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A YANG Data Model for Path Computation Element Communications Protocol
(PCEP)
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Abstract

This document defines 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. The data model includes configuration data and state data (status information and counters for the collection of statistics).

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Internet-Draft

PCE-YANG

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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). [\[I-D.ietf-pce-stateful-pce\]](#) specifies extensions to PCEP to enable stateful control of MPLS TE LSPs.

This document defines a YANG [\[RFC6020\]](#) data model for the management of PCEP speakers. It is important to establish a common data model for how PCEP speakers are identified, configured, and monitored. The data model includes configuration data and state data (status information and counters for the collection of statistics).

This document contains a specification of the PCEP YANG module, "ietf-pcep" which provides the PCEP [\[RFC5440\]](#) data model.

[2.](#) 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 [\[RFC2119\]](#).

[3.](#) Terminology and Notation

This document uses the terminology defined in [\[RFC4655\]](#) and [\[RFC5440\]](#). In particular, it uses the following acronyms.

- o Path Computation Request message (PCReq).
- o Path Computation Reply message (PCRep).
- o Notification message (PCNtf).

- o Error message (PCErr).
- o Request Parameters object (RP).
- o Synchronization Vector object (SVEC).
- o Explicit Route object (ERO).

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 [\[I-D.ietf-pce-stateful-pce\]](#) :

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

[3.1.](#) Tree Diagrams

A graphical representation of the complete data tree is presented in [Section 5](#). The meaning of the symbols in these diagrams is as follows and as per [\[I-D.ietf-netmod-rfc6087bis\]](#):

- o Brackets "[" and "]" enclose list keys.
- o Curly braces "{" and "}" contain names of optional features that make the corresponding node conditional.
- o Abbreviations before data node names: "rw" means configuration (read-write), and "ro" state data (read-only).

- o Symbols after data node names: "?" means an optional node and "*" denotes a "list" or "leaf-list".
- o Parentheses enclose choice and case nodes, and case nodes are also marked with a colon (":").
- o Ellipsis ("...") stands for contents of subtrees that are not shown.

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
yang	ietf-yang-types	[RFC6991]
inet	ietf-inet-types	[RFC6991]

Table 1: Prefixes and corresponding YANG modules

4. Objectives

This section describes some of the design objectives for the model:

- o In case of existing implementations, it needs to map the data model defined in this document to their proprietary native data model. To facilitate such mappings, the data model should be simple.
- o The data model should be suitable for new implementations to use as is.
- o Mapping to the PCEP MIB Module should be clear.

- o The data model should allow for static configurations of peers.
- o The data model should include read-only counters in order to gather statistics for sent and received PCEP messages, received messages with errors, and messages that could not be sent due to errors.
- o It should be fairly straightforward to augment the base data model for advanced PCE features.

5. The Design of PCEP Data Model

The module, "ietf-pcep", defines the basic components of a PCE speaker.

```

module: ietf-pcep
+--rw pcep
|   +--rw entity
|       +--rw addr                    inet:ip-address
|       +--rw enabled?                boolean
|       +--rw role                    pcep-role
|       +--rw description?            string
|       +--rw domain
|           +--rw domain* [domain-type domain]
|           +--rw domain-type        domain-type

```

```

|       +--rw domain                domain
|   +--rw capability
|       +--rw gmpls?                boolean {gmpls}?
|       +--rw bi-dir?              boolean
|       +--rw diverse?             boolean
|       +--rw load-balance?         boolean
|       +--rw synchronize?         boolean {svec}?
|       +--rw objective-function?   boolean {obj-fn}?
|       +--rw add-path-constraint?  boolean
|       +--rw prioritization?       boolean
|       +--rw multi-request?        boolean
|       +--rw gco?                 boolean {gco}?
|       +--rw p2mp?                boolean {p2mp}?
|       +--rw stateful {stateful}?
|           +--rw enabled?          boolean

```

```

|         +---rw active?                boolean
|         +---rw pce-initiated?         boolean
| +---rw pce-info
|         +---rw scope
|         |   +---rw intra-area-scope?    boolean
|         |   +---rw intra-area-pref?     uint8
|         |   +---rw inter-area-scope?    boolean
|         |   +---rw inter-area-scope-default? boolean
|         |   +---rw inter-area-pref?     uint8
|         |   +---rw inter-as-scope?      boolean
|         |   +---rw inter-as-scope-default? boolean
|         |   +---rw inter-as-pref?       uint8
|         |   +---rw inter-layer-scope?   boolean
|         |   +---rw inter-layer-pref?    uint8
|         +---rw neigh-domains
|         |   +---rw domain* [domain-type domain]
|         |   |   +---rw domain-type      domain-type
|         |   |   +---rw domain           domain
| +---rw connect-timer?                  uint32
| +---rw connect-max-retry?              uint32
| +---rw init-backoff-timer?             uint32
| +---rw max-backoff-timer?              uint32
| +---rw open-wait-timer?                uint32
| +---rw keep-wait-timer?                uint32
| +---rw keep-alive-timer?               uint32
| +---rw dead-timer?                     uint32
| +---rw allow-negotiation?              boolean
| +---rw max-keep-alive-timer?           uint32
| +---rw max-dead-timer?                 uint32
| +---rw min-keep-alive-timer?           uint32
| +---rw min-dead-timer?                 uint32
| +---rw sync-timer?                     uint32 {svec}?
| +---rw request-timer?                  uint32

```

```

| +---rw max-sessions?                  uint32
| +---rw max-unknown-reqs?              uint32
| +---rw max-unknown-msgs?              uint32
| +---rw pcep-notification-max-rate     uint32
| +---rw stateful-parameter {stateful}?
|   |   +---rw state-timeout?           uint32
|   |   +---rw redelegation-timeout?    uint32
|   |   +---rw rpt-non-pcep-lsp?        boolean

```

```

+--rw peers
|   +--rw peer* [addr]
|       +--rw addr                inet:ip-address
|       +--rw description?        string
|       +--rw domain
|           +--rw domain* [domain-type domain]
|               +--rw domain-type  domain-type
|               +--rw domain       domain
|       +--rw capability
|           +--rw gmpls?            boolean {gmpls}?
|           +--rw bi-dir?           boolean
|           +--rw diverse?          boolean
|           +--rw load-balance?     boolean
|           +--rw synchronize?      boolean {svec}?
|           +--rw objective-function? boolean {obj-fn}?
|           +--rw add-path-constraint? boolean
|           +--rw prioritization?   boolean
|           +--rw multi-request?    boolean
|           +--rw gco?              boolean {gco}?
|           +--rw p2mp?             boolean {p2mp}?
|           +--rw stateful {stateful}?
|               +--rw enabled?      boolean
|               +--rw active?       boolean
|               +--rw pce-initiated? boolean
|       +--rw scope
|           +--rw intra-area-scope? boolean
|           +--rw intra-area-pref?  uint8
|           +--rw inter-area-scope? boolean
|           +--rw inter-area-scope-default? boolean
|           +--rw inter-area-pref?  uint8
|           +--rw inter-as-scope?   boolean
|           +--rw inter-as-scope-default? boolean
|           +--rw inter-as-pref?    uint8
|           +--rw inter-layer-scope? boolean
|           +--rw inter-layer-pref? uint8
|       +--rw neigh-domains
|           +--rw domain* [domain-type domain]
|               +--rw domain-type  domain-type
|               +--rw domain       domain
|       +--rw delegation-pref?     uint8 {stateful}?

```

```

+--ro entity
+--ro addr?                inet:ip-address
+--ro index?               uint32
+--ro admin-status?        pcep-admin-status
+--ro oper-status?         pcep-admin-status
+--ro role?                pcep-role
+--ro domain
|   +--ro domain* [domain-type domain]
|       +--ro domain-type    domain-type
|       +--ro domain         domain
+--ro capability
|   +--ro gmpls?            boolean {gmpls}?
|   +--ro bi-dir?          boolean
|   +--ro diverse?         boolean
|   +--ro load-balance?    boolean
|   +--ro synchronize?     boolean {svec}?
|   +--ro objective-function? boolean {obj-fn}?
|   +--ro add-path-constraint? boolean
|   +--ro prioritization?  boolean
|   +--ro multi-request?   boolean
|   +--ro gco?             boolean {gco}?
|   +--ro p2mp?            boolean {p2mp}?
|   +--ro stateful {stateful}?
|       +--ro enabled?     boolean
|       +--ro active?      boolean
|       +--ro pce-initiated? boolean
+--ro pce-info
|   +--ro scope
|   |   +--ro intra-area-scope?    boolean
|   |   +--ro intra-area-pref?     uint8
|   |   +--ro inter-area-scope?    boolean
|   |   +--ro inter-area-scope-default? boolean
|   |   +--ro inter-area-pref?     uint8
|   |   +--ro inter-as-scope?      boolean
|   |   +--ro inter-as-scope-default? boolean
|   |   +--ro inter-as-pref?       uint8
|   |   +--ro inter-layer-scope?    boolean
|   |   +--ro inter-layer-pref?     uint8
|   +--ro neigh-domains
|       +--ro domain* [domain-type domain]
|           +--ro domain-type    domain-type
|           +--ro domain         domain
+--ro connect-timer?        uint32
+--ro connect-max-retry?    uint32
+--ro init-backoff-timer?   uint32
+--ro max-backoff-timer?    uint32
+--ro open-wait-timer?      uint32

```

```
+--ro keep-wait-timer?      uint32
+--ro keep-alive-timer?     uint32
+--ro dead-timer?           uint32
+--ro allow-negotiation?    boolean
+--ro max-keep-alive-timer? uint32
+--ro max-dead-timer?       uint32
+--ro min-keep-alive-timer? uint32
+--ro min-dead-timer?       uint32
+--ro sync-timer?           uint32 {svec}?
+--ro request-timer?        uint32
+--ro max-sessions?         uint32
+--ro max-unknown-reqs?     uint32
+--ro max-unknown-msgs?     uint32
+--ro stateful-parameter {stateful}?
| +--ro state-timeout?      uint32
| +--ro redelegation-timeout? uint32
| +--ro rpt-non-pcep-lsp?   boolean
+--ro lsp-db {stateful}?
| +--ro lsp* [plsp-id pcc-id]
|   +--ro plsp-id           uint32
|   +--ro pcc-id            inet:ip-address
|   +--ro admin-state?      boolean
|   +--ro operational-state? operational-state
|   +--ro delegated
|   | +--ro enabled?        boolean
|   | +--ro pce?            leafref
|   | +--ro srp-id?         uint32
|   +--ro symbolic-path-name? string
|   +--ro last-error?       lsp-error
+--ro peers
  +--ro peer* [addr]
    +--ro addr               inet:ip-address
    +--ro role?              pcep-role
    +--ro domain
      | +--ro domain* [domain-type domain]
      |   +--ro domain-type  domain-type
      |   +--ro domain       domain
    +--ro capability
      | +--ro gmpls?         boolean {gmpls}?
      | +--ro bi-dir?        boolean
      | +--ro diverse?       boolean
      | +--ro load-balance?   boolean
      | +--ro synchronize?   boolean {svec}?
      | +--ro objective-function? boolean {obj-fn}?
      | +--ro add-path-constraint? boolean
      | +--ro prioritization? boolean
```

	+++ro multi-request?	boolean
	+++ro gco?	boolean {gco}?

	+++ro p2mp?	boolean {p2mp}?
	+++ro stateful {stateful}?	
	+++ro enabled?	boolean
	+++ro active?	boolean
	+++ro pce-initiated?	boolean
	+++ro pce-info	
	+++ro scope	
	+++ro intra-area-scope?	boolean
	+++ro intra-area-pref?	uint8
	+++ro inter-area-scope?	boolean
	+++ro inter-area-scope-default?	boolean
	+++ro inter-area-pref?	uint8
	+++ro inter-as-scope?	boolean
	+++ro inter-as-scope-default?	boolean
	+++ro inter-as-pref?	uint8
	+++ro inter-layer-scope?	boolean
	+++ro inter-layer-pref?	uint8
	+++ro neigh-domains	
	+++ro domain* [domain-type domain]	
	+++ro domain-type	domain-type
	+++ro domain	domain
	+++ro delegation-pref?	uint8 {stateful}?
	+++ro discontinuity-time?	yang:timestamp
	+++ro initiate-session?	boolean
	+++ro session-exists?	boolean
	+++ro num-sess-setup-ok?	yang:counter32
	+++ro num-sess-setup-fail?	yang:counter32
	+++ro session-up-time?	yang:timestamp
	+++ro session-fail-time?	yang:timestamp
	+++ro session-fail-up-time?	yang:timestamp
	+++ro pcep-stats	
	+++ro avg-rsp-time?	uint32
	+++ro lwm-rsp-time?	uint32
	+++ro hwm-rsp-time?	uint32
	+++ro num-pcreq-sent?	yang:counter32
	+++ro num-pcreq-rcvd?	yang:counter32
	+++ro num-pcrep-sent?	yang:counter32
	+++ro num-pcrep-rcvd?	yang:counter32
	+++ro num-pcerr-sent?	yang:counter32

	+++ro num-pcerr-rcvd?	yang:counter32
	+++ro num-pcntf-sent?	yang:counter32
	+++ro num-pcntf-rcvd?	yang:counter32
	+++ro num-keepalive-sent?	yang:counter32
	+++ro num-keepalive-rcvd?	yang:counter32
	+++ro num-unknown-rcvd?	yang:counter32
	+++ro num-corrupt-rcvd?	yang:counter32
	+++ro num-req-sent?	yang:counter32
	+++ro num-req-sent-pend-rep?	yang:counter32

	+++ro num-req-sent-ero-rcvd?	yang:counter32
	+++ro num-req-sent-nopath-rcvd?	yang:counter32
	+++ro num-req-sent-cancel-rcvd?	yang:counter32
	+++ro num-req-sent-error-rcvd?	yang:counter32
	+++ro num-req-sent-timeout?	yang:counter32
	+++ro num-req-sent-cancel-sent?	yang:counter32
	+++ro num-req-rcvd?	yang:counter32
	+++ro num-req-rcvd-pend-rep?	yang:counter32
	+++ro num-req-rcvd-ero-sent?	yang:counter32
	+++ro num-req-rcvd-nopath-sent?	yang:counter32
	+++ro num-req-rcvd-cancel-sent?	yang:counter32
	+++ro num-req-rcvd-error-sent?	yang:counter32
	+++ro num-req-rcvd-cancel-rcvd?	yang:counter32
	+++ro num-rep-rcvd-unknown?	yang:counter32
	+++ro num-req-rcvd-unknown?	yang:counter32
	+++ro svec {svec}?	
	+++ro num-svec-sent?	yang:counter32
	+++ro num-svec-req-sent?	yang:counter32
	+++ro num-svec-rcvd?	yang:counter32
	+++ro num-svec-req-rcvd?	yang:counter32
	+++ro stateful {stateful}?	
	+++ro num-pcrpt-sent?	yang:counter32
	+++ro num-pcrpt-rcvd?	yang:counter32
	+++ro num-pcupd-sent?	yang:counter32
	+++ro num-pcupd-rcvd?	yang:counter32
	+++ro num-rpt-sent?	yang:counter32
	+++ro num-rpt-rcvd?	yang:counter32
	+++ro num-rpt-rcvd-error-sent?	yang:counter32
	+++ro num-upd-sent?	yang:counter32
	+++ro num-upd-rcvd?	yang:counter32
	+++ro num-upd-rcvd-unknown?	yang:counter32
	+++ro num-upd-rcvd-undelagated?	yang:counter32

```

| | +--ro num-upd-rcvd-error-sent?      yang:counter32
| +--ro num-req-sent-closed?           yang:counter32
| +--ro num-req-rcvd-closed?          yang:counter32
+--ro sessions
  +--ro session* [initiator]
    +--ro initiator                    pcep-initiator
    +--ro state-last-change?           yang:timestamp
    +--ro state?                       pcep-sess-state
    +--ro session-creation?            yang:timestamp
    +--ro connect-retry?               yang:counter32
    +--ro local-id?                    uint32
    +--ro remote-id?                   uint32
    +--ro keepalive-timer?             uint32
    +--ro peer-keepalive-timer?        uint32
    +--ro dead-timer?                  uint32
    +--ro peer-dead-timer?             uint32

```

```

+--ro ka-hold-time-rem?                uint32
+--ro overloaded?                       boolean
+--ro overload-time?                   uint32
+--ro peer-overloaded?                 boolean
+--ro peer-overload-time?              uint32
+--ro lspdb-sync?                      sync-state {stateful}?
+--ro discontinuity-time?              yang:timestamp
+--ro pcep-stats
  +--ro avg-rsp-time?                  uint32
  +--ro lwm-rsp-time?                  uint32
  +--ro hwm-rsp-time?                  uint32
  +--ro num-pcreq-sent?                 yang:counter32
  +--ro num-pcreq-rcvd?                 yang:counter32
  +--ro num-pcrep-sent?                 yang:counter32
  +--ro num-pcrep-rcvd?                 yang:counter32
  +--ro num-pcerr-sent?                 yang:counter32
  +--ro num-pcerr-rcvd?                 yang:counter32
  +--ro num-pcntf-sent?                 yang:counter32
  +--ro num-pcntf-rcvd?                 yang:counter32
  +--ro num-keepalive-sent?             yang:counter32
  +--ro num-keepalive-rcvd?            yang:counter32
  +--ro num-unknown-rcvd?              yang:counter32
  +--ro num-corrupt-rcvd?               yang:counter32
  +--ro num-req-sent?                  yang:counter32
  +--ro num-req-sent-pend-rep?          yang:counter32

```

+++ro num-req-sent-ero-rcvd?	yang:counter32
+++ro num-req-sent-nopath-rcvd?	yang:counter32
+++ro num-req-sent-cancel-rcvd?	yang:counter32
+++ro num-req-sent-error-rcvd?	yang:counter32
+++ro num-req-sent-timeout?	yang:counter32
+++ro num-req-sent-cancel-sent?	yang:counter32
+++ro num-req-rcvd?	yang:counter32
+++ro num-req-rcvd-pend-rep?	yang:counter32
+++ro num-req-rcvd-ero-sent?	yang:counter32
+++ro num-req-rcvd-nopath-sent?	yang:counter32
+++ro num-req-rcvd-cancel-sent?	yang:counter32
+++ro num-req-rcvd-error-sent?	yang:counter32
+++ro num-req-rcvd-cancel-rcvd?	yang:counter32
+++ro num-rep-rcvd-unknown?	yang:counter32
+++ro num-req-rcvd-unknown?	yang:counter32
+++ro svec {svec}?	
+++ro num-svec-sent?	yang:counter32
+++ro num-svec-req-sent?	yang:counter32
+++ro num-svec-rcvd?	yang:counter32
+++ro num-svec-req-rcvd?	yang:counter32
+++ro stateful {stateful}?	
+++ro num-pcrpt-sent?	yang:counter32
+++ro num-pcrpt-rcvd?	yang:counter32

+++ro num-pcupd-sent?	yang:counter32
+++ro num-pcupd-rcvd?	yang:counter32
+++ro num-rpt-sent?	yang:counter32
+++ro num-rpt-rcvd?	yang:counter32
+++ro num-rpt-rcvd-error-sent?	yang:counter32
+++ro num-upd-sent?	yang:counter32
+++ro num-upd-rcvd?	yang:counter32
+++ro num-upd-rcvd-unknown?	yang:counter32
+++ro num-upd-rcvd-undelegated?	yang:counter32
+++ro num-upd-rcvd-error-sent?	yang:counter32

notifications:

+++n pcep-session-up

+++ro peer-addr?	leafref
+++ro session-initiator?	leafref
+++ro state-last-change?	yang:timestamp
+++ro state?	pcep-sess-state

+++n pcep-session-down

+++ro peer-addr?	leafref
------------------	---------

```

|  +--ro session-initiator?    pcep-initiator
|  +--ro state-last-change?    yang:timestamp
|  +--ro state?                pcep-sess-state
+---n pcep-session-local-overload
|  +--ro peer-addr?            leafref
|  +--ro session-initiator?    leafref
|  +--ro overloaded?           boolean
|  +--ro overload-time?        uint32
+---n pcep-session-local-overload-clear
|  +--ro peer-addr?            leafref
|  +--ro overloaded?           boolean
+---n pcep-session-peer-overload
|  +--ro peer-addr?            leafref
|  +--ro session-initiator?    leafref
|  +--ro peer-overloaded?       boolean
|  +--ro peer-overload-time?    uint32
+---n pcep-session-peer-overload-clear
|  +--ro peer-addr?            leafref
|  +--ro peer-overloaded?       boolean

```

[5.1.](#) The Entity

The PCEP yang module may contain status information for the local PCEP entity.

The entity has an IP address (using ietf-inet-types [[RFC6991](#)]) and a "role" leaf (the local entity PCEP role) as mandatory.

Note that, the PCEP MIB module [[RFC7420](#)] uses an entity list and a system generated entity index as a primary index to the read only entity table. If the device implements the PCEP MIB, the "index" leaf MUST contain the value of the corresponding pcePcepEntityIndex and only one entity is assumed.

[5.2.](#) The Peer Lists

The peer list contains peer(s) that the local PCEP entity knows about. A PCEP speaker is identified by its IP address. If there is a PCEP speaker in the network that uses multiple IP addresses then it

looks like multiple distinct peers to the other PCEP speakers in the network.

Since PCEP sessions can be ephemeral, the peer list tracks a peer even when no PCEP session currently exists to that peer. The statistics contained are an aggregate of the statistics for all successive sessions to that peer.

To limit the quantity of information that is stored, an implementation MAY choose to discard this information if and only if no PCEP session exists to the corresponding peer.

The data model for PCEP peer presented in this document uses a flat list of peers. Each peer in the list is identified by its IP address (addr-type, addr).

There is one list for static peer configuration ("/pcep/entity/peers"), and a separate list for the operational state of all peers (i.e. static as well as discovered)("/pcep-state/entity/peers"). The former is used to enable remote PCE configuration at PCC (or PCE) while the latter has the operational state of these peers as well as the remote PCE peer which were discovered and PCC peers that have initiated session.

[5.3](#). The Session Lists

The session list contains PCEP session that the PCEP entity (PCE or PCC) is currently participating in. The statistics in session are semantically different from those in peer since the former applies to the current session only, whereas the latter is the aggregate for all sessions that have existed to that peer.

Although [\[RFC5440\]](#) forbids more than one active PCEP session between a given pair of PCEP entities at any given time, there is a window during session establishment where two sessions may exist for a given pair, one representing a session initiated by the local PCEP entity and the other representing a session initiated by the peer. If

either of these sessions reaches active state first, then the other is discarded.

The data model for PCEP session presented in this document uses a

flat list of sessions. Each session in the list is identified by its initiator. This index allows two sessions to exist transiently for a given peer, as discussed above.

There is only one list for the operational state of all sessions ("/pcep-state/entity/peers/peer/sessions/session").

[5.4.](#) Notifications

This YANG model defines a list of notifications to inform client of important events detected during the protocol operation. The notifications defined cover the PCEP MIB notifications.

[6.](#) Advanced PCE Features

This document contains a specification of the base PCEP YANG module, "ietf-pcep" which provides the basic PCEP [[RFC5440](#)] data model.

This document further handles advanced PCE features like -

- o Capability and Scope
- o Domain information (local/neighbour)
- o Path-Key
- o OF
- o GCO
- o P2MP
- o GMPLS
- o Inter-Layer
- o Stateful PCE
- o Segment Routing
- o Authentication including PCEPS (TLS)

[Editor's Note - Some of them would be added in a future revision.]

[6.1.](#) Stateful PCE's LSP-DB

In the operational state of PCEP which supports stateful PCE mode, the list of LSP state are maintained in LSP-DB. The key is the PLSP-ID and the PCC IP address.

[Editor's Note - The document currently contains PCEP specific attributes only. The generic LSP attributes need to added after discussion with the TE Yang draft authors.]

[7.](#) Open Issues and Next Step

This section is added so that open issues can be tracked. This section would be removed when the document is ready for publication.

[7.1.](#) The LSP Database

The current version of data model contains the operational state of LSPs (/pcep-state/entity/lsp-db/lsp/) with PCEP specific attributes. The generic TE attributes of the LSP would be defined in other documents [[I-D.ietf-teas-yang-te](#)]. In its current form, [[I-D.ietf-teas-yang-te](#)] models the LSP state from a device centric view (ingress, transit, egress) which is not suitable at a PCE server.

[Editor's Note: - The same issues would be amplified when PCE-Initiated LSP are supported and require LSP provisioning on PCE server rather than on the device.]

[8.](#) PCEP YANG 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@2016-01-28.yang"
module ietf-pcep {
  namespace "urn:ietf:params:xml:ns:yang:ietf-pcep";
  prefix pcep;

  import ietf-inet-types {
    prefix inet;
  }

  import ietf-yang-types {
    prefix yang;
  }
}
```

}

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organization

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

contact

"WG Web: <<http://tools.ietf.org/wg/pce/>>

WG List: <<mailto:pce@ietf.org>>

WG Chair: JP Vasseur

<<mailto:jpv@cisco.com>>

WG Chair: Julien Meuric

<<mailto:julien.meuric@orange.com>>

WG Chair: Jonathan Hardwick

<<mailto:Jonathan.Hardwick@metaswitch.com>>

Editor: Dhruv Dhody

<<mailto:dhruv.ietf@gmail.com>>;

description

"The YANG module defines a generic configuration and operational model for PCEP common across all of the vendor implementations.";

revision 2016-01-28 {

description "Initial revision.";

reference

"RFC XXXX: A YANG Data Model for Path Computation Element Communications Protocol (PCEP)";

}

/*

* Identities

*/

identity pcep {

description "Identity for the PCEP protocol.";

}

```

/*
 * Typedefs
 */
typedef pcep-role {
    type enumeration {
        enum unknown {
            value "0";

```

```

        description
            "An unknown role";
    }
    enum pcc {
        value "1";
        description
            "The role of a Path Computation Client";
    }
    enum pce {
        value "2";
        description
            "The role of Path Computation Element";
    }
    enum pcc-and-pce {
        value "3";
        description
            "The role of both Path Computation Client and
            Path Computation Element";
    }
}

description
    "The role of a PCEP speaker.
    Takes one of the following values
    - unknown(0): the role is not known.
    - pcc(1): the role is of a Path Computation
      Client (PCC).
    - pce(2): the role is of a Path Computation
      Server (PCE).
    - pccAndPce(3): the role is of both a PCC and
      a PCE.";
}

```

```

typedef pcep-admin-status {
    type enumeration {
        enum admin-status-up {
            value "1";
            description
                "Admin Status is Up";
        }
        enum admin-status-down {
            value "2";
            description
                "Admin Status is Down";
        }
    }
}

```

```

description
    "The Admin Status of the PCEP entity.
    Takes one of the following values
    - admin-status-up(1): Admin Status is Up.
    - admin-status-down(2): Admin Status is Down";
}

```

```

typedef pcep-oper-status {
    type enumeration {
        enum oper-status-up {
            value "1";
            description
                "The PCEP entity is active";
        }
        enum oper-status-down {
            value "2";
            description
                "The PCEP entity is inactive";
        }
        enum oper-status-going-up {
            value "3";
            description
                "The PCEP entity is activating";
        }
        enum oper-status-going-down {
            value "4";
        }
    }
}

```

```

        description
        "The PCEP entity is deactivating";
    }
    enum oper-status-failed {
        value "5";
        description
        "The PCEP entity has failed and will recover
        when possible.";
    }
    enum oper-status-failed-perm {
        value "6";
        description
        "The PCEP entity has failed and will not recover
        without operator intervention";
    }
}
description
"The operational status of the PCEP entity.
Takes one of the following values
- oper-status-up(1): Active
- oper-status-down(2): Inactive
- oper-status-going-up(3): Activating

```

```

        - oper-status-going-down(4): Deactivating
        - oper-status-failed(5): Failed
        - oper-status-failed-perm(6): Failed Permanantly";
    }

typedef pcep-initiator {
    type enumeration {
        enum local {
            value "1";
            description
            "The local PCEP entity initiated the session";
        }

        enum remote {
            value "2";
            description
            "The remote PCEP peer initiated the session";
        }
    }
}

```

```

description
"The initiator of the session, that is, whether the TCP
connection was initiated by the local PCEP entity or
the remote peer.
Takes one of the following values
- local(1): Initiated locally
- remote(2): Initiated remotely";
}

typedef pcep-sess-state {
  type enumeration {
    enum tcp-pending {
      value "1";
      description
        "The tcp-pending state of PCEP session.";
    }

    enum open-wait {
      value "2";
      description
        "The open-wait state of PCEP session.";
    }

    enum keep-wait {
      value "3";
      description
        "The keep-wait state of PCEP session.";
    }
  }
}

```

```

enum session-up {
  value "4";
  description
    "The session-up state of PCEP session.";
}
}
description
"The current state of the session.

The set of possible states excludes the idle state
since entries do not exist in the idle state.
Takes one of the following values

```

```

        - tcp-pending(1): PCEP TCP Pending state
        - open-wait(2): PCEP Open Wait state
        - keep-wait(3): PCEP Keep Wait state
        - session-up(4): PCEP Session Up state";
    }

typedef domain-type {
    type enumeration {
        enum ospf-area {
            value "1";
            description
                "The OSPF area.";
        }
        enum isis-area {
            value "2";
            description
                "The IS-IS area.";
        }
        enum as {
            value "3";
            description
                "The Autonomous System (AS).";
        }
    }
    description
        "The PCE Domain Type";
}

typedef domain-ospf-area {
    type union {
        type uint32;
        type yang:dotted-quad;
    }
    description
        "OSPF Area ID.";
}

```

```

typedef domain-isis-area {
    type string {
        pattern '[0-9A-Fa-f]{2}\.([0-9A-Fa-f]{4}\.){0,3}';
    }
    description

```

```

        "IS-IS Area ID.";
    }

    typedef domain-as {
        type uint32;
        description
            "Autonomous System number.";
    }

    typedef domain {
        type union {
            type domain-ospf-area;
            type domain-isis-area;
            type domain-as;
        }
        description
            "The Domain Information";
    }

    typedef operational-state {
        type enumeration {
            enum down {
                value "0";
                description
                    "not active.";
            }
            enum up {
                value "1";
                description
                    "signalled.";
            }
            enum active {
                value "2";
                description
                    "up and carrying traffic.";
            }
            enum going-down {
                value "3";
                description
                    "LSP is being torn down, resources are
                    being released.";
            }
        }
    }

```

```

        enum going-up {
            value "4";
            description
                "LSP is being signalled.";
        }
    }
    description
        "The operational status of the LSP";
}

typedef lsp-error {
    type enumeration {
        enum no-error {
            value "0";
            description
                "No error, LSP is fine.";
        }
        enum unknown {
            value "1";
            description
                "Unknown reason.";
        }
        enum limit {
            value "2";
            description
                "Limit reached for PCE-controlled LSPs.";
        }
        enum pending {
            value "3";
            description
                "Too many pending LSP update requests.";
        }
        enum unacceptable {
            value "4";
            description
                "Unacceptable parameters.";
        }
        enum internal {
            value "5";
            description
                "Internal error.";
        }
        enum admin {
            value "6";
            description
                "LSP administratively brought down.";
        }
        enum preempted {

```

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```
        value "7";
        description
            "LSP preempted.";
    }
    enum rsvp {
        value "8";
        description
            "RSVP signaling error.";
    }
}
description
    "The LSP Error Codes.";
}

typedef sync-state {
    type enumeration {
        enum pending {
            value "0";
            description
                "The state synchronization
                has not started.";
        }
        enum ongoing {
            value "1";
            description
                "The state synchronization
                is ongoing.";
        }
        enum finished {
            value "2";
            description
                "The state synchronization
                is finished.";
        }
    }
    description
        "The LSP-DB state synchronization operational status.";
}
/*
 * Features
 */
```

```
feature svec {
    description
        "Support synchronized path computation.";
}

feature gmpls {
```

```
    description
        "Support GMPLS.";
}

feature obj-fn {
    description
        "Support OF as per RFC 5541.";
}

feature gco {
    description
        "Support GCO as per RFC 5557.";
}

feature pathkey {
    description
        "Support pathkey as per RFC 5520.";
}

feature p2mp {
    description
        "Support P2MP as per RFC 6006.";
}

feature stateful {
    description
        "Support stateful PCE.";
}

/*
 * Groupings
 */
```

```

grouping pcep-entity-info{
  description
    "This grouping defines the attributes for PCEP entity.";
  leaf connect-timer {
    type uint32 {
      range "1..65535";
    }
    units "seconds";
    default 60;
    description
      "The time in seconds that the PCEP entity will wait

```

```

    to establish a TCP connection with a peer. If a
    TCP connection is not established within this time
    then PCEP aborts the session setup attempt.";
  reference
    "RFC 5440: Path Computation Element (PCE)
    Communication Protocol (PCEP)";
}

leaf connect-max-retry {
  type uint32;
  default 5;
  description
    "The maximum number of times the system tries to
    establish a TCP connection to a peer before the
    session with the peer transitions to the idle
    state.";
  reference
    "RFC 5440: Path Computation Element (PCE)
    Communication Protocol (PCEP)";
}

leaf init-backoff-timer {
  type uint32 {
    range "1..65535";
  }
  units "seconds";
  description
    "The initial back-off time in seconds for retrying

```

a failed session setup attempt to a peer.

The back-off time increases for each failed session setup attempt, until a maximum back-off time is reached. The maximum back-off time is max-backoff-timer.";

}

leaf max-backoff-timer {

type uint32;

units "seconds";

description

"The maximum back-off time in seconds for retrying a failed session setup attempt to a peer.

The back-off time increases for each failed session setup attempt, until this maximum value is reached. Session setup attempts then repeat periodically without any further increase in back-off time.";

}

leaf open-wait-timer {

type uint32 {

range "1..65535";

}

units "seconds";

default 60;

description

"The time in seconds that the PCEP entity will wait to receive an Open message from a peer after the TCP connection has come up.

If no Open message is received within this time then PCEP terminates the TCP connection and deletes the associated sessions.";

reference

"[RFC 5440](#): Path Computation Element (PCE) Communication Protocol (PCEP)";

}

leaf keep-wait-timer {

type uint32 {

```

        range "1..65535";
    }
    units "seconds";
    default 60;
    description
        "The time in seconds that the PCEP entity will wait
        to receive a Keepalive or PCErr message from a peer
        during session initialization after receiving an
        Open message.  If no Keepalive or PCErr message is
        received within this time then PCEP terminates the
        TCP connection and deletes the associated
        sessions.";
    reference
        "RFC 5440: Path Computation Element (PCE)
        Communication Protocol (PCEP)";
}

leaf keep-alive-timer {
    type uint32 {
        range "0..255";
    }
    units "seconds";
    default 30;
    description
        "The keep alive transmission timer that this PCEP
        entity will propose in the initial OPEN message of
        each session it is involved in.  This is the

```

maximum time between two consecutive messages sent to a peer. Zero means that the PCEP entity prefers not to send Keepalives at all.

Note that the actual Keepalive transmission intervals, in either direction of an active PCEP session, are determined by negotiation between the peers as specified by [RFC 5440](#), and so may differ from this configured value.";

```

reference
    "RFC 5440: Path Computation Element (PCE)
    Communication Protocol (PCEP)";
}

```

```

leaf dead-timer {
    type uint32 {
        range "0..255";
    }
    units "seconds";
    must ". >= ../keep-alive-timer" {
        error-message "The dead timer must be "
            + "larger than the keep alive timer";
        description
            "This value MUST be greater than
            keep-alive-timer.";
    }
    default 120;
    description
        "The dead timer that this PCEP entity will propose
        in the initial OPEN message of each session it is
        involved in. This is the time after which a peer
        should declare a session down if it does not
        receive any PCEP messages. Zero suggests that the
        peer does not run a dead timer at all." ;
    reference
        "RFC 5440: Path Computation Element (PCE)
        Communication Protocol (PCEP)";
}

leaf allow-negotiation{
    type boolean;
    description
        "Whether the PCEP entity will permit negotiation of
        session parameters.";
}

leaf max-keep-alive-timer{

```

```

type uint32 {
    range "0..255";
}
units "seconds";
description
    "In PCEP session parameter negotiation in seconds,
    the maximum value that this PCEP entity will

```

```

        accept from a peer for the interval between
        Keepalive transmissions. Zero means that the PCEP
        entity will allow no Keepalive transmission at
        all." ;
    }

    leaf max-dead-timer{
        type uint32 {
            range "0..255";
        }
        units "seconds";
        description
            "In PCEP session parameter negotiation in seconds,
            the maximum value that this PCEP entity will accept
            from a peer for the Dead timer. Zero means that
            the PCEP entity will allow not running a Dead
            timer.";
    }

    leaf min-keep-alive-timer{
        type uint32 {
            range "0..255";
        }
        units "seconds";
        description
            "In PCEP session parameter negotiation in seconds,
            the minimum value that this PCEP entity will
            accept for the interval between Keepalive
            transmissions. Zero means that the PCEP entity
            insists on no Keepalive transmission at all.";
    }

    leaf min-dead-timer{
        type uint32 {
            range "0..255";
        }
        units "seconds";
        description
            "In PCEP session parameter negotiation in
            seconds, the minimum value that this PCEP entity
            will accept for the Dead timer. Zero means that

```

```

        the PCEP entity insists on not running a Dead
        timer.";
    }

    leaf sync-timer{
        if-feature svec;
        type uint32 {
            range "0..65535";
        }
        units "seconds";
        default 60;
        description
            "The value of SyncTimer in seconds is used in the
            case of synchronized path computation request
            using the SVEC object. Consider the case where a
            PCReq message is received by a PCE that contains
            the SVEC object referring to M synchronized path
            computation requests. If after the expiration of
            the SyncTimer all the M path computation requests
            have not been, received a protocol error is
            triggered and the PCE MUST cancel the whole set
            of path computation requests.

            The aim of the SyncTimer is to avoid the storage
            of unused synchronized requests should one of
            them get lost for some reasons (for example, a
            misbehaving PCC).

            Zero means that the PCEP entity does not use the
            SyncTimer.";
        reference
            "RFC 5440: Path Computation Element (PCE)
            Communication Protocol (PCEP)";
    }

    leaf request-timer{
        type uint32 {
            range "1..65535";
        }
        units "seconds";
        description
            "The maximum time that the PCEP entity will wait
            for a response to a PCReq message.";
    }

    leaf max-sessions{
        type uint32;

```

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```
        description
            "Maximum number of sessions involving this PCEP
            entity that can exist at any time.";
    }

    leaf max-unknown-reqs{
        type uint32;
        default 5;
        description
            "The maximum number of unrecognized requests and
            replies that any session on this PCEP entity is
            willing to accept per minute before terminating
            the session.

            A PCRep message contains an unrecognized reply
            if it contains an RP object whose request ID
            does not correspond to any in-progress request
            sent by this PCEP entity.

            A PCReq message contains an unrecognized request
            if it contains an RP object whose request ID is
            zero.";
        reference
            "RFC 5440: Path Computation Element (PCE)
            Communication Protocol (PCEP)";
    }

    leaf max-unknown-msgs{
        type uint32;
        default 5;
        description
            "The maximum number of unknown messages that any
            session on this PCEP entity is willing to accept
            per minute before terminating the session.";
        reference
            "RFC 5440: Path Computation Element (PCE)
            Communication Protocol (PCEP)";
    }

}

} // pcep-entity-info

grouping pce-scope{
    description
```

"This grouping defines PCE path computation scope information which maybe relevant to PCE selection. This information corresponds to PCE auto-discovery information.";
reference

```
"RFC 5088: OSPF Protocol Extensions for Path
    Computation Element (PCE)
    Discovery
RFC 5089: IS-IS Protocol Extensions for Path
    Computation Element (PCE)
    Discovery";
leaf intra-area-scope{
    type boolean;
    default true;
    description
        "PCE can compute intra-area paths.";
}
leaf intra-area-pref{
    type uint8{
        range "0..7";
    }
    description
        "The PCE's preference for intra-area TE LSP
        computation.";
}
leaf inter-area-scope{
    type boolean;
    default false;
    description
        "PCE can compute inter-area paths.";
}
leaf inter-area-scope-default{
    type boolean;
    default false;
    description
        "PCE can act as a default PCE for inter-area
        path computation.";
}
leaf inter-area-pref{
    type uint8{
        range "0..7";
    }
}
```

```

    }
    description
        "The PCE's preference for inter-area TE LSP
        computation.";
}
leaf inter-as-scope{
    type boolean;
    default false;
    description
        "PCE can compute inter-AS paths.";
}
leaf inter-as-scope-default{

```

```

    type boolean;
    default false;
    description
        "PCE can act as a default PCE for inter-AS
        path computation.";
}
leaf inter-as-pref{
    type uint8{
        range "0..7";
    }
    description
        "The PCE's preference for inter-AS TE LSP
        computation.";
}
leaf inter-layer-scope{
    type boolean;
    default false;
    description
        "PCE can compute inter-layer paths.";
}
leaf inter-layer-pref{
    type uint8{
        range "0..7";
    }
    description
        "The PCE's preference for inter-layer TE LSP
        computation.";
}
} //pce-scope

```

```

grouping domain{
  description
    "This grouping specifies a Domain where the
    PCEP speaker has topology visibility.";
  leaf domain-type{
    type domain-type;
    description
      "The domain type.";
  }
  leaf domain{
    type domain;
    description
      "The domain Information.";
  }
} //domain

grouping capability{
  description

```

```

    "This grouping specifies a capability
    information of local PCEP entity. This maybe
    relevant to PCE selection as well. This
    information corresponds to PCE auto-discovery
    information.";
  reference
    "RFC 5088: OSPF Protocol Extensions for Path
    Computation Element (PCE)
    Discovery
    RFC 5089: IS-IS Protocol Extensions for Path
    Computation Element (PCE)
    Discovery";
  leaf gmpls{
    if-feature gmpls;
    type boolean;
    description
      "Path computation with GMPLS link
      constraints.";
  }
  leaf bi-dir{
    type boolean;
    description

```

```

        "Bidirectional path computation.";
    }
    leaf diverse{
        type boolean;
        description
            "Diverse path computation.";
    }
    leaf load-balance{
        type boolean;
        description
            "Load-balanced path computation.";
    }
    leaf synchronize{
        if-feature svec;
        type boolean;
        description
            "Synchronized paths computation.";
    }
    leaf objective-function{
        if-feature obj-fn;
        type boolean;
        description
            "Support for multiple objective functions.";
    }
    leaf add-path-constraint{
        type boolean;

```

```

        description
            "Support for additive path constraints (max
            hop count, etc.).";
    }
    leaf prioritization{
        type boolean;
        description
            "Support for request prioritization.";
    }
    leaf multi-request{
        type boolean;
        description
            "Support for multiple requests per message.";
    }
    leaf gco{

```

```

        if-feature gco;
        type boolean;
        description
            "Support for Global Concurrent Optimization
            (GCO).";
    }
    leaf p2mp{
        if-feature p2mp;
        type boolean;
        description
            "Support for P2MP path computation.";
    }

    container stateful{
        if-feature stateful;
        description
            "If stateful PCE feature is present";
        leaf enabled{
            type boolean;
            description
                "Enabled or Disabled";
        }
        leaf active{
            type boolean;
            description
                "Support for active stateful PCE.";
        }
        leaf pce-initiated{
            type boolean;
            description
                "Support for PCE-initiated LSP.";
        }
    }
}

```

```

} // capability

```

```

grouping info{
    description
        "This grouping specifies all information which
        maybe relevant to both PCC and PCE.
        This information corresponds to PCE auto-discovery
        information.";
}

```

```

    container domain{
        description
            "The local domain for the PCEP entity";
        list domain{
            key "domain-type domain";
            description
                "The local domain.";
            uses domain{
                description
                    "The local domain for the PCEP entity.";
            }
        }
    }
    container capability{
        description
            "The PCEP entity capability";
        uses capability{
            description
                "The PCEP entity supported
                capabilities.";
        }
    }
} //info

grouping pce-info{
    description
        "This grouping specifies all PCE information
        which maybe relevant to the PCE selection.
        This information corresponds to PCE auto-discovery
        information.";
    container scope{
        description
            "The path computation scope";
        uses pce-scope;
    }

    container neigh-domains{
        description
            "The list of neighbour PCE-Domain
            toward which a PCE can compute

```

paths";

```

    list domain{
        key "domain-type domain";

        description
            "The neighbour domain.";
        uses domain{
            description
                "The PCE neighbour domain.";
        }
    }
}
} //pce-info

grouping pcep-stats{
    description
        "This grouping defines statistics for PCEP. It is used
        for both peer and current session.";
    leaf avg-rsp-time{
        type uint32;
        units "milliseconds";
        must "(/pcep-state/entity/peers/peer/role != 'pcc'" +
            " or " +
            "(/pcep-state/entity/peers/peer/role = 'pcc'" +
            " and avg-rsp-time = 0))" {
            error-message
                "Invalid average response time";
            description
                "If role is pcc then this leaf is meaningless
                and is set to zero.";
        }
        description
            "The average response time.

            If an average response time has not been
            calculated then this leaf has the value zero.";
    }

    leaf lwm-rsp-time{
        type uint32;
        units "milliseconds";
        must "(/pcep-state/entity/peers/peer/role != 'pcc'" +
            " or " +
            "(/pcep-state/entity/peers/peer/role = 'pcc'" +
            " and lwm-rsp-time = 0))" {
            error-message
                "Invalid smallest (low-water mark)
                response time";
        }
    }
}

```

```
        description
            "If role is pcc then this leaf is meaningless
            and is set to zero.";
    }
    description
        "The smallest (low-water mark) response time seen.

        If no responses have been received then this
        leaf has the value zero.";
}

leaf hwm-rsp-time{
    type uint32;
    units "milliseconds";
    must "(/pcep-state/entity/peers/peer/role != 'pcc'" +
        " or " +
        "(/pcep-state/entity/peers/peer/role = 'pcc'" +
        " and hwm-rsp-time = 0))" {
        error-message
            "Invalid greatest (high-water mark)
            response time seen";
        description
            "If role is pcc then this field is
            meaningless and is set to zero.";
    }
    description
        "The greatest (high-water mark) response time seen.

        If no responses have been received then this object
        has the value zero.";
}

leaf num-pcreq-sent{
    type yang:counter32;
    description
        "The number of PCReq messages sent.";
}

leaf num-pcreq-rcvd{
    type yang:counter32;
    description
        "The number of PCReq messages received.";
}

leaf num-pcrep-sent{
    type yang:counter32;
```

```
description
  "The number of PCRep messages sent.";
```

```
    }

    leaf num-pcrep-rcvd{
      type yang:counter32;
      description
        "The number of PCRep messages received.";
    }

    leaf num-pcerr-sent{
      type yang:counter32;
      description
        "The number of PCErr messages sent.";
    }

    leaf num-pcerr-rcvd{
      type yang:counter32;
      description
        "The number of PCErr messages received.";
    }

    leaf num-pcntf-sent{
      type yang:counter32;
      description
        "The number of PCNtf messages sent.";
    }

    leaf num-pcntf-rcvd{
      type yang:counter32;
      description
        "The number of PCNtf messages received.";
    }

    leaf num-keepalive-sent{
      type yang:counter32;
      description
        "The number of Keepalive messages sent.";
    }

    leaf num-keepalive-rcvd{
```

```

    type yang:counter32;
    description
        "The number of Keepalive messages received.";
}

```

```

leaf num-unknown-rcvd{
    type yang:counter32;
    description
        "The number of unknown messages received.";
}

```

```

}

leaf num-corrupt-rcvd{
    type yang:counter32;
    description
        "The number of corrupted PCEP message received.";
}

leaf num-req-sent{
    type yang:counter32;
    description
        "The number of requests sent. A request corresponds
        1:1 with an RP object in a PCReq message. This might
        be greater than num-pcreq-sent because multiple
        requests can be batched into a single PCReq
        message.";
}

leaf num-req-sent-pend-rep{
    type yang:counter32;
    description
        "The number of requests that have been sent for
        which a response is still pending.";
}

leaf num-req-sent-ero-rcvd{
    type yang:counter32;
    description
        "The number of requests that have been sent for
        which a response with an ERO object was received.
        Such responses indicate that a path was
        successfully computed by the peer.";
}

```

```

}

leaf num-req-sent-nopath-rcvd{
  type yang:counter32;
  description
    "The number of requests that have been sent for
    which a response with a NO-PATH object was
    received. Such responses indicate that the peer
    could not find a path to satisfy the
    request.";
}

leaf num-req-sent-cancel-rcvd{
  type yang:counter32;
  description
    "The number of requests that were cancelled with

```

```

    a PCNtf message.

    This might be different than num-pcntf-rcvd because
    not all PCNtf messages are used to cancel requests,
    and a single PCNtf message can cancel multiple
    requests.";
}

leaf num-req-sent-error-rcvd{
  type yang:counter32;
  description
    "The number of requests that were rejected with a
    PCErr message.

    This might be different than num-pcerr-rcvd because
    not all PCErr messages are used to reject requests,
    and a single PCErr message can reject multiple
    requests.";
}

leaf num-req-sent-timeout{
  type yang:counter32;
  description
    "The number of requests that have been sent to a peer
    and have been abandoned because the peer has taken too

```

```

        long to respond to them.";
    }

    leaf num-req-sent-cancel-sent{
        type yang:counter32;
        description
            "The number of requests that were sent to the peer and
            explicitly cancelled by the local PCEP entity sending
            a PCNtf.";
    }

    leaf num-req-rcvd{
        type yang:counter32;
        description
            "The number of requests received.  A request
            corresponds 1:1 with an RP object in a PCReq
            message.

            This might be greater than num-pcreq-rcvd because
            multiple requests can be batched into a single
            PCReq message.";
    }

```

```

    leaf num-req-rcvd-pend-rep{
        type yang:counter32;
        description
            "The number of requests that have been received for
            which a response is still pending.";
    }

    leaf num-req-rcvd-ero-sent{
        type yang:counter32;
        description
            "The number of requests that have been received for
            which a response with an ERO object was sent.  Such
            responses indicate that a path was successfully
            computed by the local PCEP entity.";
    }

    leaf num-req-rcvd-nopath-sent{
        type yang:counter32;
    }

```

```

    description
      "The number of requests that have been received for
       which a response with a NO-PATH object was sent. Such
       responses indicate that the local PCEP entity could
       not find a path to satisfy the request.";
  }

  leaf num-req-rcvd-cancel-sent{
    type yang:counter32;
    description
      "The number of requests received that were cancelled
       by the local PCEP entity sending a PCNtf message.

       This might be different than num-pcntf-sent because
       not all PCNtf messages are used to cancel requests,
       and a single PCNtf message can cancel multiple
       requests.";
  }

  leaf num-req-rcvd-error-sent{
    type yang:counter32;
    description
      "The number of requests received that were cancelled
       by the local PCEP entity sending a PCErr message.

       This might be different than num-pcerr-sent because
       not all PCErr messages are used to cancel requests,
       and a single PCErr message can cancel multiple
       requests.";
  }

```

```

  leaf num-req-rcvd-cancel-rcvd{
    type yang:counter32;
    description
      "The number of requests that were received from the
       peer and explicitly cancelled by the peer sending
       a PCNtf.";
  }

  leaf num-rep-rcvd-unknown{
    type yang:counter32;
    description

```

```

        "The number of responses to unknown requests
        received. A response to an unknown request is a
        response whose RP object does not contain the
        request ID of any request that is currently
        outstanding on the session.";
    }

    leaf num-req-rcvd-unknown{
        type yang:counter32;
        description
            "The number of unknown requests that have been
            received. An unknown request is a request
            whose RP object contains a request ID of
            zero.";
    }

    container svec{
        if-feature svec;
        description
            "If synchronized path computation is supported";
        leaf num-svec-sent{
            type yang:counter32;
            description
                "The number of SVEC objects sent in PCReq messages.
                An SVEC object represents a set of synchronized
                requests.";
        }

        leaf num-svec-req-sent{
            type yang:counter32;
            description
                "The number of requests sent that appeared in one
                or more SVEC objects.";
        }

        leaf num-svec-rcvd{
            type yang:counter32;

```

```

        description
            "The number of SVEC objects received in PCReq
            messages. An SVEC object represents a set of
            synchronized requests.";

```

```

    }

    leaf num-svec-req-rcvd{
        type yang:counter32;
        description
            "The number of requests received that appeared
            in one or more SVEC objects.";
    }
}
container stateful{
    if-feature stateful;
    description
        "Stateful PCE related statistics";
    leaf num-pcrpt-sent{
        type yang:counter32;
        description
            "The number of PCRpt messages sent.";
    }

    leaf num-pcrpt-rcvd{
        type yang:counter32;
        description
            "The number of PCRpt messages received.";
    }

    leaf num-pcupd-sent{
        type yang:counter32;
        description
            "The number of PCUpd messages sent.";
    }

    leaf num-pcupd-rcvd{
        type yang:counter32;
        description
            "The number of PCUpd messages received.";
    }

    leaf num-rpt-sent{
        type yang:counter32;
        description
            "The number of LSP Reports sent. A LSP report
            corresponds 1:1 with an LSP object in a PCRpt
            message. This might be greater than
            num-pcrpt-sent because multiple reports can

```

```
        be batched into a single PCRpt message.";
    }

    leaf num-rpt-rcvd{
        type yang:counter32;
        description
            "The number of LSP Reports received.  A LSP report
            corresponds 1:1 with an LSP object in a PCRpt
            message.

            This might be greater than num-pcrpt-rcvd because
            multiple reports can be batched into a single
            PCRpt message.";
    }

    leaf  num-rpt-rcvd-error-sent{
        type yang:counter32;
        description
            "The number of reports of LSPs received that were
            responded by the local PCEP entity by sending a
            PCErr message.";
    }

    leaf num-upd-sent{
        type yang:counter32;
        description
            "The number of LSP updates sent.  A LSP update
            corresponds 1:1 with an LSP object in a PCUpd
            message. This might be greater than
            num-pcupd-sent because multiple updates can
            be batched into a single PCUpd message.";
    }

    leaf num-upd-rcvd{
        type yang:counter32;
        description
            "The number of LSP Updates received.  A LSP update
            corresponds 1:1 with an LSP object in a PCUpd
            message.

            This might be greater than num-pcupd-rcvd because
            multiple updates can be batched into a single
            PCUpd message.";
    }

    leaf  num-upd-rcvd-unknown{
        type yang:counter32;
```

```
        "The number of updates to unknown LSPs
        received. An update to an unknown LSP is a
        update whose LSP object does not contain the
        PLSP-ID of any LSP that is currently
        present.";
    }

    leaf num-upd-rcvd-undelgated{
        type yang:counter32;
        description
            "The number of updates to not delegated LSPs
            received. An update to an undelgated LSP is a
            update whose LSP object does not contain the
            PLSP-ID of any LSP that is currently
            delegated to current PCEP session.";
    }

    leaf num-upd-rcvd-error-sent{
        type yang:counter32;
        description
            "The number of updates to LSPs received that were
            responded by the local PCEP entity by sending a
            PCErr message.";
    }
}
} //pcep-stats

grouping lsp-state{
    description
        "This grouping defines the attributes for LSP in LSP-DB.
        These are the attributes specifically from the PCEP
        perspective";
    leaf plsp-id{
        type uint32{
            range "1..1048575";
        }
        description
            "A PCEP-specific identifier for the LSP. A PCC
            creates a unique PLSP-ID for each LSP that is
            constant for the lifetime of a PCEP session.
```

```

        PLSP-ID is 20 bits with 0 and 0xFFFF are
        reserved";
    }
    leaf pcc-id{
        type inet:ip-address;
        description
            "The local internet address of the PCC, that
            generated the PLSP-ID.";
    }

```

```

    }

    leaf admin-state{
        type boolean;
        description
            "The desired operational state";
    }
    leaf operational-state{
        type operational-state;
        description
            "The operational status of the LSP";
    }
    container delegated{
        description
            "The delegation related parameters";
        leaf enabled{
            type boolean;
            description
                "LSP is delegated or not";
        }
        leaf pce{
            type leafref {
                path "/pcep-state/entity/peers/peer/addr";
            }
            must "((../enabled == true)" +
                " and " +
                "((../role == 'pcc')" +
                " or " +
                "((../role == 'pcc-and-pce')))"
            {
                error-message
                    "The PCEP entity must be PCC
                    and the LSP be delegated";
            }
        }
    }

```

```

        description
            "When PCEP entity is PCC for
            delegated LSP";
    }
    description
        "The reference to the PCE peer to
        which LSP is delegated";
    }
    leaf srp-id{
        type uint32;
        description
            "The last SRP-ID-number associated with this
            LSP.";
    }
}

```

```

    leaf symbolic-path-name{
        type string;
        description
            "The symbolic path name associated with the LSP.";
    }
    leaf last-error{
        type lsp-error;
        description
            "The last error for the LSP.";
    }
} //lsp-state

grouping notification-instance-hdr {
    description
        "This group describes common instance specific data
        for notifications.";

    leaf peer-addr {
        type leafref {
            path "/pcep-state/entity/peers/peer/addr";
        }
        description
            "Reference to peer address";
    }
}

} // notification-instance-hdr

```

```

grouping notification-session-hdr {
    description
        "This group describes common session instance specific
        data for notifications.";

    leaf session-initiator {
        type leafref {
            path "/pcep-state/entity/peers/peer/sessions/" +
                "session/initiator";
        }
        description
            "Reference to pcep session initiator leaf";
    }
} // notification-session-hdr

grouping stateful-pce-parameter {
    description
        "This group describes stateful PCE specific
        parameters.";
    leaf state-timeout{
        type uint32;

```

```

        units "seconds";
        description
            "When a PCEP session is terminated, a PCC
            waits for this time period before flushing
            LSP state associated with that PCEP session
            and reverting to operator-defined default
            parameters or behaviours.";
    }
    leaf redelegation-timeout{
        type uint32;
        units "seconds";
        must "((../role == 'pcc')" +
            " or " +
            "(../role == 'pcc-and-pce'))"
        {
            error-message "The PCEP entity must be PCC";
            description
                "When PCEP entity is PCC";
        }
    }

```

```

        description
            "When a PCEP session is terminated, a PCC
            waits for this time period before revoking
            LSP delegation to a PCE and attempting to
            redelegate LSPs associated with the
            terminated PCEP session to an alternate
            PCE.";
    }
    leaf rpt-non-pcep-lsp{
        type boolean;
        must "((../role == 'pcc')" +
            " or " +
            "(../role == 'pcc-and-pce'))"
        {
            error-message "The PCEP entity must be PCC";
            description
                "When PCEP entity is PCC";
        }
        description
            "If set, a PCC reports LSPs that are not
            controlled by any PCE (for example, LSPs
            that are statically configured at the
            PCC). ";
    }
}

/*
 * Configuration data nodes

```

```

    */
    container pcep{

        description
            "Parameters for list of configured PCEP entities
            on the device.";

        container entity {

            description
                "The configured PCEP entity on the device.";

```

```

leaf addr {
    type inet:ip-address;
    mandatory true;
    description
        "The local Internet address of this PCEP
        entity.

        If operating as a PCE server, the PCEP
        entity listens on this address.

        If operating as a PCC, the PCEP entity
        binds outgoing TCP connections to this
        address.

        It is possible for the PCEP entity to
        operate both as a PCC and a PCE Server, in
        which case it uses this address both to
        listen for incoming TCP connections and to
        bind outgoing TCP connections.";
}

leaf enabled {
    type boolean;
    default true;
    description
        "The administrative status of this PCEP
        Entity.";
}

leaf role {
    type pcep-role;
    mandatory true;
    description
        "The role that this entity can play.
        Takes one of the following values.
        - unknown(0): this PCEP Entity role is not

```

```

        known.
        - pcc(1): this PCEP Entity is a PCC.
        - pce(2): this PCEP Entity is a PCE.
        - pcc-and-pce(3): this PCEP Entity is both
          a PCC and a PCE.";

```

```

}

leaf description {
    type string;
    description
        "Description of the PCEP entity configured
        by the user";
}

uses info {
    description
        "Local PCEP entity information";
}

container pce-info {
    must "((../role == 'pce')" +
        " or " +
        "(../role == 'pcc-and-pce'))"
    {
        error-message "The PCEP entity must be PCE";
        description
            "When PCEP entity is PCE";
    }
    uses pce-info {
        description
            "Local PCE information";
    }
    description
        "The Local PCE Entity PCE information";
}

uses pcep-entity-info {
    description
        "The configuration related to the PCEP
        entity.";
}

leaf pcep-notification-max-rate {
    type uint32;
    mandatory true;
}

```

```

        description
            "This variable indicates the maximum number of
            notifications issued per second. If events occur
            more rapidly, the implementation may simply fail
            to emit these notifications during that period,
            or may queue them until an appropriate time. A
            value of 0 means no notifications are emitted
            and all should be discarded (that is, not
            queued).";
    }

    container stateful-parameter{
        if-feature stateful;
        must "(../info/capability/stateful/active == true)"
        {
            error-message
                "The Active Stateful PCE must be enabled";
            description
                "When PCEP entity is active stateful
                enabled";
        }
        uses stateful-pce-parameter;

        description
            "The configured stateful parameters";
    }

    container peers{
        must "((../role == 'pcc')" +
            " or " +
            "(../role == 'pcc-and-pce'))"
        {
            error-message
                "The PCEP entity must be PCC";
            description
                "When PCEP entity is PCC, as remote
                PCE peers are configured.";
        }
        description
            "The list of configured peers for the
            entity (remote PCE)";
        list peer{
            key "addr";

            description
                "The peer configured for the entity.
                (remote PCE)";
        }
    }

```

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```
leaf addr {
    type inet:ip-address;
    description
        "The local Internet address of this
        PCEP peer.";
}

leaf description {
    type string;
    description
        "Description of the PCEP peer
        configured by the user";
}
uses info {
    description
        "PCE Peer information";
}
uses pce-info {
    description
        "PCE Peer information";
}

leaf delegation-pref{
    if-feature stateful;
    type uint8{
        range "0..7";
    }
    must "(../../info/capability/stateful/active"
        + "==" true)"
    {
        error-message
            "The Active Stateful PCE must be
            enabled";
        description
            "When PCEP entity is active stateful
            enabled";
    }
    description
        "The PCE peer delegation preference.";
}
} // peer
} // peers
```

```

    }//entity
} //pcep

/*
 * Operational data nodes
 */

```

```

container pcep-state{
    config false;
    description
        "The list of operational PCEP entities on the
        device.";

    container entity{
        description
            "The operational PCEP entity on the device.";

        leaf addr {
            type inet:ip-address;
            description
                "The local Internet address of this PCEP
                entity.

                If operating as a PCE server, the PCEP
                entity listens on this address.

                If operating as a PCC, the PCEP entity
                binds outgoing TCP connections to this
                address.

                It is possible for the PCEP entity to
                operate both as a PCC and a PCE Server, in
                which case it uses this address both to
                listen for incoming TCP connections and to
                bind outgoing TCP connections.";
        }

        leaf index{
            type uint32;
            description
                "The index of the operational PCEP
                entity";
        }
    }
}

```

```
}
```

```
leaf admin-status {  
    type pcep-admin-status;  
    description  
        "The administrative status of this PCEP Entity.  
        This is the desired operational status as  
        currently set by an operator or by default in  
        the implementation. The value of enabled  
        represents the current status of an attempt  
        to reach this desired status."  
}
```

```
leaf oper-status {  
    type pcep-admin-status;  
    description  
        "The operational status of the PCEP entity.  
        Takes one of the following values.  
        - oper-status-up(1): the PCEP entity is  
          active.  
        - oper-status-down(2): the PCEP entity is  
          inactive.  
        - oper-status-going-up(3): the PCEP entity is  
          activating.  
        - oper-status-going-down(4): the PCEP entity is  
          deactivating.  
        - oper-status-failed(5): the PCEP entity has  
          failed and will recover when possible.  
        - oper-status-failed-perm(6): the PCEP entity  
          has failed and will not recover without  
          operator intervention."  
}
```

```
leaf role {  
    type pcep-role;  
    description  
        "The role that this entity can play.  
        Takes one of the following values.  
        - unknown(0): this PCEP entity role is  
          not known.  
        - pcc(1): this PCEP entity is a PCC.
```

```

        - pce(2): this PCEP entity is a PCE.
        - pcc-and-pce(3): this PCEP entity is
          both a PCC and a PCE.";
    }

    uses info {
        description
            "Local PCEP entity information";
    }

    container pce-info {
        when "((../role == 'pce') " +
            " or " +
            " (../role == 'pcc-and-pce'))"
        {
            description
                "When PCEP entity is PCE";
        }
        uses pce-info {
            description

```

```

        "Local PCE information";
    }
    description
        "The Local PCE Entity PCE information";
}

uses pcep-entity-info{
    description
        "The operational information related to the
        PCEP entity.";
}

container stateful-parameter{
    if-feature stateful;
    must "(../info/capability/stateful/active == true)"
    {
        error-message
            "The Active Stateful PCE must be enabled";
        description
            "When PCEP entity is active stateful
            enabled";
    }
}

```

```

    }
    uses stateful-pce-parameter;

    description
        "The operational stateful parameters";
}

container lsp-db{
    if-feature stateful;
    description
        "The LSP-DB";
    list lsp{
        key "plsp-id pcc-id";
        description
            "List of all LSPs in LSP-DB";
        uses lsp-state{
            description
                "The PCEP specific attributes for
                LSP-DB.";
        }
        // To Do - add groupings and useful information
        // from TE yang model, once ready
    }
}

```

```

container peers{
    description
        "The list of peers for the entity";

    list peer{
        key "addr";

        description
            "The peer for the entity.";

        leaf addr {
            type inet:ip-address;
            description
                "The local Internet address of this PCEP

```

```

        peer.";
    }

    leaf role {
        type pcep-role;
        description
            "The role of the PCEP Peer.
            Takes one of the following values.
            - unknown(0): this PCEP peer role
              is not known.
            - pcc(1): this PCEP peer is a PCC.
            - pce(2): this PCEP peer is a PCE.
            - pcc-and-pce(3): this PCEP peer
              is both a PCC and a PCE.";
    }

    uses info {
        description
            "PCEP peer information";
    }

    container pce-info {
        when "((../role == 'pce') +
        " or " +
        "(../role == 'pcc-and-pce'))"
        {
            description
                "When PCEP entity is PCE";
        }
        uses pce-info {
            description
                "PCE Peer information";
        }
    }

```

```

    }
    description
        "The PCE Peer information";
    }

    leaf delegation-pref{
        if-feature stateful;
    }

```

```

    type uint8{
        range "0..7";
    }
    must "((../../role == 'pcc')" +
        " or " +
        "(../../role == 'pcc-and-pce'))"
    {
        error-message
            "The PCEP entity must be PCC";
        description
            "When PCEP entity is PCC";
    }
    must "((../../info/capability/stateful/active"
        + " == true)"
    {
        error-message
            "The Active Stateful PCE must be
            enabled";
        description
            "When PCEP entity is active stateful
            enabled";
    }
    description
        "The PCE peer delegation preference.";
}
leaf discontinuity-time {
    type yang:timestamp;
    description
        "The timestamp of the time when the
        information and statistics were
        last reset.";
}

leaf initiate-session {
    type boolean;
    description
        "Indicates whether the local PCEP
        entity initiates sessions to this peer,
        or waits for the peer to initiate a
        session.";
}

```

```

leaf session-exists{
    type boolean;
    description
        "Indicates whether a session with
        this peer currently exists.";
}

leaf num-sess-setup-ok{
    type yang:counter32;
    description
        "The number of PCEP sessions successfully
        successfully established with the peer,
        including any current session. This
        counter is incremented each time a
        session with this peer is successfully
        established.";
}

leaf num-sess-setup-fail{
    type yang:counter32;
    description
        "The number of PCEP sessions with the peer
        that have been attempted but failed
        before being fully established. This
        counter is incremented each time a
        session retry to this peer fails.";
}

leaf session-up-time{
    type yang:timestamp;
    must "(../num-sess-setup-ok != 0 or " +
        "(../num-sess-setup-ok = 0 and " +
        "session-up-time = 0))" {
        error-message
            "Invalid Session Up timestamp";
        description
            "If num-sess-setup-ok is zero,
            then this leaf contains zero.";
    }
    description
        "The timestamp value of the last time a
        session with this peer was successfully
        established.";
}

leaf session-fail-time{
    type yang:timestamp;
    must "(../num-sess-setup-fail != 0 or " +

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```
        "(../num-sess-setup-fail = 0 and " +
        "session-fail-time = 0))" {
            error-message
                "Invalid Session Fail timestamp";
            description
                "If num-sess-setup-fail is zero,
                then this leaf contains zero.";
        }
    description
        "The timestamp value of the last time a
        session with this peer failed to be
        established.";
}

leaf session-fail-up-time{
    type yang:timestamp;
    must "(../num-sess-setup-ok != 0 or " +
        "(../num-sess-setup-ok = 0 and " +
        "session-fail-up-time = 0))" {
        error-message
            "Invalid Session Fail from
            Up timestamp";
        description
            "If num-sess-setup-ok is zero,
            then this leaf contains zero.";
    }
    description
        "The timestamp value of the last time a
        session with this peer failed from
        active.";
}

container pcep-stats {
    description
        "The container for all statistics at peer
        level.";
    uses pcep-stats{
        description
            "Since PCEP sessions can be
            ephemeral, the peer statistics tracks
            a peer even when no PCEP session
            currently exists to that peer. The
            statistics contained are an aggregate
```

```

        of the statistics for all successive
        sessions to that peer.";
    }

    leaf num-req-sent-closed{

```

```

        type yang:counter32;
        description
            "The number of requests that were
            sent to the peer and implicitly
            cancelled when the session they were
            sent over was closed.";
    }

    leaf num-req-rcvd-closed{
        type yang:counter32;
        description
            "The number of requests that were
            received from the peer and
            implicitly cancelled when the
            session they were received over
            was closed.";
    }
} //pcep-stats

```

```

container sessions {
    description
        "This entry represents a single PCEP
        session in which the local PCEP entity
        participates.

        This entry exists only if the
        corresponding PCEP session has been
        initialized by some event, such as
        manual user configuration, auto-
        discovery of a peer, or an incoming
        TCP connection.";

    list session {
        key "initiator";

```

```

description
    "The list of sessions, note that
    for a time being two sessions
    may exist for a peer";

leaf initiator {
    type pcep-initiator;
    description
        "The initiator of the session,
        that is, whether the TCP
        connection was initiated by

```

the local PCEP entity or the peer.

There is a window during session initialization where two sessions can exist between a pair of PCEP speakers, each initiated by one of the speakers. One of these sessions is always discarded before it leaves OpenWait state. However, before it is discarded, two sessions to the given peer appear transiently in this MIB module. The sessions are distinguished by who initiated them, and so this field is the key.";

```

}

```

```

leaf state-last-change {
    type yang:timestamp;
    description
        "The timestamp value at the
        time this session entered its
        current state as denoted by
        the state leaf.";
}

```

```

leaf state {
    type pcep-sess-state;
    description
        "The current state of the
        session.

        The set of possible states
        excludes the idle state since
        entries do not exist in the
        idle state.";
}

leaf session-creation {
    type yang:timestamp;
    description
        "The timestamp value at the
        time this session was
        created.";
}

```

```

leaf connect-retry {
    type yang:counter32;
    description
        "The number of times that the
        local PCEP entity has
        attempted to establish a TCP
        connection for this session
        without success. The PCEP
        entity gives up when this
        reaches connect-max-retry.";
}

leaf local-id {
    type uint32 {
        range "0..255";
    }
    description
        "The value of the PCEP session
        ID used by the local PCEP
        entity in the Open message
        for this session.

```

```

        If state is tcp-pending then
        this is the session ID that
        will be used in the Open
        message. Otherwise, this is
        the session ID that was sent
        in the Open message.";
    }

    leaf remote-id {
        type uint32 {
            range "0..255";
        }
        must "((../state != 'tcp-pending'" +
            "and " +
            "../state != 'open-wait' )" +
            "or " +
            "((../state = 'tcp-pending'" +
            " or " +
            "../state = 'open-wait' )" +
            "and remote-id = 0))" {
            error-message
                "Invalid remote-id";
            description
                "If state is tcp-pending
                or open-wait then this
                leaf is not used and

```

```

        MUST be set to zero.";
    }
    description
        "The value of the PCEP session
        ID used by the peer in its
        Open message for this
        session.";
}

leaf keepalive-timer {
    type uint32 {
        range "0..255";
    }
    units "seconds";
    must "((../state = 'session-up'" +

```

```

        "or " +
        "(../state != 'session-up'" +
        "and keepalive-timer = 0))" {
            error-message
                "Invalid keepalive
                timer";
            description
                "This field is used if
                and only if state is
                session-up. Otherwise,
                it is not used and
                MUST be set to
                zero.";
        }
    }
    description
        "The agreed maximum interval at
        which the local PCEP entity
        transmits PCEP messages on this
        PCEP session. Zero means that
        the local PCEP entity never
        sends Keepalives on this
        session.";
}

leaf peer-keepalive-timer {
    type uint32 {
        range "0..255";
    }
    units "seconds";
    must "(../state = 'session-up'" +
        "or " +
        "(../state != 'session-up'" +
        "and " +

```

```

"peer-keepalive-timer = 0))" {
    error-message
        "Invalid Peer keepalive
        timer";
    description
        "This field is used if
        and only if state is
        session-up. Otherwise,

```

```

        it is not used and MUST
        be set to zero.";
    }
    description
        "The agreed maximum interval at
        which the peer transmits PCEP
        messages on this PCEP session.
        Zero means that the peer never
        sends Keepalives on this
        session.";
}

leaf dead-timer {
    type uint32 {
        range "0..255";
    }
    units "seconds";
    description
        "The dead timer interval for
        this PCEP session.";
}

leaf peer-dead-timer {
    type uint32 {
        range "0..255";
    }
    units "seconds";
    must "((../state != 'tcp-pending' " +
        "and " +
        "../state != 'open-wait' )" +
        "or " +
        "((../state = 'tcp-pending' " +
        "or " +
        "../state = 'open-wait' )" +
        "and " +
        "peer-dead-timer = 0))" {
        error-message
            "Invalid Peer Dead
            timer";
        description

```

```

        pending or open-wait
        then this leaf is not
        used and MUST be set to
        zero.";
    }
    description
        "The peer's dead-timer interval
        for this PCEP session.";
}

leaf ka-hold-time-rem {
    type uint32 {
        range "0..255";
    }
    units "seconds";
    must "((../state != 'tcp-pending' " +
        "and " +
        "../state != 'open-wait' ) " +
        "or " +
        "((../state = 'tcp-pending' " +
        "or " +
        "../state = 'open-wait' )" +
        "and " +
        "ka-hold-time-rem = 0)))" {
        error-message
            "Invalid Keepalive hold
            time remaining";
        description
            "If state is tcp-pending
            or open-wait then this
            field is not used and
            MUST be set to zero.";
    }
    description
        "The keep alive hold time
        remaining for this session.";
}

leaf overloaded {
    type boolean;
    description
        "If the local PCEP entity has
        informed the peer that it is
        currently overloaded, then this
        is set to true. Otherwise, it
        is set to false.";
}

```

```
leaf overload-time {
    type uint32;
    units "seconds";
    must "(../overloaded = true or" +
        "(../overloaded != true and" +
        " overload-time = 0))" {
        error-message
            "Invalid overload-time";
        description
            "This field is only used
            if overloaded is set to
            true. Otherwise, it is
            not used and MUST be set
            to zero.";
    }
    description
        "The interval of time that is
        remaining until the local PCEP
        entity will cease to be
        overloaded on this session.";
}

leaf peer-overloaded {
    type boolean;
    description
        "If the peer has informed the
        local PCEP entity that it is
        currently overloaded, then this
        is set to true. Otherwise, it
        is set to false.";
}

leaf peer-overload-time {
    type uint32;
    units "seconds";
    must "(../peer-overloaded = true" +
        " or " +
        "(../peer-overloaded != true" +
        " and " +
        "peer-overload-time = 0))" {
        error-message
            "Invalid peer overload
            time";
        description
            "This field is only used
            if peer-overloaded is
```

set to true. Otherwise,
it is not used and MUST

```
        be set to zero.";
    }
    description
        "The interval of time that is
        remaining until the peer will
        cease to be overloaded. If it
        is not known how long the peer
        will stay in overloaded state,
        this leaf is set to zero.";
}
leaf lspdb-sync {
    if-feature stateful;
    type sync-state;
    description
        "The LSP-DB state synchronization
        status.";
}
leaf discontinuity-time {
    type yang:timestamp;
    description
        "The timestamp value of the time
        when the statistics were last
        reset.";
}

container pcep-stats {
    description
        "The container for all statistics
        at session level.";
    uses pcep-stats{
        description
            "The statistics contained are
            for the current sessions to
            that peer. These are lost
            when the session goes down.
            ";
    }
}
} //pcep-stats
```

```

        } // session
    } // sessions
} // peers
} // peers
} // entity
} // pcep-state

/*
 * Notifications

```

```

 */
notification pcep-session-up {
    description
        "This notification is sent when the value of
        '/pcep/pcep-state/peers/peer/sessions/session/state'
        enters the 'session-up' state.";

    uses notification-instance-hdr;

    uses notification-session-hdr;

    leaf state-last-change {
        type yang:timestamp;
        description
            "The timestamp value at the time this session entered
            its current state as denoted by the state leaf.";
    }

    leaf state {
        type pcep-sess-state;
        description
            "The current state of the session.

            The set of possible states excludes the idle state
            since entries do not exist in the idle state.";
    }
} // notification

notification pcep-session-down {
    description
        "This notification is sent when the value of
        '/pcep/pcep-state/peers/peer/sessions/session/state'

```

```

        leaves the 'session-up' state.";

uses notification-instance-hdr;

leaf session-initiator {
    type pcep-initiator;
    description
        "The initiator of the session.";
}

leaf state-last-change {
    type yang:timestamp;
    description
        "The timestamp value at the time this session entered
        its current state as denoted by the state leaf.";
}

```

```

leaf state {
    type pcep-sess-state;
    description
        "The current state of the session.

        The set of possible states excludes the idle state
        since entries do not exist in the idle state.";
}
} //notification

notification pcep-session-local-overload {
    description
        "This notification is sent when the local PCEP entity
        enters overload state for a peer.";

    uses notification-instance-hdr;

    uses notification-session-hdr;

leaf overloaded {
    type boolean;
    description
        "If the local PCEP entity has informed the peer that
        it is currently overloaded, then this is set to
        true. Otherwise, it is set to false.";
}
}

```

```

    }

    leaf overload-time {
        type uint32;
        units "seconds";
        must "(../overloaded = true or " +
            "(../overloaded != true and " +
            "overload-time = 0))" {
            error-message
                "Invalid overload-time";
            description
                "This field is only used if overloaded is
                set to true. Otherwise, it is not used
                and MUST be set to zero.";
        }
        description
            "The interval of time that is remaining until the
            local PCEP entity will cease to be overloaded on
            this session.";
    }
} //notification

notification pcep-session-local-overload-clear {

```

```

    description
        "This notification is sent when the local PCEP entity
        leaves overload state for a peer.";

    uses notification-instance-hdr;

    leaf overloaded {
        type boolean;
        description
            "If the local PCEP entity has informed the peer
            that it is currently overloaded, then this is set
            to true. Otherwise, it is set to false.";
    }
} //notification

notification pcep-session-peer-overload {
    description
        "This notification is sent when a peer enters overload

```

```

        state.";

uses notification-instance-hdr;

uses notification-session-hdr;

leaf peer-overloaded {
    type boolean;
    description
        "If the peer has informed the local PCEP entity that
        it is currently overloaded, then this is set to true.
        Otherwise, it is set to false.";
}

leaf peer-overload-time {
    type uint32;
    units "seconds";
    must "(../peer-overloaded = true or " +
        "(../peer-overloaded != true and " +
        "peer-overload-time = 0))" {
        error-message
            "Invalid peer-overload-time";
        description
            "This field is only used if
            peer-overloaded is set to true.
            Otherwise, it is not used and MUST
            be set to zero.";
    }
    description
        "The interval of time that is remaining until the

```

```

        peer will cease to be overloaded. If it is not known
        how long the peer will stay in overloaded state, this
        leaf is set to zero.";
    }
} //notification

notification pcep-session-peer-overload-clear {
    description
        "This notification is sent when a peer leaves overload
        state.";
}

```

```

        uses notification-instance-hdr;

        leaf peer-overloaded {
            type boolean;
            description
                "If the peer has informed the local PCEP entity that
                 it is currently overloaded, then this is set to true.
                 Otherwise, it is set to false.";
        }
    } //notification
} //module

<CODE ENDS>

```

[9.](#) Security Considerations

The YANG module defined in this memo is designed to be accessed via the NETCONF protocol [[RFC6241](#)]. The lowest NETCONF layer is the secure transport layer and the mandatory-to-implement secure transport is SSH [[RFC6242](#)]. The NETCONF access control model [[RFC6536](#)] provides the means to restrict access for particular NETCONF users to a pre-configured subset of all available NETCONF 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.

TBD: List specific Subtrees and data nodes and their sensitivity/vulnerability.

[10.](#) Manageability Considerations

[10.1.](#) Control of Function and Policy

- [10.2.](#) Information and Data Models
- [10.3.](#) Liveness Detection and Monitoring
- [10.4.](#) Verify Correct Operations
- [10.5.](#) Requirements On Other Protocols
- [10.6.](#) Impact On Network Operations
- [11.](#) 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

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
Prefix:	pcep
Reference:	This I-D

[12.](#) Acknowledgements

The initial document is based on the PCEP MIB [[RFC7420](#)]. Further this document structure is based on Routing Yang Module [[I-D.ietf-netmod-routing-cfg](#)]. We would like to thank the authors of aforementioned documents.

[13.](#) References

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