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PCEP Extensions for Receiving SRLG Information
draft-dhody-pce-recv-srlg-02

Abstract

   The Path Computation Element (PCE) provides functions of path
   computation in support of traffic engineering (TE) in networks
   controlled by Multi-Protocol Label Switching (MPLS) and Generalized
   MPLS (GMPLS).

   This document provides extensions for the Path Computation Element
   Protocol (PCEP) to receive Shared Risk Link Group (SRLG) information
   during path computation via encoding this information in the path
   computation reply message.

Status of This Memo

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1. Introduction

As per [RFC4655], PCE based path computation model is deployed in
large, multi-domain, multi-region, or multi-layer networks. In such
case PCEs may cooperate with each other to provide end to end optimal
path.

It is important to understand which TE links in the network might be
at risk from the same failures. In this sense, a set of links may
constitute a 'shared risk link group' (SRLG) if they share a resource
whose failure may affect all links in the set [RFC4202]. H-LSP
(Hierarchical LSP) or S-LSP (Stitched LSP) can be used for carrying
one or more other LSPs as described in [RFC4206] and [RFC6107].
H-LSP and S-LSP may be computed by PCE(s) and further form as a TE
link. The SRLG information of such LSPs can be obtained during path
computation itself and encoded in the PCEP Path Computation Reply
(PCRep) message. [I-D.zhang-ccamp-gmpls-uni-app] describes the use
of a PCE for end to end User-Network Interface (UNI) path
computation.

Note that [I-D.ietf-ccamp-rsvp-te-srlg-collect] specifies a extension
to Resource ReserVation Protocol-Traffic Engineering (RSVP-TE) where
SRLG information is collected at the time of signaling. But in case
a PCE or cooperating PCEs are used for path computation it is
recommended that SRLG information is provided by the PCE(s) during
the path computation itself.

[I-D.farrel-interconnected-te-info-exchange] describes a scaling
problem with SRLGs in multi-layer environment and introduce a concept
of Macro SRLG (MSRLG). Lower layer SRLG are abstracted at the time
of path computation and can be the basis to generate such a Macro
SRLG at the PCE.

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. Terminology

The following terminology is used in this document.

CPS: Confidential Path Segment. A segment of a path that contains
   nodes and links that the policy requires not to be disclosed
   outside the domain.

PCE: Path Computation Element. An entity (component, application,
   or network node) that is capable of computing a network path or
   route based on a network graph and applying computational
   constraints.

SRLG: Shared Risk Link Group.

UNI: User-Network Interface.

3. Usage of SRLG

   [RFC4202] states that a set of links may constitute a 'shared risk
   link group' (SRLG) if they share a resource whose failure may affect
   all links in the set. For example, two fibers in the same conduit
   would be in the same SRLG. If an LSR is required to have multiple
   diversely routed LSPs to another LSR, the path computation should
   attempt to route the paths so that they do not have any links in
   common, and such that the path SRLGs are disjoint.

   In case a PCE or cooperating PCEs are used for path computation, the
   SRLG information is provided by the PCE(s). For example, disjoint
   paths for inter-domain or inter-layer LSPs. In order to achieve path
   computation for a secondary (backup) path, a PCC may request the PCE
   for a route that must be SRLG disjoint from the primary (working)
   path. The Exclude Route Object (XRO) [RFC5521] is used to specify
   SRLG information to be explicitly excluded.

4. PCEP Requirements

   Following key requirements are identified for PCEP to receive SRLG
   information during path computation:

   SRLG Indication: The PCEP speaker must be capable of indicating
      whether the SRLG information of the path should be received during
      the path computation procedure.

   SRLG: If requested, the SRLG information should be received during
      the path computation and encoded in the PCRep message.

   Cooperating PCEs [RFC4655] with inter-PCE Communication work together
   to provide the end to end optimal path as well as the SRLG
   information of this path. During inter-domain or inter-layer path
   computation, the aggregating PCE (Parent PCE [RFC6805] or Ingress
   PCE(1) [RFC5441] or Higher-Layer PCE [RFC5623]) should receive the
   SRLG information of path segments from other PCEs and provide the end
   to end SRLG information of the optimal path to the Path Computation
   Client (PCC).

5. Extension to PCEP

   This document extends the existing RP (Request Parameters) object
   [RFC5440] so that a PCEP speaker can request SRLG information during
   path computation. The SRLG subobject maybe carried inside the
   Explicit Route Object (ERO) in the PCRep message.

5.1. The Extension of the RP Object
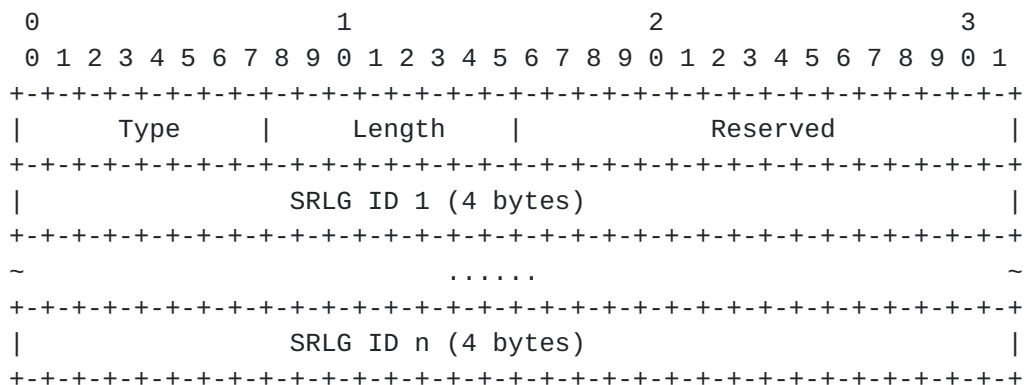
   This document adds the following flags to the RP Object:

   S (SRLG - 1 bit): when set, in a PCReq message, this indicates that
      the SRLG information of the path should be provided in the PCRep
      message. Otherwise, when cleared, this indicates that the SRLG
      information should not be included in the PCRep message. In a
      PCRep message, when the S bit is set this indicates that the
      returned path in ERO also carry the SRLG information; otherwise
      (when the S bit is cleared), the returned path does not carry SRLG
      information.

5.2. SRLG Subobject in ERO

   As per [RFC5440], ERO is used to encode the path and is carried
   within a PCRep message to provide the computed path when computation
   was successful.

   The SRLG of a path is the union of the SRLGs of the links in the path
   [RFC4202]. The SRLG subobject is defined in
   [I-D.ietf-ccamp-rsvp-te-srlg-collect] for ROUTE_RECORD object (RRO).
   The same subobject format (as shown below) can be encoded inside the
   ERO object in the PCRep message.

```
    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      |    Length     |             Reserved          |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                    SRLG ID 1 (4 bytes)                        |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   ~                         ......                                ~
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                    SRLG ID n (4 bytes)                        |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   The meaning and description of Type, Length and SRLG ID can be found
   in [I-D.ietf-ccamp-rsvp-te-srlg-collect]. Reserved field SHOULD be
   set to zero on transmission and MUST be ignored on receipt.

   The SRLG subobject should be encoded inside the ERO object in the
   PCRep message when the S-Bit (SRLG) is set in the PCReq message.

6. Other Considerations

6.1. Backward Compatibility

If a PCE receives a request and the PCE does not understand the new
SRLG flag in the RP object, then the PCE SHOULD reject the request.

If PCEP speaker receives a PCRep message with SRLG subobject that it
does not support or recognize, it must act according to the existing
processing rules of ERO.

6.2. Confidentiality via PathKey

[RFC5520] defines a mechanism to hide the contents of a segment of a
path, called the Confidential Path Segment (CPS). The CPS may be
replaced by a path-key that can be conveyed in the PCEP and signaled
within in a RSVP-TE ERO.

When path-key confidentiality is used, encoding SRLG information in
PCRep along with the path-key could be useful to compute a SRLG
disjoint backup path at the later instance.

The path segment that needs to be hidden (that is, CPS) MAY be
replaced in the ERO with a PKS. The PCE MAY use the SRLG Sub-objects
in the ERO along with the PKS sub-object.

6.3. Coherent SRLG IDs

In a multi-layer multi-domain scenario, SRLG ids may be configured by
different management entities in each layer/domain. In such
scenarios, maintaining a coherent set of SRLG IDs is a key
requirement in order to be able to use the SRLG information properly.
Thus, SRLG IDs must be unique. Note that current procedure is
targeted towards a scenario where the different layers and domains
belong to the same operator, or to several coordinated administrative
groups. Ensuring the aforementioned coherence of SRLG IDs is beyond
the scope of this document. Further scenarios, where coherence in
the SRLG IDs cannot be guaranteed are out of the scope of the present
document and are left for further study.

7. Security Considerations

This document does not add any new security concerns beyond those
discussed in [RFC5440].

8. Manageability Considerations

8.1. Control of Function and Policy

   A PCE involved in inter-domain or inter-layer path computation should
   be capable of being configured with a SRLG processing policy to
   specify if the SRLG IDs of the domain or specific layer network can
   be exposed to the PCC outside the domain or layer network, or whether
   they should be summarized, mapped to values that are comprehensible
   to PCC outside the domain or layer network, or removed entirely.

8.2. Information and Data Models

   [I-D.ietf-pce-pcep-mib] describes the PCEP MIB, there are no new MIB
   Objects for this document.

8.3. Liveness Detection and Monitoring

   Mechanisms defined in this document do not imply any new liveness
   detection and monitoring requirements in addition to those already
   listed in [RFC5440].

8.4. Verify Correct Operations

   Mechanisms defined in this document do not imply any new operation
   verification requirements in addition to those already listed in
   [RFC5440].

8.5. Requirements On Other Protocols

   Mechanisms defined in this document do not imply any new requirements
   on other protocols.

8.6. Impact On Network Operations

   Mechanisms defined in this document do not have any impact on network
   operations in addition to those already listed in [RFC5440].

9. IANA Considerations

   IANA assigns values to PCEP parameters in registries defined in
   [RFC5440]. IANA is requested to make the following additional
   assignments.

9.1. New Subobjects for the ERO Object

IANA has previously assigned an Object-Class and Object-Type to the
ERO carried in PCEP messages [RFC5440]. IANA also maintains a list
of subobject types valid for inclusion in the ERO.

IANA is requested to assign one new subobject types for inclusion in
the ERO as follows:

```
            Subobject        Meaning                  Reference
             xx (TBA)        SRLG sub-object      This document
```

10. Acknowledgments

Special thanks to the authors of
[I-D.ietf-ccamp-rsvp-te-srlg-collect]. This document borrows some of
text from it.

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