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**A YANG Data Model for Segment Routing in IPv6 (SRv6) support in Path
Computation Element Communications Protocol (PCEP)
draft-dhody-pce-pcep-srv6-yang-00**

Abstract

This document augments a YANG data model for the management of Path Computation Element communications Protocol (PCEP) for communications between a Path Computation Client (PCC) and a Path Computation Element (PCE), or between two PCEs in support for Segment Routing in IPv6. The data model includes configuration data and state data (status information and counters for the collection of statistics).

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[1.](#) Introduction

The Path Computation Element (PCE) defined in [[RFC4655](#)] is an entity that is capable of computing a network path or route based on a network graph, and applying computational constraints. A Path Computation Client (PCC) may make requests to a PCE for paths to be computed.

PCEP is the communication protocol between a PCC and PCE and is defined in [[RFC5440](#)]. PCEP interactions include path computation requests and path computation replies as well as notifications of specific states related to the use of a PCE in the context of Multiprotocol Label Switching (MPLS) and Generalized MPLS (GMPLS) Traffic Engineering (TE). [[RFC8231](#)] specifies extensions to PCEP to enable stateful control of MPLS TE LSPs.

[I-D.negi-pce-segment-routing-ipv6] extends [[I-D.ietf-pce-segment-routing](#)] to support SR for IPv6 data plane.

[I-D.ietf-pce-pcep-yang] defines a YANG [[RFC7950](#)] data model for the management of PCEP speakers. This document contains a specification of the PCEP-SRV6 YANG module, "ietf-pcep-srv6" which provides the PCEP-SRV6 [[I-D.negi-pce-segment-routing-ipv6](#)] data model.

The PCEP operational state is included in the same tree as the PCEP configuration consistent with Network Management Datastore Architecture [RFC8342]. The origin of the data is indicated as per the origin metadata annotation.

2. Requirements Language

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. Terminology and Notation

This document also uses the following terms defined in [RFC7420]:

- o PCEP entity: a local PCEP speaker.
- o PCEP peer: to refer to a remote PCEP speaker.
- o PCEP speaker: where it is not necessary to distinguish between local and remote.

Further, this document also uses the following terms defined in [RFC8231] :

- o Stateful PCE, Passive Stateful PCE, Active Stateful PCE
- o Delegation, Revocation, Redefinition
- o LSP State Report, Path Computation Report message (PCRpt).
- o LSP State Update, Path Computation Update message (PCUpd).

[RFC8281] :

- o PCE-initiated LSP, Path Computation LSP Initiate Message (PCInitiate).

[RFC8408] :

- o Path Setup Type (PST).

[I-D.ietf-pce-segment-routing] :

- o Segment Routing (SR).

[I-D.negi-pce-segment-routing-ipv6] :

- o Segment Routing in IPv6 (SRv6).

3.1. Tree Diagrams

A simplified graphical representation of the data model is used in this document. The meaning of the symbols in these diagrams is defined in [RFC8340].

3.2. Prefixes in Data Node Names

In this document, names of data nodes and other data model objects are often used without a prefix, as long as it is clear from the context in which YANG module each name is defined. Otherwise, names are prefixed using the standard prefix associated with the corresponding YANG module, as shown in Table 1.

Prefix	YANG module	Reference
te-types	ietf-te-types	[I-D.ietf-teas-yang-te]
p	ietf-pcep	[I-D.ietf-pce-pcep-yang]
st	ietf-srv6-types	[I-D.raza-spring-srv6-yang]

Table 1: Prefixes and corresponding YANG modules

4. The Design of PCEP-SRv6 Data Model

4.1. The Overview of PCEP SRv6 Data Model

The PCEP-SRv6 YANG module defined in this document has all the common building blocks for the PCEP-SRv6 extension.

```

module: ietf-pcep-srv6
  augment /p:pcep/p:entity/p:capability:
    +--rw srv6 {srv6}?
      +--rw enabled?    boolean
      +--rw max-sl?    uint8
      +--rw sl-limit?  boolean
  augment /p:pcep/p:entity/p:peers/p:peer/p:capability:
    +--rw srv6 {srv6}?
      +--rw enabled?    boolean
      +--rw max-sl?    uint8
      +--rw sl-limit?  boolean
  augment /p:pcep/p:entity/p:lsp-db/p:lsp:
    +--ro srv6 {srv6}?
      +--ro segment-list
        +--ro segment* [index]
          +--ro index      uint32
          +--ro sid-value? st:srv6-sid
  groupings:
    segment-list
      +---- segment-list
        +---- segment* [index]
          +---- index?    uint32
          +---- sid-value? st:srv6-sid

    segment-properties
      +---- index?      uint32
      +---- sid-value? st:srv6-sid

  srv6
    +---- srv6 {srv6}?
      +---- enabled?    boolean
      +---- max-sl?    uint8
      +---- sl-limit?  boolean

```

5. PCEP-SRV6 YANG Modules

5.1. ietf-pcep-srv6 module

RFC Ed.: In this section, replace all occurrences of 'XXXX' with the actual RFC number and all occurrences of the revision date below with the date of RFC publication (and remove this note).

```

<CODE BEGINS> file "ietf-pcep-srv6@2018-10-19.yang"
module ietf-pcep-srv6 {

  yang-version 1.1;

```

```
namespace "urn:ietf:params:xml:ns:yang:ietf-pcep-srv6";
prefix ps;

import ietf-srv6-types {
  prefix "st";
  reference "RFC XXXX";
}

import ietf-te-types {
  prefix "te-types";
  reference "RFC XXXX";
}

import ietf-pcep {
  prefix "p";
  reference "RFC XXXX";
}

organization
  "IETF PCE (Path Computation Element) Working Group";

contact
  "WG Web: <http://tools.ietf.org/wg/pce/>
  WG List: <mailto:pce@ietf.org>
  Editor: Dhruv Dhody
  <mailto:dhruv.ietf@gmail.com>";

description
  "The YANG module augments the PCEP yang operational
  model with SRv6";

revision 2018-10-19 {
  description "Initial revision.";
  reference
    "RFC XXXX: A YANG Data Model for Path Computation
    Element Communications Protocol
    (PCEP) - Segment Routing in IPv6
    (SRv6)";
}

/* Identity */
identity path-setup-srv6 {
  base te-types:path-signaling-type;
  description
    "SRv6 path setup type";
}
```

```
/* Features */
feature srv6 {
  description
    "Support Segment Routing in IPV6 (SRV6) for PCE.";
}

/* Groupings */
grouping srv6 {
  description
    "SRv6";
  container srv6 {
    if-feature srv6;
    description
      "If SRv6 is supported";
    leaf enabled{
      type boolean;
      description
        "Enabled or Disabled";
    }
    leaf max-sl {
      type uint8;
      description
        "Max value of the segment left field in SRH";
    }
    leaf sl-limit{
      type boolean;
      default false;
      description
        "True indicates no limit on SL, the
        leaf max-sl is ignored";
    }
  }
}

grouping segment-list {
  description
    "Segment list grouping";
  container segment-list {
    description
      "Segments for given segment list";

    list segment {
      key "index";
      description "Configure Segment/hop at the index";
      uses segment-properties;
    }
  }
}
```

```
    grouping segment-properties {
      description "Segment properties grouping";
      leaf index {
        type uint32;
        description "Segment index";
      }
      leaf sid-value {
        type st:srv6-sid;
        description "SRv6 SID value";
      }
    }
  }

  /*
   * Augment modules to add SRv6
   */
  augment "/p:pcep/p:entity/p:capability"{
    description
      "Augmenting SRv6";
    uses srv6;
  }
  augment "/p:pcep/p:entity/p:peers/p:peer/p:capability"{
    description
      "Augmenting SRv6";
    uses srv6;
  }
  augment "/p:pcep/p:entity/p:lsp-db/p:lsp"{
    description
      "Augmenting SRv6";
    container srv6 {
      when "/p:pcep/p:entity/p:lsp-db/p:lsp/p:pst
        = 'path-setup-srv6'" {
        description
          "For SRv6 path";
      }
      if-feature srv6;
      uses segment-list;
      description
        "SRv6";
    }
  }
}

} //module

<CODE ENDS>
```


6. Security Considerations

The YANG module defined in this document is designed to be accessed via network management protocol such as NETCONF [[RFC6241](#)] or RESTCONF [[RFC8040](#)]. The lowest NETCONF layer is the secure transport layer and the mandatory-to-implement secure transport is SSH [[RFC6242](#)]. The lowest RESTCONF layer is HTTPS, and the mandatory-to-implement secure transport is TLS [[RFC8446](#)].

The NETCONF access control model [[RFC8341](#)] provides the means to restrict access for particular NETCONF or RESTCONF users to a pre-configured subset of all available NETCONF or RESTCONF protocol operations and content.

There are a number of data nodes defined in the YANG module which are writable/creatable/deletable (i.e., config true, which is the default). These data nodes may be considered sensitive or vulnerable in some network environments. Write operations (e.g., <edit-config>) to these data nodes without proper protection can have a negative effect on network operations. These are the subtrees and data nodes and their sensitivity/vulnerability:

`/p:pcep/p:entity/p:capability/ps:srv6` - configure local SRv6 capability and parameters.

`/p:pcep/p:entity/p:peers/p:peer/p:capability/ps:srv6` - configure peer's SRv6 capability and parameters.

Unauthorized access to above list can adversely affect the PCEP session between the local entity and the peers. This may lead to inability to compute new paths, stateful operations on the delegated as well as PCE-initiated LSPs.

Some of the readable data nodes in this YANG module may be considered sensitive or vulnerable in some network environments. It is thus important to control read access (e.g., via get, get-config, or notification) to these data nodes. These are the subtrees and data nodes and their sensitivity/vulnerability:

`/p:pcep/p:entity/p:lsp-db/p:lsp/ps:srv6` - The SRv6 SID in the network. Unauthorized access to this could provide the all path and network usage information.

7. IANA Considerations

This document registers a URI in the "IETF XML Registry" [[RFC3688](#)]. Following the format in [RFC 3688](#), the following registration has been made.

URI: urn:ietf:params:xml:ns:yang:ietf-pcep-srv6

Registrant Contact: The PCE WG of the IETF.

XML: N/A; the requested URI is an XML namespace.

This document registers a YANG module in the "YANG Module Names" registry [[RFC6020](#)].

Name: ietf-pcep
Namespace: urn:ietf:params:xml:ns:yang:ietf-pcep-srv6
Prefix: ps
Reference: This I-D

8. Acknowledgements

9. References

9.1. Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), DOI 10.17487/RFC2119, March 1997, <<https://www.rfc-editor.org/info/rfc2119>>.
- [RFC3688] Mealling, M., "The IETF XML Registry", [BCP 81](#), [RFC 3688](#), DOI 10.17487/RFC3688, January 2004, <<https://www.rfc-editor.org/info/rfc3688>>.
- [RFC5440] Vasseur, JP., Ed. and JL. Le Roux, Ed., "Path Computation Element (PCE) Communication Protocol (PCEP)", [RFC 5440](#), DOI 10.17487/RFC5440, March 2009, <<https://www.rfc-editor.org/info/rfc5440>>.
- [RFC6020] Bjorklund, M., Ed., "YANG - A Data Modeling Language for the Network Configuration Protocol (NETCONF)", [RFC 6020](#), DOI 10.17487/RFC6020, October 2010, <<https://www.rfc-editor.org/info/rfc6020>>.
- [RFC6241] Enns, R., Ed., Bjorklund, M., Ed., Schoenwaelder, J., Ed., and A. Bierman, Ed., "Network Configuration Protocol (NETCONF)", [RFC 6241](#), DOI 10.17487/RFC6241, June 2011, <<https://www.rfc-editor.org/info/rfc6241>>.
- [RFC6242] Wasserman, M., "Using the NETCONF Protocol over Secure Shell (SSH)", [RFC 6242](#), DOI 10.17487/RFC6242, June 2011, <<https://www.rfc-editor.org/info/rfc6242>>.

- [RFC7950] Bjorklund, M., Ed., "The YANG 1.1 Data Modeling Language", [RFC 7950](#), DOI 10.17487/RFC7950, August 2016, <<https://www.rfc-editor.org/info/rfc7950>>.
- [RFC8040] Bierman, A., Bjorklund, M., and K. Watsen, "RESTCONF Protocol", [RFC 8040](#), DOI 10.17487/RFC8040, January 2017, <<https://www.rfc-editor.org/info/rfc8040>>.
- [RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in [RFC 2119](#) Key Words", [BCP 14](#), [RFC 8174](#), DOI 10.17487/RFC8174, May 2017, <<https://www.rfc-editor.org/info/rfc8174>>.
- [RFC8231] Crabbe, E., Minei, I., Medved, J., and R. Varga, "Path Computation Element Communication Protocol (PCEP) Extensions for Stateful PCE", [RFC 8231](#), DOI 10.17487/RFC8231, September 2017, <<https://www.rfc-editor.org/info/rfc8231>>.
- [RFC8281] Crabbe, E., Minei, I., Sivabalan, S., and R. Varga, "Path Computation Element Communication Protocol (PCEP) Extensions for PCE-Initiated LSP Setup in a Stateful PCE Model", [RFC 8281](#), DOI 10.17487/RFC8281, December 2017, <<https://www.rfc-editor.org/info/rfc8281>>.
- [RFC8340] Bjorklund, M. and L. Berger, Ed., "YANG Tree Diagrams", [BCP 215](#), [RFC 8340](#), DOI 10.17487/RFC8340, March 2018, <<https://www.rfc-editor.org/info/rfc8340>>.
- [RFC8341] Bierman, A. and M. Bjorklund, "Network Configuration Access Control Model", STD 91, [RFC 8341](#), DOI 10.17487/RFC8341, March 2018, <<https://www.rfc-editor.org/info/rfc8341>>.
- [RFC8408] Sivabalan, S., Tantsura, J., Minei, I., Varga, R., and J. Hardwick, "Conveying Path Setup Type in PCE Communication Protocol (PCEP) Messages", [RFC 8408](#), DOI 10.17487/RFC8408, July 2018, <<https://www.rfc-editor.org/info/rfc8408>>.
- [RFC8446] Rescorla, E., "The Transport Layer Security (TLS) Protocol Version 1.3", [RFC 8446](#), DOI 10.17487/RFC8446, August 2018, <<https://www.rfc-editor.org/info/rfc8446>>.
- [I-D.ietf-teas-yang-te]
Saad, T., Gandhi, R., Liu, X., Beeram, V., Shah, H., and I. Bryskin, "A YANG Data Model for Traffic Engineering Tunnels and Interfaces", [draft-ietf-teas-yang-te-16](#) (work in progress), July 2018.

- [I-D.ietf-pce-segment-routing]
Sivabalan, S., Filsfils, C., Tantsura, J., Henderickx, W.,
and J. Hardwick, "PCEP Extensions for Segment Routing",
[draft-ietf-pce-segment-routing-14](#) (work in progress),
October 2018.
- [I-D.raza-spring-srv6-yang]
Raza, K., Rajamanickam, J., Liu, X., Hu, Z., Hussain, I.,
Shah, H., daniel.voyer@bell.ca, d., Elmalky, H.,
Matsushima, S., Horiba, K., and A. Abdelsalam, "YANG Data
Model for SRv6 Base and Static", [draft-raza-spring-
srv6-yang-01](#) (work in progress), March 2018.
- [I-D.ietf-pce-pcep-yang]
Dhody, D., Hardwick, J., Beeram, V., and J. Tantsura, "A
YANG Data Model for Path Computation Element
Communications Protocol (PCEP)", [draft-ietf-pce-pcep-
yang-09](#) (work in progress), October 2018.
- [I-D.negi-pce-segment-routing-ipv6]
Negi, M., Kaladharan, P., Dhody, D., and S. Sivabalan,
"PCEP Extensions for Segment Routing leveraging the IPv6
data plane", [draft-negi-pce-segment-routing-ipv6-02](#) (work
in progress), June 2018.

9.2. Informative References

- [RFC4655] Farrel, A., Vasseur, J., and J. Ash, "A Path Computation
Element (PCE)-Based Architecture", [RFC 4655](#),
DOI 10.17487/RFC4655, August 2006,
<<https://www.rfc-editor.org/info/rfc4655>>.
- [RFC7420] Koushik, A., Stephan, E., Zhao, Q., King, D., and J.
Hardwick, "Path Computation Element Communication Protocol
(PCEP) Management Information Base (MIB) Module",
[RFC 7420](#), DOI 10.17487/RFC7420, December 2014,
<<https://www.rfc-editor.org/info/rfc7420>>.
- [RFC8342] Bjorklund, M., Schoenwaelder, J., Shafer, P., Watsen, K.,
and R. Wilton, "Network Management Datastore Architecture
(NMDA)", [RFC 8342](#), DOI 10.17487/RFC8342, March 2018,
<<https://www.rfc-editor.org/info/rfc8342>>.

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