounters an internal error during the processing of the PCInitiate message, it MUST trigger a PCErr with error-type=TBD (PCE instantiation error) and error-value=2 (Internal error).

A PCC MUST relay to the PCE errors it encounters in the setup of PCE-initiated LSP by sending a PCErr with error-type=TBD (PCE instantiation error) and error-value=3 (RSVP signaling error). The PCErr MUST echo the SRP-id-number of the PCInitiate message. The PCEP-ERROR object SHOULD include the RSVP Error Spec TLV (if an ERROR SPEC was returned to the PCC by a downstream node). After the LSP is set up, errors in RSVP signaling are reported in PCRpt messages, as described in [I-D.ietf-pce-stateful-pce].

A PCC SHOULD be able to place a limit on either the number of LSPs or the percentage of resources that are allocated to honor PCE-initiated LSP requests. As soon as that limit is reached, the PCC MUST send a PCErr message of type 19 (Invalid Operation) and value TBD "PCE-initiated limit reached" and is free to drop any incoming PCInitiate messages without additional processing.

Similarly, the PCE SHOULD be able to place a limit on either the number of LSP initiation requests pending for a particular PCC, or on the time it waits for a response (positive or negative) to a PCInitiate request from a PCC and MAY take further action (such as

closing the session or removing all its LSPs) if this limit is
reached.

On succesful completion of the LSP instantiation, the PCC assigns a
PLSP-ID, and immediately delegates the LSP to the PCE by sending a
PCRpt with the Delegate flag set. The PCRpt MUST include the SRP-ID-
number of the PCInitiate request that triggered its creation. PCE-
initiated LSPs are identified with the Create flag in the LSP Object.

5.3.1. The Create flag

The LSP object is defined in [I-D.ietf-pce-stateful-pce] 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  |C|   O|A|R|S|D|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//                        TLVs                                 //
|                                                              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
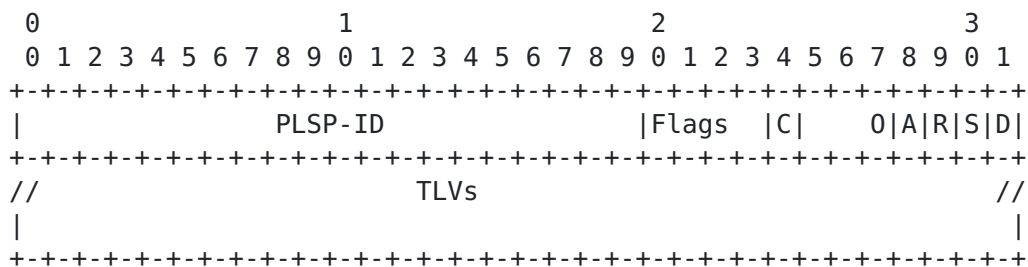
Figure 3: The LSP Object format

A new flag, the Create (C) flag is introduced. On a PCRpt message,
the C Flag set to 1 indicates that this LSP was created via a
PCInitiate message. The C Flag MUST be set to 1 on each PCRpt
message for the duration of existence of the LSP. The Create flag
allows PCEs to be aware of which LSPs were PCE-initiated (a state
that would otherwise only be known by the PCC and the PCE that
initiated them).

The optional SPEAKER-IDENTITY-ID TLV defined in
[I-D.ietf-pce-stateful-sync-optimizations] MAY be included in the LSP
object as an optional TLV for LSPs for which the C-flag is 1, to
identify the PCE who initiated the creation of the LSP on all PCEP
sessions. If the TLV appears for an LSP for which the C flag is 0,
the TLV MUST be ignored the PCC MUST send a PCErr message with Error-
type 23 ("Bad parameter value") and error value 2 ("Speaker identity
included for an LSP that is not PCE-initiated").

5.4. LSP deletion

PCE-initiated removal of a PCE-initiated LSP is done by setting the R
(remove) flag in the SRP Object in the PCInitiate message from the
PCE. The LSP is identified by the PLSP-ID in the LSP object. If the
PLSP-ID is unknown, the PCC MUST generate a PCErr with error type 19,

error value 3, "Unknown PLSP-ID". A PLSP-ID of zero removes all LSPs
that were initiated by the PCE. If the PLSP-ID specified in the
PCInitiate message is not delegated to the PCE, the PCC MUST send a
PCErr message indicating "LSP is not delegated" (Error code 19, error
value 1 ([I-D.ietf-pce-stateful-pce]). If the PLSP-ID specified in
the PCInitiate message was not created by the PCE, the PCC MUST send
a PCErr message indicating "LSP is not PCE initiated" (Error code 19,
error value TBD). Following the removal of the LSP, the PCC MUST
send a PCRpt as described in [I-D.ietf-pce-stateful-pce]. The SRP
object in the PCRpt MUST include the SRP-ID-number from the
PCInitiate message that triggered the removal. The R flag in the SRP
object SHOULD be set.

6. LSP delegation and cleanup

PCE-initiated LSPs are automatically delegated by the PCC to the PCE
upon instantiation. The PCC MUST set the delegation bit to 1 in the
PCRpt that includes the assigned PLSP-ID. All subsequent messages
from the PCC must have the delegation bit set to 1. The PCC cannot
revoke the delegation for PCE-initiated LSPs for an active PCEP
session. Sending a PCRpt message with the delegation bit set to 0
results in a PCErr message of type 19 (Invalid Operation) and value
TBD "Delegation for PCE-initiated LSP cannot be revoked". The PCE
MAY further react by closing the session.

A PCE MAY return a delegation to the PCC, to allow for LSP transfer
between PCEs. Doing so MUST trigger the State Timeout Interval timer
([I-D.ietf-pce-stateful-pce]).

In case of PCEP session failure, control over PCE-initiated LSPs
reverts to the PCC at the expiration of the redelegation timeout. To
obtain control of a PCE-initiated LSP, a PCE (either the original or
one of its backups) sends a PCInitiate message, including just the
SRP and LSP objects, and carrying the PLSP-ID of the LSP it wants to
take control of. Receipt of a PCInitiate message with a non-zero
PLSP-ID normally results in the generation of a PCErr. If the State
Timeout timer is running, the PCC MUST NOT generate an error and
redelegate the LSP to the PCE. The State Timeout timer is stopped
upon the redelegation. After obtaining control of the LSP, the PCE
may remove it using the procedures described in this document.

The State Timeout timer ensures that a PCE crash does not result in
automatic and immediate disruption for the services using PCE-
initiated LSPs. PCE-initiated LSPs are not be removed immediately
upon PCE failure. Instead, they are cleaned up on the expiration of
this timer. This allows for network cleanup without manual
intervention. The PCC SHOULD support removal of PCE-initiated LSPs
as one of the behaviors applied on expiration of the State Timeout

Interval [I-D.ietf-pce-stateful-pce]. The behavior SHOULD be picked
based on local policy, and can result either in LSP removal, or into
reverting to operator-defined default parameters.

7. Implementation status

This section to be removed by the RFC editor.

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 [RFC6982].
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 RFC 6982, "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".

Two vendors are implementing the extensions described in this draft
and have included the functionality in releases that will be shipping
in the near future. An additional entity is working on implementing
these extensions in the scope of research projects.

8. IANA considerations

8.1. PCEP Messages

This document defines the following new PCEP messages:

```
            Value    Meaning              Reference
             12      Initiate             This document
```

8.2. LSP Object

The following values are defined in this document for the Flags field
in the LSP Object.

                    Bit   Description   Reference

                     4   Create   This document

8.3. PCEP-Error Object

   This document defines new Error-Type and Error-Value for the
   following new error conditions:

    Error-Type Meaning
       6   Mandatory Object missing

                 Error-value=13: LSP cleanup TLV missing
                 Error-value=14: SYMBOLIC-PATH-NAME TLV missing
      19   Invalid operation

                 Error-value=6: PCE-initiated LSP limit reached
                 Error-value=7: Delegation for PCE-initiated LSP cannot
                                 be revoked
                 Error-value=8: Non-zero PLSP-ID in LSP initiation
                                 request
      23   Bad parameter value

                 Error-value=1: SYMBOLIC-PATH-NAME in use
                 Error-value=2: Speaker identity included for an LSP
                                 that is not PCE-initiated
      24   LSP instantiation error

                 Error-value=1: Unacceptable instantiation parameters
                 Error-value=2: Internal error
                 Error-value=3: RSVP signaling error

9. Security Considerations

   The security considerations described in [I-D.ietf-pce-stateful-pce]
   apply to the extensions described in this document. Additional
   considerations related to a malicious PCE are introduced.

9.1. Malicious PCE

   The LSP instantiation mechanism described in this document allows a
   PCE to generate state on the PCC and throughout the network. As a
   result, it introduces a new attack vector: an attacker may flood the
   PCC with LSP instantiation requests and consume network and LSR
   resources, either by spoofing messages or by compromising the PCE
   itself.

A PCC can protect itself from such an attack by imposing a limit on
either the number of LSPs or the percentage of resources that are
allocated to honor PCE-initiated LSP requests. As soon as that limit
is reached, the PCC MUST send a PCErr message of type 19 (Invalid
Operation) and value 3 "PCE-initiated LSP limit reached" and is free
to drop any incoming PCInitiate messages for LSP instantiation
without additional processing.

Rapid flaps triggered by the PCE can also be an attack vector. This
will be discussed in a future version of this document.

9.2. Malicious PCC

The LSP instantiation mechanism described in this document requires
the PCE to keep state for LSPs that it instantiates and relies on the
PCC responding (with either a state report or an error message) to
requests for LSP instantiation. A malicious PCC or one that reached
the limit of the number of PCE-initiated LSPs, can ignore PCE
requests and consume PCE resources. A PCE can protect itself by
imposing a limit on the number of requests pending, or by setting a
timeout and it MAY take further action such as closing the session or
removing all the LSPs it initiated.

10. Acknowledgements

We would like to thank Jan Medved, Ambrose Kwong, Ramon Casellas,
Dhruv Dhody, and Raveendra Trovi for their contributions to this
document.

11. References

11.1. Normative References

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