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YANG Data Models for the Port Control Protocol (PCP)
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Abstract

This document defines YANG data models for the Port Control Protocol (PCP), including PCP client, PCP server, PCP proxy, and Universal Plug and Play (UPnP) Internet Gateway Device - Port Control Protocol Interworking Function.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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1. Introduction

This document defines a data model for the Port Control Protocol (PCP, [RFC6887]) using the YANG data modeling language [RFC6020]. The following functional elements are in scope:

- PCP client [RFC6887].
- PCP server [RFC6887].
- PCP proxy [RFC7648].
- Universal Plug and Play (UPnP) Internet Gateway Device - Port Control Protocol Interworking Function (UPnP IGD-PCP IWF)

[RFC6970].

In addition to the base features defined in [RFC6887], this document covers the following capabilities:

- PCP Description option [RFC7220].
- PCP Prefix64 discovery option [RFC7225].
- PCP Port set allocation [RFC7753].

In conformance with [RFC7291] and [RFC7488], this document assumes that multiple PCP servers may be configured to a PCP client, PCP proxy, or UPnP IGD-PCP IWF; each server is defined by a list of IP addresses.

This document follows the guidelines of [RFC6087].

This document uses the common YANG types defined in [RFC6991].

This document does not allow to manage advanced PCP authentication features [RFC7652].

1.1. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

This document makes use of the terms defined in [RFC6887], [RFC7648], [RFC6970], and [RFC6970].

The terminology for describing YANG data models is defined in [RFC6020].

1.2. Tree Diagrams

The meaning of the symbols in these diagrams is as follows:

- Brackets "[" and "]" enclose list keys.

- Curly braces "{" and "}" contain names of optional features that make the corresponding node conditional.

- Abbreviations before data node names: "rw" means configuration (read-write), "ro" state data (read-only).

- Symbols after data node names: "?" means an optional node, "!" a container with presence, and "*" denotes a "list" or "leaf-list".

- Parentheses enclose choice and case nodes, and case nodes are also marked with a colon (":").

- Ellipsis ("...") stands for contents of subtrees that are not shown.

1.3. IP Address Format

Following the rationale defined in Section 5 of [RFC6887], this document uses IPv4-mapped IPv6 addresses to encode IPv4 addresses.

The all-zeros IPv6 address are expressed as (::).

The all-zeros IPv4 address is expressed by 80 bits of zeros, 16 bits of ones, and 32 bits of zeros (::ffff:0:0).

2. Overview of the PCP Data Models

The following sub-sections provide an overview of the PCP data models.

2.1. Common PCP

Common PCP YANG data model groups a set of common definitions that are used in all PCP modules.

2.2. PCP Client

Figure 1 depicts the YANG data model for the PCP client.

```
module: ietf-pcp-client
   +--rw pcp-client-config
```

```
|  +--rw enable?                 boolean
|  +--rw description?            string
|  +--rw pcp-client-instances
|     +--rw pcp-client-instance* [id]
|        +--rw id                        uint32
|        +--rw name?                     string
|        +--rw version* [version]
|        |  +--rw version                 uint8
|        +--rw pcp-servers* [pcp-server-id]
|        |  +--rw pcp-server-id                uint32
|        |  +--rw pcp-server-ip-address* [address-id]
|        |  |  +--rw address-id             uint32
|        |  |  +--rw ip-address          inet:ipv6-address
|        |  +--rw external-address-familly     inet:ip-version
|        |  +--rw stale-external-ip-address?   inet:ipv6-prefix
|        +--rw authentication-enable?   boolean
|        +--rw opcode-configuration
|        |  +--rw map?        boolean
|        |  +--rw peer?       boolean
```



```
|        |  +--rw announce?   boolean
|        +--rw option-configuration
|        |  +--rw third-party?      boolean
|        |  +--rw prefer-failure?   boolean
|        |  +--rw filter
|        |  |  +--rw filter-enabled               boolean
|        |  |  +--rw max-filters?      uint32
|        |  +--rw port-set?         boolean
|        |  +--rw description
|        |  |  +--rw description-enabled               boolean
|        |  |  +--rw max-description?       uint32
|        |  +--rw prefix64?         boolean
|        +--rw mapping-table
|           +--rw mapping-entry* [index]
|              +--rw index                    uint32
|              +--rw status?                  enumeration
|              +--rw mapping-nonce           string
|              +--rw internal-ip-address     inet:ipv6-prefix
|              +--rw internal-port
|              |  +--rw (port-type)?
|              |     +--:(single-port-number)
|              |     |  +--rw single-port-number?   inet:port-number
```

```
|              |     +--:(port-range)
|              |        +--rw start-port-number?    inet:port-number
|              |        +--rw end-port-number?      inet:port-number
|              +--rw external-ip-address      inet:ipv6-prefix
|              +--rw external-port
|              |  +--rw (port-type)?
|              |     +--:(single-port-number)
|              |     |  +--rw single-port-number?   inet:port-number
|              |     +--:(port-range)
|              |        +--rw start-port-number?    inet:port-number
|              |        +--rw end-port-number?      inet:port-number
|              +--rw protocol       uint8
|              +--rw lifetime                  uint32
|              +--rw third-party-address?     inet:ipv6-prefix
|              +--rw filter* [filter-id]
|              |  +--rw filter-id              uint32
|              |  +--rw remote-ip-prefix      inet:ipv6-prefix
|              |  +--rw remote-port-number        inet:port-number
|              +--rw description?              string
|              +--rw prefer-failure-tagged?   boolean
+--ro pcp-client-state
   +--ro pcp-client-instances
      +--ro pcp-client-instance* [id]
         +--ro id                          int32
         +--ro name?                       string
         +--ro pcp-client-ip-address* [address-id]
```



```
            |  +--ro address-id             uint32
            |  +--ro ip-address?   inet:ipv6-address
            +--ro supported-version* [version]
            |  +--ro version                uint8
            +--ro preferred-version?        uint8
            +--ro pcp-server-address* [pcp-server-id]
            |  +--ro pcp-server-id                uint32
            |  +--ro pcp-server-ip-address* [address-id]
            |  |  +--ro address-id             uint32
            |  |  +--ro ip-address          inet:ipv6-address
            |  +--ro external-address-familly     inet:ip-version
            |  +--ro stale-external-ip-address?   inet:ipv6-prefix
            |  +--ro source?                      enumeration
            |  +--ro in-use?                      boolean
            |  +--ro server-epoch?                uint32
```

```
|  +--ro client-epoch?                uint32
|  +--ro current-version?             uint8
+--ro authentication-support?   boolean
+--ro opcode-capability
|  +--ro map?         boolean
|  +--ro peer?        boolean
|  +--ro announce?    boolean
+--ro option-capability
|  +--ro third-party?       boolean
|  +--ro prefer-failure?    boolean
|  +--ro filter
|  |  +--ro filter-enabled                 boolean
|  |  +--ro max-filters?       uint32
|  +--ro port-set?          boolean
|  +--ro description
|  |  +--ro description-enabled                 boolean
|  |  +--ro max-description?       uint32
|  +--ro prefix64?          boolean
+--ro opcode-configuration
|  +--ro map?         boolean
|  +--ro peer?        boolean
|  +--ro announce?    boolean
+--ro option-configuration
|  +--ro third-party?       boolean
|  +--ro prefer-failure?    boolean
|  +--ro filter
|  |  +--ro filter-enabled                 boolean
|  |  +--ro max-filters?       uint32
|  +--ro port-set?          boolean
|  +--ro description
|  |  +--ro description-enabled                 boolean
|  |  +--ro max-description?       uint32
|  +--ro prefix64?          boolean
```



```
+--ro authentication-enabled?   boolean
+--ro mapping-table
|  +--ro mapping-entry* [index]
|     +--ro index                    uint32
|     +--ro status?                  enumeration
|     +--ro mapping-nonce            string
|     +--ro internal-ip-address      inet:ipv6-prefix
|     +--ro internal-port
```

```
|     |  +--ro (port-type)?
|     |     +--:(single-port-number)
|     |     |  +--ro single-port-number?   inet:port-number
|     |     +--:(port-range)
|     |        +--ro start-port-number?    inet:port-number
|     |        +--ro end-port-number?      inet:port-number
|     +--ro external-ip-address      inet:ipv6-prefix
|     +--ro external-port
|     |  +--ro (port-type)?
|     |     +--:(single-port-number)
|     |     |  +--ro single-port-number?   inet:port-number
|     |     +--:(port-range)
|     |        +--ro start-port-number?    inet:port-number
|     |        +--ro end-port-number?      inet:port-number
|     +--ro protocol       uint8
|     +--ro lifetime                 uint32
|     +--ro third-party-address?     inet:ipv6-prefix
|     +--ro filter* [filter-id]
|     |  +--ro filter-id             uint32
|     |  +--ro remote-ip-prefix      inet:ipv6-prefix
|     |  +--ro remote-port-number          inet:port-number
|     +--ro description?             string
|     +--ro prefer-failure-tagged?   boolean
|     +--ro status-code?             enumeration
+--ro traffic-statistics
   +--ro traffic-statistics
   |  +--ro sent-packet?      yang:zero-based-counter64
   |  +--ro sent-byte?        yang:zero-based-counter64
   |  +--ro rcvd-packet?      yang:zero-based-counter64
   |  +--ro rcvd-byte?        yang:zero-based-counter64
   |  +--ro dropped-packet?   yang:zero-based-counter64
   |  +--ro dropped-byte?     yang:zero-based-counter64
   +--ro opcode-statistics
   |  +--ro sent-map?         yang:zero-based-counter64
   |  +--ro rcvd-map?         yang:zero-based-counter64
   |  +--ro sent-peer?        yang:zero-based-counter64
   |  +--ro rcvd-peer?        yang:zero-based-counter64
   |  +--ro sent-annonce?     yang:zero-based-counter64
   |  +--ro rcvd-announce?    yang:zero-based-counter64
   |  +--ro rcvd-unknown?     yang:zero-based-counter64
```



```
   |  +--ro rcvd-malformed?   yang:zero-based-counter64
```

```
            +--ro mapping-table
               +--ro current-mt-size?   yang:zero-based-counter64
               +--ro max-mt-size?       uint32
```

Figure 1: PCP Client YANG Data Model

2.3. UPnP IGD/PCP Interworking Function

Figure 2 depicts the YANG data model for the UPnP IGD-PCP IWF.

```
module: ietf-pcp-iwf
   +--rw pcp-iwf-config
   |  +--rw enable?                    boolean
   |  +--rw pcp-igd-iwf-instances
   |     +--rw pcp-igd-iwf-instance* [id]
   |        +--rw id                          uint32
   |        +--rw name?                       string
   |        +--rw version* [version]
   |        |  +--rw version                   uint8
   |        +--rw pcp-servers* [pcp-server-id]
   |        |  +--rw pcp-server-id                  uint32
   |        |  +--rw pcp-server-ip-address* [address-id]
   |        |  |  +--rw address-id                  uint32
   |        |  |  +--rw ip-address                inet:ipv6-address
   |        |  +--rw external-address-familly     inet:ip-version
   |        |  +--rw stale-external-ip-address?   inet:ipv6-prefix
   |        +--rw authentication-enable?   boolean
   |        +--rw igd-version
   |        |  +--rw igd-version?   enumeration
   |        +--rw mapping-table
   |           +--rw mapping-entry* [index]
   |              +--rw igd-control-point-address?   inet:ip-address
   |              +--rw igd-control-point-port?      inet:port-number
   |              +--rw index                        uint32
   |              +--rw status?                      enumeration
   |              +--rw mapping-nonce                string
   |              +--rw internal-ip-address          inet:ipv6-prefix
   |              +--rw internal-port
   |              |  +--rw (port-type)?
   |              |     +--:(single-port-number)
   |              |     |  +--rw single-port-number?   inet:port-number
   |              |     +--:(port-range)
   |              |        +--rw start-port-number?    inet:port-number
   |              |        +--rw end-port-number?      inet:port-number
   |              +--rw external-ip-address          inet:ipv6-prefix
   |              +--rw external-port
```

```
|              |  +--rw (port-type)?
|              |     +--:(single-port-number)
|              |     |  +--rw single-port-number?   inet:port-number
|              |     +--:(port-range)
|              |        +--rw start-port-number?    inet:port-number
|              |        +--rw end-port-number?      inet:port-number
|              +--rw protocol           uint8
|              +--rw lifetime                      uint32
|              +--rw third-party-address?          inet:ipv6-prefix
|              +--rw filter* [filter-id]
|              |  +--rw filter-id              uint32
|              |  +--rw remote-ip-prefix       inet:ipv6-prefix
|              |  +--rw remote-port-number         inet:port-number
|              +--rw description?                  string
|              +--rw prefer-failure-tagged?        boolean
+--ro pcp-iwf-state
   +--ro pcp-igd-iwf-instances
      +--ro pcp-igd-iwf-instance* [id]
         +--ro id                          int32
         +--ro name?                       string
         +--ro supported-version* [version]
         |  +--ro version                  uint8
         +--ro preferred-version?          uint8
         +--ro pcp-igd-iwf-ip-address* [address-id]
         |  +--ro address-id               uint32
         |  +--ro ip-address?   inet:ipv6-address
         +--ro authentication-support?     boolean
         +--ro authentication-enabled?     boolean
         +--ro igd-version-capability
         |  +--ro igd-version?   enumeration
         +--ro enabled-igd-version
         |  +--ro igd-version?   enumeration
         +--ro pcp-server-address* [pcp-server-id]
         |  +--ro pcp-server-id                 uint32
         |  +--ro pcp-server-ip-address* [address-id]
         |  |  +--ro address-id              uint32
         |  |  +--ro ip-address           inet:ipv6-address
         |  +--ro external-address-familly     inet:ip-version
         |  +--ro stale-external-ip-address?   inet:ipv6-prefix
         |  +--ro source?                      enumeration
         |  +--ro in-use?                      boolean
         |  +--ro server-epoch?                uint32
         |  +--ro client-epoch?                uint32
         |  +--ro current-version?             uint8
         +--ro mapping-table
         |  +--ro mapping-entry* [index]
```

```
|     +--ro index                          uint32
|     +--ro status?                        enumeration
```



```
|     +--ro mapping-nonce                  string
|     +--ro internal-ip-address            inet:ipv6-prefix
|     +--ro internal-port
|     |  +--ro (port-type)?
|     |     +--:(single-port-number)
|     |     |  +--ro single-port-number?   inet:port-number
|     |     +--:(port-range)
|     |        +--ro start-port-number?    inet:port-number
|     |        +--ro end-port-number?      inet:port-number
|     +--ro external-ip-address            inet:ipv6-prefix
|     +--ro external-port
|     |  +--ro (port-type)?
|     |     +--:(single-port-number)
|     |     |  +--ro single-port-number?   inet:port-number
|     |     +--:(port-range)
|     |        +--ro start-port-number?    inet:port-number
|     |        +--ro end-port-number?      inet:port-number
|     +--ro protocol           uint8
|     +--ro lifetime                       uint32
|     +--ro third-party-address?           inet:ipv6-prefix
|     +--ro filter* [filter-id]
|     |  +--ro filter-id             uint32
|     |  +--ro remote-ip-prefix      inet:ipv6-prefix
|     |  +--ro remote-port-number         inet:port-number
|     +--ro description?                   string
|     +--ro prefer-failure-tagged?         boolean
|     +--ro status-code?                   enumeration
|     +--ro igd-control-point-address?     inet:ip-address
|     +--ro igd-control-point-port?        inet:port-number
+--ro traffic-statistics
   +--ro traffic-statistics
   |  +--ro sent-packet?      yang:zero-based-counter64
   |  +--ro sent-byte?        yang:zero-based-counter64
   |  +--ro rcvd-packet?      yang:zero-based-counter64
   |  +--ro rcvd-byte?        yang:zero-based-counter64
   |  +--ro dropped-packet?   yang:zero-based-counter64
   |  +--ro dropped-byte?     yang:zero-based-counter64
   +--ro opcode-statistics
   |  +--ro sent-map?         yang:zero-based-counter64
```

```
|  +--ro rcvd-map?          yang:zero-based-counter64
|  +--ro sent-peer?         yang:zero-based-counter64
|  +--ro rcvd-peer?         yang:zero-based-counter64
|  +--ro sent-annonce?      yang:zero-based-counter64
|  +--ro rcvd-announce?     yang:zero-based-counter64
|  +--ro rcvd-unknown?      yang:zero-based-counter64
|  +--ro rcvd-malformed?    yang:zero-based-counter64
+--ro mapping-table
   +--ro current-mt-size?   yang:zero-based-counter64
```



```
   +--ro max-mt-size?       uint32
```

Figure 2: IWF YANG Data Model

2.4. PCP Proxy

Figure 3 depicts the YANG data model for the PCP proxy.

```
module: ietf-pcp-proxy
   +--rw pcp-proxy-config
   |  +--rw enable?                boolean
   |  +--rw description?           string
   |  +--rw pcp-proxy-instances
   |     +--rw pcp-proxy-instance* [id]
   |     |  +--rw id                        uint32
   |     |  +--rw name?                     string
   |     |  +--rw version* [version]
   |     |  |  +--rw version                 uint8
   |     |  +--rw pcp-servers* [pcp-server-id]
   |     |  |  +--rw pcp-server-id                uint32
   |     |  |  +--rw pcp-server-ip-address* [address-id]
   |     |  |  |  +--rw address-id             uint32
   |     |  |  |  +--rw ip-address          inet:ipv6-address
   |     |  |  +--rw external-address-familly     inet:ip-version
   |     |  |  +--rw stale-external-ip-address?   inet:ipv6-prefix
   |     |  +--rw authentication-enable?   boolean
   |     |  +--rw opcode-configuration
   |     |     +--rw map?                    boolean
   |     |     +--rw peer?                   boolean
   |     |     +--rw announce?               boolean
   |     |     +--rw relay-unknown?   boolean
```

```
|     +--rw option-configuration
|     |  +--rw third-party?                       boolean
|     |  +--rw prefer-failure?                    boolean
|     |  +--rw filter
|     |  |  +--rw filter-enabled                boolean
|     |  |  +--rw max-filters?      uint32
|     |  +--rw port-set?                          boolean
|     |  +--rw description
|     |  |  +--rw description-enabled                boolean
|     |  |  +--rw max-description?       uint32
|     |  +--rw prefix64?                          boolean
|     |  +--rw relay-mandatory-unknown-option?   boolean
|     |  +--rw relay-optionnal-unknown-option?   boolean
|     +--rw terminate-proxy-recursion?   boolean
|     +--rw mapping-table
|        +--rw mapping-entry* [index]
```



```
|           +--rw index                         uint32
|           +--rw status?                       enumeration
|           +--rw mapping-nonce                 string
|           +--rw internal-ip-address           inet:ipv6-prefix
|           +--rw internal-port
|           |  +--rw (port-type)?
|           |     +--:(single-port-number)
|           |     |  +--rw single-port-number?   inet:port-number
|           |     +--:(port-range)
|           |        +--rw start-port-number?    inet:port-number
|           |        +--rw end-port-number?      inet:port-number
|           +--rw external-ip-address           inet:ipv6-prefix
|           +--rw external-port
|           |  +--rw (port-type)?
|           |     +--:(single-port-number)
|           |     |  +--rw single-port-number?   inet:port-number
|           |     +--:(port-range)
|           |        +--rw start-port-number?    inet:port-number
|           |        +--rw end-port-number?      inet:port-number
|           +--rw protocol           uint8
|           +--rw lifetime                      uint32
|           +--rw third-party-address?          inet:ipv6-prefix
|           +--rw filter* [filter-id]
|           |  +--rw filter-id              uint32
|           |  +--rw remote-ip-prefix      inet:ipv6-prefix
```

```
|           |  +--rw remote-port-number         inet:port-number
|           +--rw description?                  string
|           +--rw prefer-failure-tagged?        boolean
|           +--rw local-assigned-ip-address?    inet:ipv6-prefix
|           +--rw local-assigned-port
|              +--rw (port-type)?
|                 +--:(single-port-number)
|                 |  +--rw single-port-number?   inet:port-number
|                 +--:(port-range)
|                    +--rw start-port-number?    inet:port-number
|                    +--rw end-port-number?      inet:port-number
+--ro pcp-proxy-state
   +--ro pcp-proxy-instances
      +--ro pcp-proxy-instance* [id]
         +--ro id                                     int32
         +--ro name?                                  string
         +--ro supported-version* [version]
         |  +--ro version                uint8
         +--ro preferred-version?                     uint8
         +--ro pcp-proxy-ip-address* [address-id]
         |  +--ro address-id              uint32
         |  +--ro pcp-proxy-ip-address?   inet:ipv6-address
         +--ro pcp-server-address* [pcp-server-id]
```



```
            |  +--ro pcp-server-id                uint32
            |  +--ro pcp-server-ip-address* [address-id]
            |  |  +--ro address-id             uint32
            |  |  +--ro ip-address          inet:ipv6-address
            |  +--ro external-address-familly     inet:ip-version
            |  +--ro stale-external-ip-address?   inet:ipv6-prefix
            |  +--ro source?                      enumeration
            |  +--ro in-use?                      boolean
            |  +--ro server-epoch?                uint32
            |  +--ro client-epoch?                uint32
            |  +--ro current-version?             uint8
            +--ro authentication-support?           boolean
            +--ro pcp-controlled-function-capability
            |  +--ro nat44?               boolean
            |  +--ro nat64?               boolean
            |  +--ro ds-lite?             boolean
            |  +--ro nptv6?               boolean
            |  +--ro ipv4-firewall?       boolean
```

```
|  +--ro ipv6-firewall?       boolean
|  +--ro port-range-router?   boolean
+--ro opcode-capability
|  +--ro map?                    boolean
|  +--ro peer?                   boolean
|  +--ro announce?               boolean
|  +--ro relay-unknown?   boolean
+--ro option-capability
|  +--ro third-party?                      boolean
|  +--ro prefer-failure?                   boolean
|  +--ro filter
|  |  +--ro filter-enabled                boolean
|  |  +--ro max-filters?      uint32
|  +--ro port-set?                         boolean
|  +--ro description
|  |  +--ro description-enabled               boolean
|  |  +--ro max-description?       uint32
|  +--ro prefix64?                         boolean
|  +--ro relay-mandatory-unknown-option?   boolean
|  +--ro relay-optionnal-unknown-option?   boolean
+--ro opcode-configuration
|  +--ro map?        boolean
|  +--ro peer?       boolean
|  +--ro announce?   boolean
+--ro option-configuration
|  +--ro third-party?                      boolean
|  +--ro prefer-failure?                   boolean
|  +--ro filter
|  |  +--ro filter-enabled                boolean
|  |  +--ro max-filters?      uint32
```



```
|  +--ro port-set?                         boolean
|  +--ro description
|  |  +--ro description-enabled               boolean
|  |  +--ro max-description?       uint32
|  +--ro prefix64?                         boolean
|  +--ro relay-mandatory-unknown-option?   boolean
|  +--ro relay-optionnal-unknown-option?   boolean
+--ro authentication-enabled?               boolean
+--ro terminate-proxy-recursion-status?     boolean
+--ro mapping-table
|  +--ro mapping-entry* [index]
```

```
|     +--ro index                          uint32
|     +--ro status?                        enumeration
|     +--ro mapping-nonce                  string
|     +--ro internal-ip-address            inet:ipv6-prefix
|     +--ro internal-port
|     |  +--ro (port-type)?
|     |     +--:(single-port-number)
|     |     |  +--ro single-port-number?   inet:port-number
|     |     +--:(port-range)
|     |        +--ro start-port-number?    inet:port-number
|     |        +--ro end-port-number?      inet:port-number
|     +--ro external-ip-address           inet:ipv6-prefix
|     +--ro external-port
|     |  +--ro (port-type)?
|     |     +--:(single-port-number)
|     |     |  +--ro single-port-number?   inet:port-number
|     |     +--:(port-range)
|     |        +--ro start-port-number?    inet:port-number
|     |        +--ro end-port-number?      inet:port-number
|     +--ro protocol           uint8
|     +--ro lifetime                       uint32
|     +--ro third-party-address?           inet:ipv6-prefix
|     +--ro filter* [filter-id]
|     |  +--ro filter-id              uint32
|     |  +--ro remote-ip-prefix       inet:ipv6-prefix
|     |  +--ro remote-port-number          inet:port-number
|     +--ro description?                   string
|     +--ro prefer-failure-tagged?         boolean
|     +--ro local-assigned-ip-address?     inet:ipv6-prefix
|     +--ro local-assigned-port
|     |  +--ro (port-type)?
|     |     +--:(single-port-number)
|     |     |  +--ro single-port-number?   inet:port-number
|     |     +--:(port-range)
|     |        +--ro start-port-number?    inet:port-number
|     |        +--ro end-port-number?      inet:port-number
|     +--ro status-code?                   enumeration
```



```
           +--ro traffic-statistics
              +--ro client-facing-interface
              |  +--ro traffic-statistics
              |  |  +--ro sent-packet?      yang:zero-based-counter64
```

```
|  |  +--ro sent-byte?         yang:zero-based-counter64
|  |  +--ro rcvd-packet?       yang:zero-based-counter64
|  |  +--ro rcvd-byte?         yang:zero-based-counter64
|  |  +--ro dropped-packet?    yang:zero-based-counter64
|  |  +--ro dropped-byte?      yang:zero-based-counter64
|  +--ro opcode-statistics
|     +--ro sent-map?          yang:zero-based-counter64
|     +--ro rcvd-map?          yang:zero-based-counter64
|     +--ro sent-peer?         yang:zero-based-counter64
|     +--ro rcvd-peer?         yang:zero-based-counter64
|     +--ro sent-annonce?      yang:zero-based-counter64
|     +--ro rcvd-announce?     yang:zero-based-counter64
|     +--ro rcvd-unknown?      yang:zero-based-counter64
|     +--ro rcvd-malformed?    yang:zero-based-counter64
+--ro server-facing-interface
|  +--ro traffic-statistics
|  |  +--ro sent-packet?       yang:zero-based-counter64
|  |  +--ro sent-byte?         yang:zero-based-counter64
|  |  +--ro rcvd-packet?       yang:zero-based-counter64
|  |  +--ro rcvd-byte?         yang:zero-based-counter64
|  |  +--ro dropped-packet?    yang:zero-based-counter64
|  |  +--ro dropped-byte?      yang:zero-based-counter64
|  +--ro opcode-statistics
|     +--ro sent-map?          yang:zero-based-counter64
|     +--ro rcvd-map?          yang:zero-based-counter64
|     +--ro sent-peer?         yang:zero-based-counter64
|     +--ro rcvd-peer?         yang:zero-based-counter64
|     +--ro sent-annonce?      yang:zero-based-counter64
|     +--ro rcvd-announce?     yang:zero-based-counter64
|     +--ro rcvd-unknown?      yang:zero-based-counter64
|     +--ro rcvd-malformed?    yang:zero-based-counter64
+--ro mapping-table
   +--ro current-mt-size?   yang:zero-based-counter64
   +--ro max-mt-size?       uint32
```

Figure 3: PCP Proxy YANG Data Model

2.5. PCP Server

Figure 4 depicts the YANG data model for the PCP server.

```
module: ietf-pcp-server
   +--rw pcp-server-config
```

```
|  +--rw enable?                  boolean
|  +--rw pcp-server-instances
|     +--rw pcp-server-instance* [id]
|        +--rw id                                  uint32
|        +--rw name?                               string
|        +--rw version* [version]
|        |  +--rw version                 uint8
|        +--rw pcp-server-ip-address* [address-id]
|        |  +--rw address-id              uint32
|        |  +--rw ip-address?   inet:ipv6-address
|        +--rw authentication-enable?             boolean
|        +--rw opcode-configuration
|        |  +--rw map?         boolean
|        |  +--rw peer?        boolean
|        |  +--rw announce?    boolean
|        +--rw option-configuration
|        |  +--rw third-party?       boolean
|        |  +--rw prefer-failure?    boolean
|        |  +--rw filter
|        |  |  +--rw filter-enabled                 boolean
|        |  |  +--rw max-filters?      uint32
|        |  +--rw port-set-option
|        |  |  +--rw port-set-enable          boolean
|        |  |  +--rw default-port-set-size?   uint16
|        |  |  +--rw maximum-port-set-size?   uint16
|        |  +--rw description
|        |  |  +--rw description-enabled             boolean
|        |  |  +--rw max-description?       uint32
|        |  +--rw prefix64-option
|        |     +--rw prefix64-option-enable?   boolean
|        |     +--rw prefix64* [prefix64-id]
|        |        +--rw prefix64-id         uint32
|        |        +--rw prefix64?           inet:ipv6-prefix
|        |        +--rw suffix?             yang:hex-string
|        |        +--rw dest-ipv4-prefix* [ipv4-prefix-id]
|        |           +--rw ipv4-prefix-id        uint32
|        |           +--rw ipv4-prefix?     inet:ipv4-prefix
|        +--rw port-selelection-scheme
|        |  +--rw (port-selelection)?
|        |     +--:(port-randomization)
|        |     |  +--rw port-randomization-enable?         boolean
|        |     +--:(port-preservation)
|        |     |  +--rw port-preservation-enable?          boolean
|        |     +--:(port-parity-preservation)
|        |        +--rw port-parity-preservation-enable?   boolean
|        +--rw nonce-validation-checks-enable?    boolean
|        +--rw subscriber-mask?                  uint8
```

```
|        +--rw port-quota?                        uint16
```



```
|        +--rw exclude-ports* [id]
|        |  +--rw id                     uint16
|        |  +--rw (port-type)?
|        |     +--:(single-port-number)
|        |     |  +--rw single-port-number?   inet:port-number
|        |     +--:(port-range)
|        |        +--rw start-port-number?    inet:port-number
|        |        +--rw end-port-number?      inet:port-number
|        +--rw protocol* [protocol-id]
|        |  +--rw protocol-id                 uint8
|        +--rw epoch-set?                         uint32
|        +--rw lifetime
|        |  +--rw minimum-lifetime?   uint32
|        |  +--rw maximum-lifetime?   uint32
|        +--rw error-lifetime
|        |  +--rw minimum-error-lifetime?   uint32
|        |  +--rw maximum-error-lifetime?   uint32
|        +--rw mapping-table
|           +--rw mapping-entry* [index]
|              +--rw index                    uint32
|              +--rw status?                  enumeration
|              +--rw mapping-nonce            string
|              +--rw internal-ip-address      inet:ipv6-prefix
|              +--rw internal-port
|              |  +--rw (port-type)?
|              |     +--:(single-port-number)
|              |     |  +--rw single-port-number?   inet:port-number
|              |     +--:(port-range)
|              |        +--rw start-port-number?    inet:port-number
|              |        +--rw end-port-number?      inet:port-number
|              +--rw external-ip-address      inet:ipv6-prefix
|              +--rw external-port
|              |  +--rw (port-type)?
|              |     +--:(single-port-number)
|              |     |  +--rw single-port-number?   inet:port-number
|              |     +--:(port-range)
|              |        +--rw start-port-number?    inet:port-number
|              |        +--rw end-port-number?      inet:port-number
|              +--rw protocol       uint8
|              +--rw lifetime                 uint32
```

```
   |              +--rw third-party-address?     inet:ipv6-prefix
   |              +--rw filter* [filter-id]
   |              |  +--rw filter-id             uint32
   |              |  +--rw remote-ip-prefix      inet:ipv6-prefix
   |              |  +--rw remote-port-number         inet:port-number
   |              +--rw description?             string
   |              +--rw prefer-failure-tagged?   boolean
   +--ro pcp-server-state
```



```
      +--ro pcp-server-instances
         +--ro pcp-server-instance* [id]
            +--ro id                                        int32
            +--ro name?                                     string
            +--ro supported-version* [version]
            |  +--ro version                uint8
            +--ro preferred-version?                        uint8
            +--ro configured-pcp-server-ip-address* [address-id]
            |  +--ro address-id             uint32
            |  +--ro ip-address?   inet:ipv6-address
            +--ro external-ip-address-pool* [address-id]
            |  +--ro address-id          uint32
            |  +--ro external-ip-pool?   inet:ipv6-prefix
            +--ro authentication-support?               boolean
            +--ro opcode-capability
            |  +--ro map?        boolean
            |  +--ro peer?       boolean
            |  +--ro announce?   boolean
            +--ro option-capability
            |  +--ro third-party?      boolean
            |  +--ro prefer-failure?   boolean
            |  +--ro filter
            |  |  +--ro filter-enabled               boolean
            |  |  +--ro max-filters?      uint32
            |  +--ro port-set?         boolean
            |  +--ro description
            |  |  +--ro description-enabled             boolean
            |  |  +--ro max-description?       uint32
            |  +--ro prefix64?         boolean
            |  |  +--ro (port-selelection)?
            |  |     +--:(port-randomization)
            |  |     |  +--ro port-randomization-enable?         boolean
            |  |     +--:(port-preservation)
```

```
|  |     |  +--ro port-preservation-enable?           boolean
|  |     +--:(port-parity-preservation)
|  |        +--ro port-parity-preservation-enable?    boolean
+--ro protocol-capabilities* [protocol-id]
|  +--ro protocol-id                 uint8
+--ro pcp-controlled-function-capability
|  +--ro nat44?               boolean
|  +--ro nat64?               boolean
|  +--ro ds-lite?             boolean
|  +--ro nptv6?               boolean
|  +--ro ipv4-firewall?       boolean
|  +--ro ipv6-firewall?       boolean
|  +--ro port-range-router?   boolean
+--ro opcode-configuration
|  +--ro map?        boolean
```



```
|  +--ro peer?       boolean
|  +--ro announce?   boolean
+--ro option-configuration
|  +--ro third-party?       boolean
|  +--ro prefer-failure?    boolean
|  +--ro filter
|  |  +--ro filter-enabled           boolean
|  |  +--ro max-filters?             uint32
|  +--ro port-set-option
|  |  +--ro port-set-enable          boolean
|  |  +--ro default-port-set-size?   uint16
|  |  +--ro maximum-port-set-size?   uint16
|  +--ro description
|  |  +--ro description-enabled      boolean
|  |  +--ro max-description?         uint32
|  +--ro prefix64-option
|     +--ro prefix64-option-enable?   boolean
|     +--ro prefix64* [prefix64-id]
|        +--ro prefix64-id         uint32
|        +--ro prefix64?           inet:ipv6-prefix
|        +--ro suffix?             yang:hex-string
|        +--ro dest-ipv4-prefix* [ipv4-prefix-id]
|           +--ro ipv4-prefix-id      uint32
|           +--ro ipv4-prefix?    inet:ipv4-prefix
+--ro authentication-enabled?               boolean
+--ro port-randomization-enable?            boolean
```

```
+--ro port-preservation-enable?              boolean
+--ro port-parity-preservation-enable?      boolean
+--ro enabled-protocol* [protocol-id]
|  +--ro protocol-id                  uint8
+--ro subscriber-mask-support?              boolean
+--ro subscriber-mask?                      uint8
+--ro port-quota?                           uint16
+--ro exclude-ports* [id]
|  +--ro id                     uint16
|  +--ro (port-type)?
|     +--:(single-port-number)
|     |  +--ro single-port-number?   inet:port-number
|     +--:(port-range)
|        +--ro start-port-number?    inet:port-number
|        +--ro end-port-number?      inet:port-number
+--ro nonce-validation-checks-enable?       boolean
+--ro epoch?                                uint32
+--ro lifetime
|  +--ro minimum-lifetime?   uint32
|  +--ro maximum-lifetime?   uint32
+--ro error-lifetime
|  +--ro minimum-error-lifetime?   uint32
```



```
|  +--ro maximum-error-lifetime?   uint32
+--ro mapping-table
|  +--ro mapping-entry* [index]
|     +--ro index                    uint32
|     +--ro status?                  enumeration
|     +--ro mapping-nonce            string
|     +--ro internal-ip-address      inet:ipv6-prefix
|     +--ro internal-port
|     |  +--ro (port-type)?
|     |     +--:(single-port-number)
|     |     |  +--ro single-port-number?   inet:port-number
|     |     +--:(port-range)
|     |        +--ro start-port-number?    inet:port-number
|     |        +--ro end-port-number?      inet:port-number
|     +--ro external-ip-address      inet:ipv6-prefix
|     +--ro external-port
|     |  +--ro (port-type)?
|     |     +--:(single-port-number)
|     |     |  +--ro single-port-number?   inet:port-number
```

```
|     |     +--:(port-range)
|     |        +--ro start-port-number?    inet:port-number
|     |        +--ro end-port-number?      inet:port-number
|     +--ro protocol       uint8
|     +--ro lifetime                  uint32
|     +--ro third-party-address?     inet:ipv6-prefix
|     +--ro filter* [filter-id]
|     |  +--ro filter-id               uint32
|     |  +--ro remote-ip-prefix        inet:ipv6-prefix
|     |  +--ro remote-port-number      inet:port-number
|     +--ro description?               string
|     +--ro prefer-failure-tagged?     boolean
|     +--ro status-code?               enumeration
+--ro traffic-statistics
   +--ro traffic-statistics
   |  +--ro sent-packet?      yang:zero-based-counter64
   |  +--ro sent-byte?        yang:zero-based-counter64
   |  +--ro rcvd-packet?      yang:zero-based-counter64
   |  +--ro rcvd-byte?        yang:zero-based-counter64
   |  +--ro dropped-packet?   yang:zero-based-counter64
   |  +--ro dropped-byte?     yang:zero-based-counter64
   +--ro opcode-statistics
   |  +--ro sent-map?         yang:zero-based-counter64
   |  +--ro rcvd-map?         yang:zero-based-counter64
   |  +--ro sent-peer?        yang:zero-based-counter64
   |  +--ro rcvd-peer?        yang:zero-based-counter64
   |  +--ro sent-annonce?     yang:zero-based-counter64
   |  +--ro rcvd-announce?    yang:zero-based-counter64
   |  +--ro rcvd-unknown?     yang:zero-based-counter64
```



```
   |  +--ro rcvd-malformed?   yang:zero-based-counter64
   +--ro mapping-table
   |  +--ro current-mt-size?   yang:zero-based-counter64
   |  +--ro max-mt-size?       uint32
   +--ro port-in-use?          percent
```

Figure 4: PCP Server YANG Data Model

3. YANG Modules

3.1. Common PCP Module

```
<CODE BEGINS> file "ietf-pcp@2015-08-05.yang"
module ietf-pcp {
  namespace "urn:ietf:params:xml:ns:yang:ietf-pcp";
  prefix pcp;

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

  organization "xxx Working Group";
  contact
     "Mohamed Boucadair <mohamed.boucadair@orange.com>
      Christian Jacquenet <christian.jacquenet@orange.com>";

  description
     "This module embeds the core PCP characteristics, including
      the description of PCP operations, options and mapping entries.

      Copyright (c) 2017 IETF Trust and the persons identified as
      authors of the code.  All rights reserved.

      Redistribution and use in source and binary forms, with or
      without modification, is permitted pursuant to, and subject
      to the license terms contained in, the Simplified BSD License
      set forth in Section 4.c of the IETF Trust's Legal Provisions
      Relating to IETF Documents
      (http://trustee.ietf.org/license-info).

     This version of this YANG module is part of RFC XXXX; see
     the RFC itself for full legal notices.";


  revision 2015-08-05 {
      description "Changes tbc.";
       reference "tbc";
   }
```



```
     /*
      * Grouping
      */

  //Description option
```

```
   grouping description-option {
      description
              "used to configure DESCRIPTION option [RFC7220].";

       leaf description-enabled {
          type boolean;
          description
              "Enable/disable DESCRIPTION option.";
       }

       leaf max-description {
          type uint32;
          description
            "Indicates the maximum length of the description
              associated with a mapping.";
       }
   }

   //Filter option

   grouping filter-option {
       description
          "FILTER option as defined in [RFC6887].";

       leaf filter-enabled {
          type boolean;
          description
             "Enable/disable FILTER option.";
       }

       leaf max-filters {
          type uint32;
          description
              "Indicates the maximum number of filters
                associated with a mapping.";
      }
   }

   // Port set option

   grouping port-set-option {
       description
```

```
      "PORT_SET option [RFC7753].";

    leaf port-set-enable {
       type boolean;
       description
          "Enable/disable PORT_SET option.";
    }

    leaf default-port-set-size {
       type uint16;
       description
          "Indicates the default size of a port set.";
    }

    leaf maximum-port-set-size {
       type uint16;
       description
          "Indicates the maximum size of a port set.";
    }
}

//Opcodes

grouping opcode {
    description
        "Indicates the set of supported/enabled PCP opcodes.";

    leaf map {
       type boolean;
       description
           "MAP opcode";
    }

    leaf peer {
       type boolean;
        description
          "PEER opcode";
    }

    leaf announce {
       type boolean;
       description
           "ANNOUNCE opcode.";
    }
}

//Options
```

```
   grouping option {
          description
              "A set of PCP options.";

          leaf third-party {
             type boolean;
             description
               "THIRD_PARTY option is used when a PCP client wants
                 to control a mapping to an internal host other
                 than itself [RFC6887].";
          }

          leaf prefer-failure {
             type boolean;
             description
               "This option indicates that if the PCP server is unable
                to map both the suggested external port and suggested
                external address, the PCP server should not create
                a mapping.  This differs from the behavior without this
                option, which is to create a mapping.

                PREFER_FAILURE is never necessary for a PCP client to
                manage mappings for itself, and its use causes
                additional work in the PCP client and in the PCP
                server. See Section 13.2 of [RFC6887].";
          }

          container filter {
             description
               "This option indicates that filtering incoming packets
                is desired.";

                 uses filter-option;
          }

          leaf port-set {
             type boolean;
             description
              "Indicates whether PORT_SET is supported/enabled.";

          }
```

```
          container description {
             description
                "Associates a description with a mapping [RFC7220].";
             uses description-option;
          }
```



```
          leaf prefix64 {
             type boolean;
             description
                "PREFIX64 PCP option [RFC7225].";
          }
   }

   // port numbers: single or port range

    grouping port-number {
          description
                 "individual port or a range of ports.";

            choice port-type {
                default single-port-number;
                description
                 "port type: single or port-range.";

                case single-port-number {
                    leaf single-port-number {
                        type inet:port-number;
                        description
                           "used for single port numbers.";
                    }
                }

            case port-range {
              leaf start-port-number {
                 type inet:port-number;
                 description
                 "Begining of the port range.";
              }

              leaf end-port-number {
                 type inet:port-number;
```

```
                description
                "End of the port range.";
            }
          }
      }
   }

   // Filter

   grouping filter {
        description
          "The remote peer IP address and remote peer port of
           the FILTER option indicate the permitted remote peer's
```



```
           source IP address and source port for packets from
           the Internet; other traffic from other addresses
           is blocked.";

      leaf filter-id {
        type uint32;
        description
          "An identifier of the filter.";
      }

      leaf remote-ip-prefix {
         type inet:ipv6-prefix;
         description
            "The IP address of the remote peer.";

      }

      leaf remote-port-number {
         type inet:port-number;
         description
             "The port number of the remote peer. Value 0
              indicates 'all ports'.";
      }
   }

   // PCP mapping entry

   grouping mapping-entry {
```

```
      description
        "A PCP mapping entry.";

      leaf index {
          type uint32;
          description
               "A unique identifier of a mapping entry.";
      }

      leaf status {
           type enumeration {

           enum "disabled"  {
              description
                 "The mapping entry is not in use (Disabled).";
             }

           enum "requested" {
              description
               "A PCP request has been sent for this mapping.
```



```
                Still waiting for a response from the server.";
           }

           enum "assigned" {
              description
                 "This mapping has been granted by the server.";
           }

           enum "stale" {
              description
                 "This is a stale mapping (case of reboot).";
           }
          }
          description
             "Indicates the status of a mapping entry.";
       }

      leaf mapping-nonce {
          type string;
          description
             "A random value chosen by the PCP client";
```

```
      }

       leaf internal-ip-address {
              type inet:ipv6-prefix;
              description
                "Corresponds to the PCP Client's IP Address
                 defined in [RFC6887].";
        }

       container internal-port {
           description
              "Internal port for the mapping. Value 0 indicates
               'all ports', and is legal when the lifetime is zero
               (a delete request), if the protocol does not use
               16-bit port numbers, or the client is requesting
               'all ports'.  If the protocol is zero
               (meaning 'all protocols'), then internal port
               is set to zero.";

            uses port-number;
       }

      leaf external-ip-address {
          type inet:ipv6-prefix;
          description
            "External IP address. Can be 'Suggested' or 'Assigned'.
```



```
             It can be set by a client to stale-ip-address, if available
             or to (::) (for requesting external IPv6 addresses)
             or (::ffff:0:0) (for requesting external IPv4 addresses).";
      }

      container external-port {
          description
            "External port number. Can be 'Suggested' or 'Assigned'.";

             uses port-number;
      }

      leaf protocol {
          type uint8;
```

```
        description
          "Upper-layer protocol associated with this Opcode.
           Values are taken from the IANA protocol registry.
           For example, this field contains 6 (TCP) if the Opcode
           is intended to create a TCP mapping.  This field contains
           17 (UDP) if the Opcode is intended to create a UDP mapping.
           The value 0 has a special meaning for 'all protocols'.";
      }

      leaf lifetime {
          type uint32;
          description
             "Lifetime of the mapping.
               Can be requested/assigned/remaining";
      }

      leaf third-party-address {
          type inet:ipv6-prefix;
          description
              "used to indicate the internal IP address
                when THIRD_PARTY is in use.";
      }

      list filter {
        key filter-id;

        description
          "a list of filters associated with the mapping.";
        uses filter;
      }

      leaf description {
          type string;
          description
```



```
            "a description string associated with the mapping.";
      }

      leaf prefer-failure-tagged {
          type boolean;
          description
             "a tag which indicates whether PREFER_FAILURE
```

```
                is (to be) used.";
        }
    }

    // PCP result code

    grouping status-code {

        description
          "stores the result status code";

        leaf status-code {
             type enumeration {
                 enum "SUCCESS" {
                     description
                      "Success";
                 }

                 enum "unsupported-version" {
                    description
                       "The version number at the start of the PCP Request
                        header is not recognized by this PCP server.
                        This is a long lifetime error.";
                 }

                 enum "not-authorized" {
                     description
                       "The requested operation is disabled for this PCP
                        client, or the PCP client requested an operation
                        that cannot be fulfilled by the PCP server's
                        security policy.

                        This is a long lifetime error.";
                 }

                 enum "malformed-request" {
                      description
                        "The request could not be successfully parsed.

                         This is a long lifetime error.";
                 }
```

```
enum "unsupported-opcode" {
    description
      "Unsupported Opcode.
       This is a long lifetime error.";
}

enum "unsupported-option" {
    description
      "Unsupported option.  This error only occurs if
       the option is in the mandatory-to-process range.

       This is a long lifetime error.";
}

enum "malformed-option" {
    description
        "Malformed option (e.g., appears too many times,
         invalid length).

         This is a long lifetime error.";
}

enum "network-failure" {
    description
        "The PCP server or the device it controls is
         experiencing a network failure of some sort
         (e.g., has not yet obtained an external
         IP address).

         This is a short lifetime error.";
}

enum "no-resources" {
    description
      "Request is well-formed and valid, but the server
       has insufficient resources to complete
       the requested operation at this time.

       For example, the NAT device cannot create more
       mappings at this time, is short of CPU cycles
       or memory, or is unable to handle the request
       due to some other temporary condition.
       The same request may succeed in the future.
       This is a system-wide error, different from
       USER_EX_QUOTA.  This can be used as a
       catch-all error, should no other error
       message be suitable.
```

```
                This is a short lifetime error.";
            }

            enum "unsupported-protocol" {
                 description
                   "Unsupported transport protocol, e.g.,
                    SCTP in a  NAT that handles only UDP and TCP.

                    This is a long lifetime error.";
            }

            enum "ex-quota" {
                description
                   "This attempt to create a new mapping would
                    exceed this subscriber's port quota.

                    This is a short lifetime error.";
            }

            enum "cannot-provide-external" {
                 description
                    "The suggested external port and/or
                     external address cannot be provided.
                     This error must only be returned for:
                      *  MAP requests that included the
                         PREFER_FAILURE option
                      *  MAP requests for the SCTP protocol
                        (PREFER_FAILURE is implied)
                      *  PEER requests.";
            }

            enum "address-mismatch" {
                description
                  "The source IP address of the request
                   packet does not match the contents of the
                   PCP Client's IP Address field, due to an
                   unexpected NAT on the path between the PCP
                   client and the PCP-controlled NAT or firewall.

                   This is a long lifetime error.";
            }

            enum "extensive-remote-peer" {
```

```
                    description
                       "The PCP server was not able to create the
                        filters in this request.  This result code must
                        only be returned if the MAP request contained
                        the FILTER option.
```



```
                        This is a long lifetime error.";
                }
            }
            description
                "result status code.";
        }
    }

    // PCP servers list

    grouping pcp-server-address {

        description
              "A list of PCP servers. Each PCP server can be identified
               by one or multiple IP addresses.";

        leaf pcp-server-id {
          type uint32;
          description
               "A unique identifier.";
        }

        list pcp-server-ip-address {

            key address-id;

            description
                "a list of IP addresses of a PCP server";

            leaf address-id {
                  type uint32;
                  description
                    "An identifier";
            }

            leaf ip-address {
```

```
            type inet:ipv6-address;
            description
              "An IP address of a PCP server.";
         }
       }

       leaf external-address-familly {
           type inet:ip-version;
               description
                   "The address family of the external address(es)
                    managed by the PCP server.
                    Can be IPv4, IPv6 or both.";
```



```
      }

       leaf stale-external-ip-address {
          type inet:ipv6-prefix;
              description
                 "A stale address that can be used by the PCP client
                  to be assigned the same address upon reboot
                  or other failure events.";
      }
   }

   // status of the communication with configured PCP servers

   grouping pcp-server-address-status {

     description
           "Groups the status of the communication between
            a PCP client a server.";

     uses pcp-server-address;

     leaf source {
           type enumeration {
               enum "manual-configuration"{
               description
                 "The server has been manually configured.";
               }

               enum "dhcpv6"{
```

```
            description
              "Retrieved from DHCPv6 [RFC7291].";
            }

            enum "dhcpv4"{
            description
               "Retrieved from DHCPv4 [RFC7291].";
            }

            enum "else"{
            description
              "Else (e.g., TR-96.)";
            }
         }
       description
         "source of the PCP server reachability information.";
       }

     leaf in-use {
```



```
        type boolean;
        description
          "Indicates whether this in-use instance of the server
           is the result of the selection
           process defined in [RFC7488].";
     }

     leaf server-epoch {
        type uint32;
        description
           "The PCP server's Epoch.";
     }

     leaf client-epoch {
        type uint32;
        description
           "The PCP client's Epoch.";
     }

     leaf current-version {
        type uint8;
        description
```

```
            "The version that is selected as per the version negotiation
             procedure specified in Section 9 of [RFC6877].";
        }
    }

    // type of the PCP-controlled function.

    grouping pcp-controlled-function {
        description
           "A set of PCP-controlled functions.
            One or multiple functions can be controlled
            by the same PCP server. ";

        leaf nat44 {
           type boolean;
           description
              "NAT44";
        }

        leaf nat64 {
           type boolean;
           description
              "NAT64";
        }

        leaf ds-lite {
```



```
           type boolean;
           description
              "DS-Lite";
        }

        leaf nptv6 {
           type boolean;
           description
              "NPTv6";
        }

        leaf ipv4-firewall {
           type boolean;
           description
              "IPv4 firewall";
```

```
      }

      leaf ipv6-firewall {
         type boolean;
         description
            "IPv6 firewall";
      }

      leaf port-range-router {
         type boolean;
         description
            "Port Range Router";
      }
   }


   // traffic statistics

   grouping traffic-stat {
      description
           "Groups a set of statistics.";

       container traffic-statistics {
           description
             "Generic traffic statistics.";

           leaf sent-packet {
             type yang:zero-based-counter64;
              description
               "Packets sent";
           }

           leaf sent-byte {
```



```
             type yang:zero-based-counter64;
             description
               "Counter for sent traffic in bytes.";
           }

           leaf rcvd-packet {
             type yang:zero-based-counter64;
             description
```

```
                "Counter for received packets.";
            }

            leaf rcvd-byte {
              type yang:zero-based-counter64;
              description
                "Counter for received traffic in bytes.";
            }

            leaf dropped-packet {
              type yang:zero-based-counter64;
              description
                "Counter for dropped packets.";
            }

            leaf dropped-byte {
              type yang:zero-based-counter64;
              description
                "Counter for dropped traffic in bytes.";
            }
          }

        container opcode-statistics {
            description
                "Opcode-related statistics.";

            leaf sent-map {
                type yang:zero-based-counter64;
                description
                  "Counter for sent MAP messages";
            }

            leaf rcvd-map {
                type yang:zero-based-counter64;
                description
                  "Counter for received MAP messages";
            }

            leaf sent-peer {
                type yang:zero-based-counter64;
```



```
                description
```

```
                "Counter for sent PEER messages";
            }

            leaf rcvd-peer {
                type yang:zero-based-counter64;
                description
                  "Counter for received PEER messages";
            }

            leaf sent-annonce {
                type yang:zero-based-counter64;
                description
                  "Counter for sent ANNOUNCE messages";
            }

            leaf rcvd-announce {
                type yang:zero-based-counter64;
                description
                  "Counter for received ANNOUNCED messages";
            }

            leaf rcvd-unknown {
              type yang:zero-based-counter64;
                description
                  "Counter for received unknown opcodes";
            }

            leaf rcvd-malformed {
              type yang:zero-based-counter64;
                description
                   "Counter for received malformed opcodes";
            }
        }
    }

    // mapping table statistics

    grouping mapping-table-stats {
        description
            "PCP mapping table related statistics.";

        leaf current-mt-size {
          type yang:zero-based-counter64;
          description
              "Size of the mapping table";
        }
```

```
        leaf max-mt-size {
          type uint32;
          description
              "Maximum configured size of the mapping table.";
        }
    }


    // PCP versions

    grouping pcp-version {
        description
         "PCP version(s)";

        leaf version {
          type uint8;
          description
             "Indicates a PCP server.
               Current versions are: 0, 1, and 2.";
        }
    }
    }
    <CODE ENDS>
```

3.2. PCP Client

```
    <CODE BEGINS> file "ietf-pcp-client@2015-08-05.yang"
    module ietf-pcp-client {
      namespace "urn:ietf:params:xml:ns:yang:ietf-pcp-client";
      prefix pcp-client;

      import ietf-inet-types { prefix inet; }
      import ietf-pcp { prefix pcp; }

      organization "N/A Working Group";
      contact
         "Mohamed Boucadair <mohamed.boucadair@orange.com>
          Christian Jacquenet <christian.jacquenet@orange.com>";

      description
           "This module contains a collection of YANG definitions for
            PCP client implementations.

            Copyright (c) 2016 IETF Trust and the persons identified as
            authors of the code.  All rights reserved.
```

```
    revision 2015-08-05 {
        description "Changes tbc.";
         reference "tbc";
     }

   /*
     *PCP Configuration
     */

       container pcp-client-config {
          description
            "PCP client configuration";


           leaf enable {
               type boolean;
               description
                       "Enable/disable the PCP client.";
           }

           leaf description {
             type string;
             description
               "Associated a description with the module.";
           }

           container pcp-client-instances {
              description
                "A set of PCP client instances.";

               list pcp-client-instance {
```

```
                 key "id";

                 description
                     "A PCP client instance.";

                leaf id {
                   type uint32;
                   description
                     "An identifier of the PCP client instance.";
```



```
                }

                leaf name {
                   type string;
                   description
                      "A name of the PCP client instance.";
                }

                list version {
                   key version;
                   description
                    "Indicates the set of supported PCP versions
                      (0, 1, 2)";

                   uses pcp:pcp-version;
                }

                list pcp-servers {
                   key "pcp-server-id";
                   description
                     "List of provisioned PCP servers.";
                   uses pcp:pcp-server-address;
                }

                leaf authentication-enable {
                   type boolean;
                   description
                    "Enable/Disable PCP authentication.";
                }

                 container opcode-configuration {
                     description
```

```
                      "Opcode-related configuration";
                    uses pcp:opcode;
                }

                container option-configuration {
                    description
                      "Options-related configuration.";
                    uses pcp:option;
                }

                container mapping-table {
                    description
                      "Mapping table maintained by a PCP client
                        instance.";

                    list mapping-entry {
```



```
                        key "index";
                        description
                            "PCP Mapping entry.";
                        uses pcp:mapping-entry;
                    }
                }
            }
        }
    }

    /*
     * PCP state
     */

        container pcp-client-state {

            config false;

            description
                "PCP client state";

            container pcp-client-instances {
                description
                       "PCP client instances";
```

```
   list pcp-client-instance {

     key "id";

     description
          "PCP client instance";

     leaf id {
       type int32;
       description
          "PCP client instance identifier.";
     }

     leaf name {
       type string;
       description
          "A name associated with the PCP client instance.";
     }

list pcp-client-ip-address {

key address-id;
```



```
  description
    "list of configured PCP client addresses.";

leaf address-id {
     type uint32;
     description
         "Address identifier";
  }

leaf ip-address {
     type inet:ipv6-address;
     description
      "IP address";
  }
}

      list supported-version {
         key version;
```

```
                    description
                    "list of supported PCP versions";
                    uses pcp:pcp-version;
                  }

                  leaf preferred-version {
                    type uint8;
                    description
                      "The preferred version configured
                        by an administrator.";
                  }

                  list pcp-server-address {
                    key "pcp-server-id";
                    description
                      "list of provisioned PCP server.";

                    uses pcp:pcp-server-address-status;
                  }

                 leaf authentication-support {
                   type boolean;
                   description
                     "Indicates whether PCP authentication is
                       supported.";
                 }

                 container opcode-capability {
                   description
                     "Opcode-related capabilities.";
```



```
                   uses pcp:opcode;
                 }

                 container option-capability {
                   description
                     "Option-related capabilities";
                   uses pcp:option;
                 }

                 container opcode-configuration {
                   description
```

```
            "Opcode-related configuration.";
          uses pcp:opcode;
        }

        container option-configuration {
          description
            "Option-related configuration.";

          uses pcp:option;
        }

        leaf authentication-enabled {
          type boolean;
          description
            "Enable/disable PCP authentication";
        }

      container mapping-table {
        description
          "Mapping table";

          list mapping-entry {
              key "index";
              description
                  "Mapping entry";

              uses pcp:mapping-entry;
              uses pcp:status-code;
          }
      }

       container traffic-statistics {
          description
              "traffic statistics.";

          uses pcp:traffic-stat;
```



```
          container mapping-table {
              description
                  "mapping table related statistics.";
```

```
                        uses pcp:mapping-table-stats;
                    }
                    }
                }
            }
        }
    }
```

<CODE ENDS>

3.3. UPnP IGD/PCP Interworking Function

```
<CODE BEGINS> file "ietf-pcp-iwf@2015-08-05.yang"
module ietf-pcp-iwf {
  namespace "urn:ietf:params:xml:ns:yang:ietf-pcp-iwf";
  prefix pcp-iwf;

  import ietf-inet-types { prefix inet; }
  import ietf-pcp { prefix pcp; }


  organization "xxxx Working Group";
  contact
     "Mohamed Boucadair <mohamed.boucadair@orange.com>
      Christian Jacquenet <christian.jacquenet@orange.com>";

  description
       "This module contains a collection of YANG definitions for
        UPnP IGD/PCP Interworking implementations.

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        authors of the code.  All rights reserved.

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        set forth in Section 4.c of the IETF Trust's Legal Provisions
        Relating to IETF Documents
        (http://trustee.ietf.org/license-info).

        This version of this YANG module is part of RFC XXXX; see
        the RFC itself for full legal notices.";

  revision 2015-08-05 {
```

```
         description "Changes xxxx.";
          reference "xxxx";
       }


   // IGD versions

   grouping igd-version {
       description
         "UPnp IGD Version";

      leaf igd-version {

         type enumeration {

            enum "igd:1" {
                description
                  "UPnP IGD:1";
            }

            enum "igd:2" {
                description
                 "UPnP IGD:2";
            }

            enum "both" {
                description
                 "UPnP IGD:1 and UPnP IGD:2";
            }
         }
      description
       "UPnP IGD Version";
    }
   }

   /*
     *PCP Configuration
     */

       container pcp-iwf-config {
          description
            "UPnP IGD/PCP Interworking Function";

          leaf enable {
               type boolean;
               description
                 "Enable/Disable the UPnP IGD-PCP IWF";
```

```
          }
```



```
         container pcp-igd-iwf-instances {
              description
                "UPnP IGD/PCP Interworking Function instances";

               list pcp-igd-iwf-instance {
                   key "id";

                   description
                    "UPnP IGD/PCP Interworking Function instance";

                  leaf id {
                     type uint32;
                     description
                        "An identifier of the IWF instance.";
                  }

                  leaf name {
                     type string;
                     description
                       "A name of the UPnP IGD-PCP IWF instance";
                  }

                  list version {
                     key version;
                     description
                       "configures one or several PCP versions.";

                     uses pcp:pcp-version;
                  }

                  list pcp-servers {
                     key "pcp-server-id";
                     description
                       "List of configured PCP servers.";
                     uses pcp:pcp-server-address;
                  }

                  leaf authentication-enable {
                     type boolean;
                     description
```

```
                    "Enable/disable PCP authentication";
                }

                container igd-version {
                   description
                    "Configure UPnP IGD version(s).";

                   uses igd-version;
```



```
                }

                container mapping-table {
                     description
                         "Mapping table as maintained by a
                           UPnP IGD-PCP IWF instance";

                     list mapping-entry {
                       key "index";
                       description
                         "PCP Mapping Entry.";

                     leaf igd-control-point-address {
                         type inet:ip-address;
                         description
                           "IP address of the UPnP Control Point.";
                     }

                     leaf igd-control-point-port {
                         type inet:port-number;
                         description
                          "Port number";
                     }
                     uses pcp:mapping-entry;
                     }
                 }
             }
          }
       }

   /*
    * PCP state
    */
```

```
        container pcp-iwf-state {

            config false;

            description
               "UPnP IGD/PCP Interworking Function";

            container pcp-igd-iwf-instances {
                description
                   "UPnP IGD/PCP Interworking Function instances";

                list pcp-igd-iwf-instance {

                    key "id";
```



```
                    description
                        "UPnP IGD/PCP Interworking Function instance";

                    leaf id {
                        type int32;
                        description
                            "the identifier of the instance";
                    }

                    leaf name {
                        type string;
                        description
                         "the name of the instance";
                    }

                   list supported-version {
                      key version;
                      description
                       "list of supported PCP versions.";

                      uses pcp:pcp-version;
                   }

                   leaf preferred-version {
                      type uint8;
                      description
```

```
                "Preferred version";
              }

        list pcp-igd-iwf-ip-address {

        key address-id;

          description
            "local IP addresses of the UPnP IGD-PCP IWF";

        leaf address-id {
             type uint32;
             description
               "An identifier of the address";
          }

        leaf ip-address {
             type inet:ipv6-address;
             description
               "An address of the UPnP IGD-PCP IWF";
          }
        }
```



```
              leaf authentication-support {
                  type boolean;
                  description
                   "Indicates whether PCP authentication is
                     supported.";
              }

              leaf authentication-enabled{
                  type boolean;
                  description
                    "Indicates whether PCP authentication
                      is enabled.";
              }

              container igd-version-capability {
                 description
                  "List of supported UPnP IGD versions.";

                 uses igd-version;
```

```
                }

                container enabled-igd-version {
                   description
                     "Configured UPnP IGD versions";

                   uses igd-version;
                }

               list pcp-server-address {
                  key "pcp-server-id";
                  description
                   "List of provisioned PCP servers";

                  uses pcp:pcp-server-address-status;
               }

          container mapping-table {
               description
                   "PCP Mapping table";

               list mapping-entry {
                   key "index";
                   description
                       "PCP mapping entry.";

                   uses pcp:mapping-entry;
                   uses pcp:status-code;
```



```
                   leaf igd-control-point-address {
                       type inet:ip-address;
                       description
                        "The IP address of a UPnP Control Point";
                       }

                   leaf igd-control-point-port {
                       type inet:port-number;
                       description
                        "The port number of a UPnP Control Point";
                       }
               }
```

```
            }

            container traffic-statistics {

                 description
                     "traffic statistics";

                 uses pcp:traffic-stat;

                 container mapping-table {
                     description
                         "Mapping table related statistics";

                     uses pcp:mapping-table-stats;
                 }
            }
          }
        }
      }
    }
    <CODE ENDS>
```

3.4. PCP Proxy

```
    <CODE BEGINS> file "ietf-pcp-proxy@2015-08-05.yang"
    module ietf-pcp-proxy {
      namespace "urn:ietf:params:xml:ns:yang:ietf-pcp-proxy";
      prefix pcp-proxy;

      import ietf-inet-types { prefix inet; }
      import ietf-pcp { prefix pcp; }

      organization "xxxx Working Group";
      contact
         "Mohamed Boucadair <mohamed.boucadair@orange.com>
          Christian Jacquenet <christian.jacquenet@orange.com>";
```



```
      description
           "This module contains a collection of YANG definitions for
            PCP proxy implementations.

            Copyright (c) 2016 IETF Trust and the persons identified as
```

```
          authors of the code.  All rights reserved.

          Redistribution and use in source and binary forms, with or
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          to the license terms contained in, the Simplified BSD License
          set forth in Section 4.c of the IETF Trust's Legal Provisions
          Relating to IETF Documents
          (http://trustee.ietf.org/license-info).

          This version of this YANG module is part of RFC XXXX; see
          the RFC itself for full legal notices.";

    revision 2015-08-05 {
        description "Changes xxxx.";
         reference "xxxx";
     }

  /*
    *PCP Configuration
    */

      container pcp-proxy-config {
         description
           "PCP proxy";

         leaf enable {
              type boolean;
              description
                 "Enable/Disable PCP proxy";
         }

      leaf description {
        type string;
        description
          "Associated a description with the module.";
      }

        container pcp-proxy-instances {
            description
              "PCP proxy instances";

             list pcp-proxy-instance {
                 key "id";
```

```
   description
     "PCP proxy instance";

leaf id {
   type uint32;
   description
    "An identifier of the PCP proxy instance";
}

leaf name {
   type string;
   description
    "A name of the PCP proxy instance";
}

list version {
   key version;
   description
    "Supported PCP versions.";
   uses pcp:pcp-version;
}

list pcp-servers {
   key "pcp-server-id";
   description
    "List of provisioned PCP servers.";
   uses pcp:pcp-server-address;
}

leaf authentication-enable {
   type boolean;
   description
    "Enable/disable PCP authentication.";
}

 container opcode-configuration {
     description
    "Opcode-related configuration";
     uses pcp:opcode;

     leaf relay-unknown-opcode {
        type boolean;
        description
            "The proxy can be instructed to relay
              or to reject unknown opcodes.";
     }
     }
 }
```

```
                container option-configuration {
                    description
                      "Option-related configuration";
                    uses pcp:option;

                    leaf relay-mandatory-unknown-option {
                       type boolean;
                       description
                          "The proxy can be instructed to relay or
                            to reject mandatory unknown options.";
                    }

                    leaf relay-optionnal-unknown-option {
                       type boolean;
                       description
                          "The proxy can be instructed to relay or
                            to reject optional unknown options.";
                    }
                }


               leaf terminate-proxy-recursion {
                  type boolean;
                  description
                          "The proxy can be instructed to terminate
                            proxy recursion.";
               }

               container mapping-table {
                  description
                    "PCP mapping table maintained by the PCP proxy";

                    list mapping-entry {
                      key "index";
                      description
                        "PCP mapping entry";

                      uses pcp:mapping-entry;

                      leaf local-assigned-ip-address {
                            type inet:ipv6-prefix;
                            description
```

```
                                    "If the local PCP-controlled function
                                      alters the source IP address, this
                                      information must be stored.";
                                }

                                container local-assigned-port {
```



```
                                    description
                                        "If the local PCP-controlled function
                                          alters the source port, this
                                          information must be stored.";

                                    uses pcp:port-number;
                                }

                            }
                        }
                    }
                }

    /*
     * PCP state
     */

     container pcp-proxy-state {

        config false;

            description
              "PCP proxy";

            container pcp-proxy-instances {
                description
                    "PCP proxy Instances";

                list pcp-proxy-instance {

                    key "id";
                    description
                      "PCP proxy Instance";

                    leaf id {
```

```
                    type int32;
                    description
                        "Identifier";
                }

                leaf name {
                    type string;
                    description
                     "Name of the PCP proxy Instance";
                }

               list supported-version {
                  key version;
```



```
                  description
                   "List of supported versions";

                  uses pcp:pcp-version;
               }

               leaf preferred-version {
                  type uint8;
                  description
                   "Configured preferred version";
               }

         list pcp-proxy-ip-address {

               key address-id;

               description
                  "List of configured addresses to the
                    PCP proxy instance.";

               leaf address-id {
                  type uint32;
                  description
                    "An identifier";
               }

               leaf pcp-proxy-ip-address {
                  type inet:ipv6-address;
```

```
            description
             "An address";
          }
      }


      list pcp-server-address {
         key "pcp-server-id";
         description
          "list of provisioned PCP servers.";

         uses pcp:pcp-server-address-status;
      }

      leaf authentication-support {
         type boolean;
         description
           "Indicates whether PCP authentication is
            enabled/disabled.";
      }
```



```
      container pcp-controlled-function-capability {
         description
            "list of controlled local functions.";

         uses pcp:pcp-controlled-function;
      }

      container opcode-capability {
          description
           "Opcode-related capabilities.";

          uses pcp:opcode;

          leaf relay-unknown-opcode {
              type boolean;
              description
               "instruction related to the processing of unknown
                 opcodes.";
          }
      }
```

```
            container option-capability {
                      description
                       "Option-related capabilities.";

                       uses pcp:option;

                       leaf relay-mandatory-unknown-option {
                          type boolean;
                          description
                             "instruction related to the processing
                               of mandatory unknown options.";
                       }

                       leaf relay-optionnal-unknown-option {
                          type boolean;
                          description
                              "instruction related to the processing
                                of optional unknown options.";
                       }
            }

                    container opcode-configuration {
                       description
                          "opcode-related configurations.";
                       uses pcp:opcode;
                    }
```



```
                    container option-configuration {
                        description
                          "opcode-related configurations.";

                        uses pcp:option;

                        leaf relay-mandatory-unknown-option {
                            type boolean;
                           description
                                 "instruction related to the processing
                                   of mandatory unknown options.";
                        }

                        leaf relay-optionnal-unknown-option {
```

```
                type boolean;
                description
                     "instruction related to the processing
                       of optional unknown options.";
            }
         }

         leaf authentication-enabled {
             type boolean;
             description
              "status of the PCP authentication activation";
         }

        leaf terminate-proxy-recursion-status {
             type boolean;
             description
              "Indicates whether recursion is
                terminated or not";
        }

        container mapping-table {
             description
                 "mapping table";
             list mapping-entry {
                 key "index";
                 description
                     "mapping entry";
                 uses pcp:mapping-entry;

                leaf local-assigned-ip-address {
                       type inet:ipv6-prefix;
                       description
                        "An address assigned locally by
                         the proxy";
```



```
                }

                container local-assigned-port {
                       description
                        "a port assigned locally by the proxy";

                       uses pcp:port-number;
```

```
                    }

                    uses pcp:status-code;
                  }
                }

              container traffic-statistics {

                  description
                      "traffic statistics";

                  container client-facing-interface {
                      description
                          "traffic statistics in the client-facing
                            interface";

                      uses pcp:traffic-stat;
                  }

                  container server-facing-interface {
                      description
                          "traffic statistics in the server-facing
                            interface";
                      uses pcp:traffic-stat;
                  }

                  container mapping-table {
                      description
                          "mapping table statistics";
                      uses pcp:mapping-table-stats;
                  }
                }
            }
        }
    }
}
<CODE ENDS>
```

3.5. PCP Server

```
<CODE BEGINS> file "ietf-pcp-server@2017-05-16.yang"
module ietf-pcp-server {
    namespace "urn:ietf:params:xml:ns:yang:ietf-pcp-server";
    prefix pcp-server;

    import ietf-inet-types { prefix inet; }
    import ietf-yang-types { prefix yang; }
    import ietf-pcp { prefix pcp; }

    organization "xxxx Working Group";
    contact
     "Mohamed Boucadair <mohamed.boucadair@orange.com>
      Christian Jacquenet <christian.jacquenet@orange.com>";

   description
      "This module contains a collection of YANG definitions for
        PCP server implementations.

        Copyright (c) 2017 IETF Trust and the persons identified as
        authors of the code.  All rights reserved.

        Redistribution and use in source and binary forms, with or
        without modification, is permitted pursuant to, and subject
        to the license terms contained in, the Simplified BSD License
        set forth in Section 4.c of the IETF Trust's Legal Provisions
        Relating to IETF Documents
        (http://trustee.ietf.org/license-info).

        This version of this YANG module is part of RFC XXXX; see
        the RFC itself for full legal notices.";

    revision 2017-05-16 {
      description "fix port selection schemes.";
       reference "-04";
    }

    revision 2015-08-05 {
      description "Changes xxxx.";
       reference "xxxx";
    }

// Typedef

    typedef percent {
        type uint8 {
            range "0 .. 100";
```

```
            }
            description
             "Percentage";
        }

    /*
     * Grouping
     */

    // Port set option

    grouping port-set-option {
        description
                     "PORT_SET option.";

        leaf port-set-enable {
           type boolean;
           description
              "Enable/disable PORT_SET option.";
        }

        leaf default-port-set-size {
           type uint16;
           description
              "Indicates the default size of a port set.";
        }

        leaf maximum-port-set-size {
           type uint16;
           description
              "Indicates the maximum size of a port set.";
        }
    }

    // Prefix64 port set

    grouping prefix64-option {
        description
               "PREFIX64 option as defined in [RFC7225].";

        leaf prefix64-option-enable {
            type boolean;
            description
```

```
            "Indicates whether the option is enabled/disabled.";
        }

        list prefix64 {
            key "prefix64-id";
```



```
            description
                    "maintains a list of Prefix64s.";

            leaf prefix64-id {
                  type uint32;
                  description
                     "An identifier of a Prefix64.";
            }

            leaf prefix64 {
                 type inet:ipv6-prefix;
                 description
                     "A Prefix64";
            }

            leaf suffix {
                 type yang:hex-string;
                 description
                   "The suffix is used for constructing an
                     IPv4-converted IPv6 address from an IPv4 address as
                     specified in Section 2.2 of [RFC6052]. No suffix is
                     included if a /96 Prefix64 is used.";
            }

            list dest-ipv4-prefix {
                 key "ipv4-prefix-id";
                 description
                    "used to solve the destination-dependent
                      Pref64::/n discovery problem discussed in
                      Section 5.1 of [RFC7050].";

                 leaf ipv4-prefix-id {
                      type uint32;
                     description
                       "An identifier of a destination IPv4 prefix";
                 }
```

```
                leaf ipv4-prefix {
                     type inet:ipv4-prefix;
                     description
                    "an IPv4 prefix.";
                }
            }
        }
    }

    //option list: server side
```



```
    grouping option-server {
       description
         "Used for option-related operations
           at the server's side.";

       leaf third-party {
           type boolean;
           description
             "enable/disable THIRD_PARTY option.";
       }

       leaf prefer-failure {
           type boolean;
           description
              "enable/disable PREFER_FAILURE option.";
       }

       container filter {
           description
            "enable/disable FILTER option.";

           uses pcp:filter-option;
       }

       container port-set-option {
           description
             "enable/disable PORT_SET option.";

           uses pcp:port-set-option;
```

```
    }

    container description {
        description
          "enable/disable DESCRIPTION option.";
        uses pcp:description-option;
    }

    container prefix64-option {
        description
          "enable/disable PREFIX64 option.";
        uses prefix64-option;
    }
  }

  /*
    * PCP server Configuration
    */
```



```
  container pcp-server-config {
      description
       "PCP server";

      leaf enable {
          type boolean;
          description
           "Enable/Disable PCP server function.";
      }

      container pcp-server-instances {
         description
           "PCP server instances";

          list pcp-server-instance {
              key "id";
                description
                  "a PCP server instance.";

             leaf id {
                type uint32;
                description
```

```
        "PCP server instance identifier.";
    }

    leaf name {
       type string;
       description
         "A name associated with the PCP server instance";
    }

    list version {
       key version;
       description
         "Indicates the PCP version(s) supported by the
           PCP server.
           Current supported versions are 0, 1, and 2.";

       uses pcp:pcp-version;
    }

     list pcp-server-ip-address {

         key address-id;

         description
          "set one or multiple IP addresses for
           the PCP server";
```



```
         leaf address-id {
           type uint32;
           description
              "The identifier of the address";
         }

         leaf ip-address {
           type inet:ipv6-address;
           description
             "IP (v4/v6) address of the PCP server";
        }
      }

     leaf authentication-enable {
       type boolean;
```

```
                description
                 "Enable/disable PCP authentication";
              }

              container opcode-configuration {
                  description
                    "Opcode-related configuration";

                  uses pcp:opcode;
              }

              container option-configuration {
                  description
                   "Option-related configuration";

                  uses option-server;
              }


    container port-selelection-scheme {
          description
                 "How ports are selected.";

          choice port-selelection {
              default port-randomization;
              description
               "port selection: random, preserved, parity preserved.";

              case port-randomization {
                  leaf port-randomization-enable {
                    type boolean;
                    description
                      "Enable/disable port randomization
```



```
                       feature.";
                   }
              }

              case port-preservation {
                 leaf port-preservation-enable {
                  type boolean;
                  description
```

```
                "Indicates whether the PCP server should
                 preserve the internal port number.";
              }
            }

            case port-parity-preservation {
               leaf port-parity-preservation-enable {
                  type boolean;
                  description
                    "Indicates whether the PCP server should
                     preserve the port parity of the
                  internal port number.";
               }
             }
           }
         }

          leaf nonce-validation-checks-enable {
             type boolean;
             description
               "Indicates whether the PCP server has to
                 disable/enable Nonce validation checks.";
          }

          leaf subscriber-mask {
             type uint8 {
                range "0 .. 128";
             }
          description
           "The subscriber-mask is an integer that indicates
            the length of significant bits to be applied on
            the source IPv6 address (internal side) to
            identify unambiguously a CPE.

            Subscriber-mask is a system-wide configuration
            parameter that is used to enforce generic per-subscriber
            policies (e.g., port-quota).

            Applying these generic policies does not require
            configuring every subscriber's prefix.
```



```
            Example: suppose the 2001:db8:100:100::/56 prefix is
```

```
      assigned to a DS-Lite enabled CPE. Suppose also that the
      2001:db8:100:100::1 is the IPv6 address used by the
      client that resides in that CPE. When the server
      receives a packet from this client,
      the server applies the subscriber-mask (e.g., 56) on
      the source IPv6 address to compute the associated prefix
      for this client (that is 2001:db8:100:100::/56).  Then,
      the server enforces policies based on that prefix
      (2001:db8:100:100::/56), not on the exact
      source IPv6 address.";
    }

    leaf port-quota {
       type uint16;
       description
         "configure a port quota to be assigned per
           PCP client/subscriber.";
    }

    list exclude-ports {
         key "id";
         description
            "The set of ports not to be assigned
              by the server.";

         leaf id {
             type uint16;
             description
               "An identifier";
         }

         uses pcp:port-number;
    }

    list protocol {
         key "protocol-id";
         description
           "set of protocols supported by
             the PCP-controlled function.";

         leaf protocol-id {
         type uint8;
         description
          "identifier of the protocol";
         }
    }
```

```
            leaf epoch-set {
               type uint32;
               description
                 "Set the Epoch parameter.";
            }

            container lifetime {
               description
                "Configure values for the lifetime to be
                 assigned to requesting PCP clients.

                The client requests a certain lifetime, and the server
                responds with the assigned lifetime.

                The server may grant a lifetime smaller or larger than
                the requested lifetime.

                The minimum value should be 120 seconds.

                The maximum value should be the remaining
                lifetime of the IP address assigned to
                the PCP client if that information is available,
                or half the lifetime of IP address
                assignments, or 24 hours.

                Excessively long lifetimes can cause consumption
                of ports even if the internal host is no longer
                interested in receiving the traffic or is no
                longer connected to the network.
                (Section 15 [RFC6877].";

                 leaf minimum-lifetime {
                     type uint32;
                     default 120;
                     description
                       "Minimum lifetime.";
                 }

                 leaf maximum-lifetime {
                     type uint32;
                     default 86400;
                     description
                      "Maximum lifetime.";
                 }
            }
```

```
            container error-lifetime {
               description
```



```
                "Configure values for the error lifetime to be
                 returned to requesting PCP clients.";

                 leaf minimum-error-lifetime {
                     type uint32;
                     default 30;
                     description
                       "Minimum error lifetime, in seconds.

                        [RFC6877] recommends that short lifetime
                        errors use a 30-second lifetime.";
                 }

                 leaf maximum-error-lifetime {
                     type uint32;
                     default 1800;
                     description
                      "Maximum error lifetime, in seconds.

                       [RFC6877] recommends that long lifetime
                       errors use a 30-minute lifetime.";
                 }
            }

            container mapping-table {
               description
                 "PCP mapping table as maintained by
                   the PCP server";

                 list mapping-entry {
                   key "index";
                   description
                     "PCP mapping entry";
                   uses pcp:mapping-entry;
                 }
             }
         }
     }
  }
```

```
   /*
    * PCP server State
    */

   container pcp-server-state {

       config false;
```



```
       description
          "PCP server";

       container pcp-server-instances {
           description
               "PCP server instances";

           list pcp-server-instance {
               key "id";

               description
                "PCP server instance";

               leaf id {
                   type int32;
                    description
                     "The identifier of the PCP server instance.";
               }

               leaf name {
                   type string;
                   description
                    "The name of the PCP server instance";
               }

              list supported-version {
                 key version;
                 description
                    "List of supported PCP versions.";

                 uses pcp:pcp-version;
              }
```

```
          leaf preferred-version {
             type uint8;
             description
               "List of preferred version.
                 Mainly used for unsolicited messages.";
          }

        list configured-pcp-server-ip-address {

        key address-id;

          description
            "List of PCP server IP addresses";

        leaf address-id {
```



```
             type uint32;
             description
                "The identifier of the address";
          }

        leaf ip-address {
             type inet:ipv6-address;
             description
               "IP address of the PCP server";
          }
        }

        list external-ip-address-pool {

        key address-id;

          description
            "Pool of external IP addresses used to service
             requesting clients.";

        leaf address-id {
             type uint32;
             description
              "An identifier";
          }
```

```
        leaf external-ip-pool {
             type inet:ipv6-prefix;
             description
               "An address or prefix";
          }
        }

         leaf authentication-support {
           type boolean;
           description
            "Status of the support of PCP authentication";
         }

         container opcode-capability {
           description
            "Opcode-related capabilities";
           uses pcp:opcode;
         }

         container option-capability {
           description
            "Option-related capabilities";
```



```
           uses pcp:option;
         }

            choice port-selelection {
                default port-randomization;
                description
                 "port selection: random, preserved, parity preserved.";

                case port-randomization {
                    leaf port-randomization-enable {
                      type boolean;
                      description
                        "Enable/disable port randomization
                         feature.";
                     }
                }

                case port-preservation {
```

```
                leaf port-preservation-enable {
                 type boolean;
                 description
                   "Indicates whether the PCP server should
                    preserve the internal port number.";
                 }
               }

               case port-parity-preservation {
                  leaf port-parity-preservation-enable {
                     type boolean;
                     description
                       "Indicates whether the PCP server should
                        preserve the port parity of the
                     internal port number.";
                  }
                }
              }
             }

          list protocol-capabilities {
            key "protocol-id";
            description
              "A set of supported transported protocols";

            leaf protocol-id {
               type uint8;
               description
                 "transport protocol";
            }
```



```
          }

          container pcp-controlled-function-capability {
            description
              "list of controlled functions.";

            uses pcp:pcp-controlled-function;
          }

          container opcode-configuration {
            description
```

```
          "Opcode-related configuration";

        uses pcp:opcode;
      }

      container option-configuration {
        description
         "Option-related configuration";

        uses option-server;
      }

      leaf authentication-enabled{
        type boolean;
        description
           "Indicates whether PCP authentication
            is enabled/disabled";
      }

       choice port-selelection {
           default port-randomization;
           description
            "port selection: random, preserved, parity preserved.";

           case port-randomization {
               leaf port-randomization-enable {
                 type boolean;
                 description
                   "Enable/disable port randomization
                    feature.";
                }
           }

           case port-preservation {
              leaf port-preservation-enable {
               type boolean;
               description
```



```
                 "Indicates whether the PCP server should
                  preserve the internal port number.";
               }
           }
```

```
          case port-parity-preservation {
             leaf port-parity-preservation-enable {
                type boolean;
                description
                  "Indicates whether the PCP server should
                   preserve the port parity of the
                  internal port number.";
             }
           }
         }
       }

     list enabled-protocol {
       key "protocol-id";
       description
          "Indicates the set of enabled transport protocols.";

       leaf protocol-id {
          type uint8;
          description
           "A transport protocol";
       }
     }

     leaf subscriber-mask-support{
         type boolean;
         description
           "Indicates if the subscriber-mask feature is supported";
      }

     leaf subscriber-mask {
         type uint8 {
             range "0 .. 128";
         }
         description
            "Indicates the configured subscriber-mask";
     }

     leaf port-quota {
        type uint16;
        description
         "Indicates the configured port quota.";
     }
```

```
          list exclude-ports {
            key "id";
            description
              "Indicates ports that are excluded from
               dynamic assignment.";

            leaf id {
               type uint16;
               description
                "identifier";
            }

           uses pcp:port-number;
          }

          leaf nonce-validation-checks-enable {
             type boolean;
             description
              "Indicates whether NONCE validation checks are
                enabled/disabled";
          }

          leaf epoch {
             type uint32;
             description
               "value of the current server's epoch.";
          }

          container lifetime {
             description
                "lifetime-related configuration";

            leaf minimum-lifetime {
               type uint32;
               description
                  "configured minimum lifetime";
            }

            leaf maximum-lifetime {
               type uint32;
               description
                 "configured maximum-lifetime";
            }
          }

              container error-lifetime {
                 description
```

```
                "Vvalues for the error lifetime to be
```



```
                returned to requesting PCP clients.";

                leaf minimum-error-lifetime {
                    type uint32;
                    description
                      "Configured minimum error lifetime,
                       in seconds.";
                }

                leaf maximum-error-lifetime {
                    type uint32;
                    description
                     "Configured maximum error lifetime,
                      in seconds.";
                }
            }
        container mapping-table {
            description
                "Mapping table";
            list mapping-entry {
                key "index";
                description
                    "mapping entry";
                uses pcp:mapping-entry;
                uses pcp:status-code;
            }
        }

        container traffic-statistics {

            description
             "traffic statistics";

            uses pcp:traffic-stat;

            container mapping-table {
                description
                    "mapping table statistics";

                uses pcp:mapping-table-stats;
```

```
                }

                leaf port-in-use {
                     type percent;
                     description
                      "ratio of the port usage.";
                }
           }
```



```
      }
   }
   }
   }
   <CODE ENDS>
```

4. 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 support of SSH is mandatory to implement secure transport [RFC6242]. The NETCONF access control model [RFC6536] provides means to restrict access for particular NETCONF users to a pre-configured subset of all available NETCONF protocol operations and contents.

There is a number of data nodes defined in the YANG module which can, be created, modified and deleted (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) applied to these data nodes without proper protection can negatively affect network operations. In particular, configuring a fake PCP server may ve used to redirect the traffic from a PCP client to an illegitimate server.

5. IANA Considerations

This document requests IANA to register the following URIs in the "IETF XML Registry" [RFC3688]:

```
URI: urn:ietf:params:xml:ns:yang:ietf-pcp
Registrant Contact: The IESG.
XML: N/A; the requested URI is an XML namespace.

URI: urn:ietf:params:xml:ns:yang:ietf-pcp-client
Registrant Contact: The IESG.
XML: N/A; the requested URI is an XML namespace.

URI: urn:ietf:params:xml:ns:yang:ietf-pcp-iwf
Registrant Contact: The IESG.
XML: N/A; the requested URI is an XML namespace.

URI: urn:ietf:params:xml:ns:yang:ietf-pcp-proxy
Registrant Contact: The IESG.
XML: N/A; the requested URI is an XML namespace.

URI: urn:ietf:params:xml:ns:yang:ietf-pcp-server
Registrant Contact: The IESG.
XML: N/A; the requested URI is an XML namespace.
```

This document requests IANA to register the following YANG modules in the "YANG Module Names" registry [RFC6020].

```
name: ietf-pcp
namespace: urn:ietf:params:xml:ns:yang:ietf-pcp
prefix: pcp
```

```
            reference: RFC XXXX

            name: ietf-pcp-client
            namespace: urn:ietf:params:xml:ns:yang:ietf-pcp-client
            prefix: pcp-client
            reference: RFC XXXX

            name: ietf-pcp-iwf
            namespace: urn:ietf:params:xml:ns:yang:ietf-pcp-iwf
            prefix: pcp-iwf
            reference: RFC XXXX

            name: ietf-pcp-proxy
            namespace: urn:ietf:params:xml:ns:yang:ietf-pcp-proxy
            prefix: pcp-proxy
            reference: RFC XXXX

            name: ietf-pcp-server
            namespace: urn:ietf:params:xml:ns:yang:ietf-pcp-server
            prefix: pcp-server
            reference: RFC XXXX
```


6. References

6.1. Normative references

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <http://www.rfc-editor.org/info/rfc2119>.

[RFC3688] Mealling, M., "The IETF XML Registry", BCP 81, RFC 3688, DOI 10.17487/RFC3688, January 2004, <http://www.rfc-editor.org/info/rfc3688>.

[RFC6020] Bjorklund, M., Ed., "YANG - A Data Modeling Language for the Network Configuration Protocol (NETCONF)", RFC 6020, DOI 10.17487/RFC6020, October 2010, <http://www.rfc-editor.org/info/rfc6020>.

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