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**DHCP and DHCPv6 Options for Port Control Protocol (PCP)
draft-bpw-software-pcp-dhcp-01**

Abstract

This document specifies DHCP (IPv4 and IPv6) Options to convey the IP address or a FQDN of a PCP Server. A dedicated option to prevent overloading PCP Servers is also specified.

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 [RFC 2119](#) [[RFC2119](#)].

Status of this Memo

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1. Introduction

[I-D.wing-software-port-control-protocol] recommends the use of DHCP as one of the mechanisms to discover a PCP Server. To that aim, this document defines DHCP [[RFC2131](#)] and DHCPv6 [[RFC3315](#)] Options which can be used to provision a PCP Server reachability information (IP address, FQDN) to a PCP Client. The use of DHCP or DHCPv6 depends on the PCP deployment scenarios.

For flexibility reasons, this document defines both IP address and FQDN Options. It is up to Service Providers to decide which option is convenient for them according to their engineering policies.

This document does not make any assumption on the IP address to be conveyed in a DHCP/DHCPv6 Option. In particular, this document does not prevent Service Providers to use the IANA-to-be-assigned IP address [[I-D.wing-software-port-control-protocol](#)] to be conveyed in DHCP/DHCPv6 Options.

In some deployment contexts, the PCP Server may be reachable with an IPv4 address but DHCPv6 is used to provision the PCP Client. In such scenarios, this document suggests to include IPv4-mapped IPv6 addresses (see [Section 3.1](#)) as a reachability information of the PCP Server (or use the domain name option). As described in Section 3.1 of [[I-D.wing-behave-dns64-config](#)], dual-stack hosts can issue IPv4 datagrams successfully to that IP address.

2. Consistent NAT and PCP Configuration

The PCP Server discovered through DHCP MUST be able to install mappings on the NAT that will be crossed by packets issued by the host or any terminal belonging to the same realm (e.g., DHCP client is embedded in a CP router). If DHCP is used to provision the reachability information of a PCP Server, Service Providers SHOULD configure appropriately their DHCP servers to meet this requirement. In case this prerequisite is not met, customers would experience service troubles and their service(s) won't be delivered appropriately.

Note that this constraint is implicitly met in scenarios where only one single PCP-controlled device is deployed in the network.

3. DHCPv6 Options

Two DHCPv6 Options defined in the following sub-sections are used to convey the PCP Server reachability information. The first option

(i.e., `OPTION_PCP_SERVER_A`) can be used to include an IPv6 address or an IPv4-mapped IPv6 address. The second option (i.e., `OPTION_PCP_SERVER_D`) conveys a domain name to be used to retrieve the IP address of the PCP Server.

For example, in the context of a DS-Lite architecture [[I-D.ietf-softwire-dual-stack-lite](#)] DHCPv6 can be used to include the IPv4-mapped IPv6 address [[RFC2373](#)] of a PCP Server (a PCP Client can use an IPv4-mapped IPv6 address to send IPv4 PCP messages), and in the case of NAT64 [[I-D.ietf-behave-v6v4-xlate-stateful](#)] to provision the IPv6 address of the PCP Server.

A third option (`OPTION_PCP_SERVICE_T`) is defined to convey a timer used to prevent overload events.

3.1. PCP Server Address DHCPv6 Option

This option specifies an IP address of the PCP Server to be used by the PCP Client to send PCP messages.

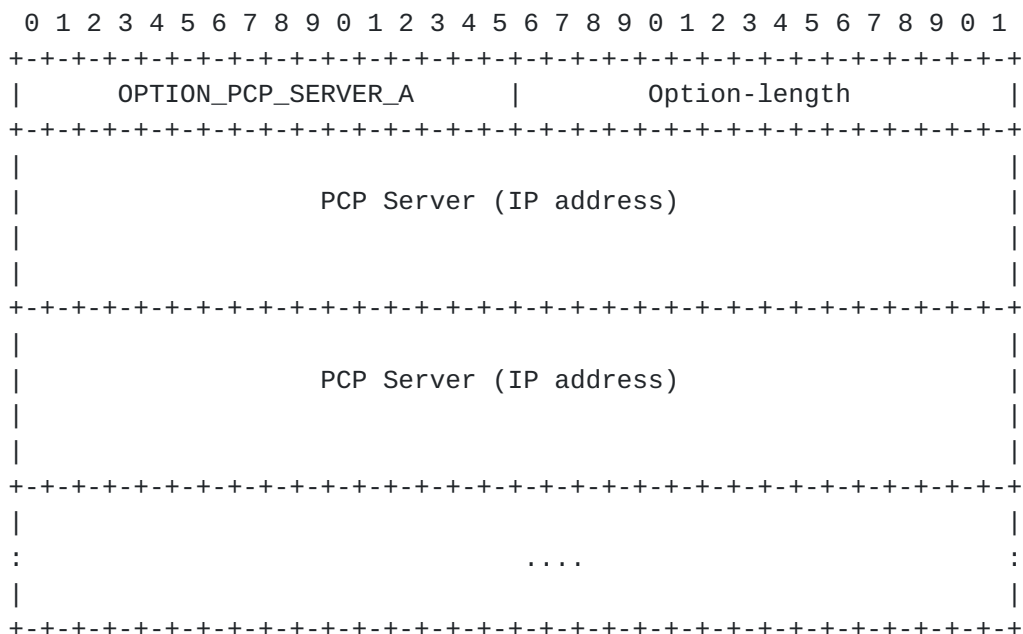


Figure 1: PCP Server IP Address DHCPv6 Option

The description of the fields of the option shown in Figure 1 is described below:

- o Option-code: `OPTION_PCP_SERVER_A` (TBA, see [Section 6](#))

- o Option-length: MUST be a multiple of 16.
- o PCP Server: One or a list of IP address(es) of PCP Server(s) to be used by a PCP Client. In particular, IPv4-mapped IPv6 addresses can be included in this field when the PCP Server is reachable over IPv4 (e.g., in a DS-Lite architecture, the PCP Server can be reachable over IPv4 (i.e., PCP messages will be encapsulated in IPv6). An IPv4-mapped IPv6 address can be used to provision the PCP Client with the reachability information of the PCP Server).

If several IP addresses are included in the option, these addresses MUST be listed in the order of preference. A PCP Client MUST use a reachable address with higher preference order.

In case several addresses are to be conveyed in a DHCPv6 option, it is RECOMMENDED to use OPTION_PCP_SERVER_D DHCPv6 option.

3.2. PCP Server FQDN DHCPv6 Option

This option includes a FQDN of the PCP Server to be used by the PCP Client. In order to exploit this option, this document assumes that a DNS server is configured on the host client by DHCP or other means.

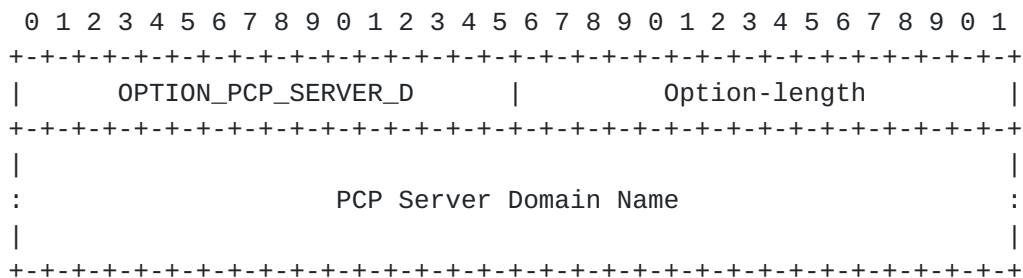


Figure 2: PCP Server FQDN DHCPv6 Option

The fields of the option shown in Figure 2 are:

- o Option-code: OPTION_PCP_SERVER_D (TBA, see [Section 6](#))
- o Option-length: Length of the 'PCP Server Domain Name' field in octets. This length is variable.
- o PCP Server Domain Name: The domain name of the PCP Server to be used by the PCP Client. The domain name is encoded as specified in [\[RFC3315\]](#).

3.3. PCP Service Time Wait DHCPv6 Option

[NOTE: This section will be removed if the avalanche restart concern is handled by a generic initiative such as HomeGate. See for example [\[RFC3435\]](#) how this issue is covered for MGCP.]

In order to avoid overload phenomena (e.g., power outage event in a big city), the following option (Figure 3) is used to ask a PCP Client to wait N seconds before sending its first PCP message. If no overload control mechanism is supported, avalanche restart phenomena would lead to a huge amount of requests to the PCP Server which would impact the serviceability of the PCP-controlled device and would even induce a service outage for a large number of customers serviced by the same CGN device. Distributing all PCP requests in a random or a pre-defined manner will avoid experiencing load bursts.

This option SHOULD be used only with a non-null TimeWait value.

The format of the OPTION_PCP_SERVICE_T option is shown in Figure 3.

```

  0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|      OPTION_PCP_SERVICE_T      |      Option-length      |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|              Method              |      TimeWait            |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+

```

This option can be generalized to all services (e.g., SIP, PCP, NTP, etc.) by including a field which specifies the associated service.

Figure 3: PCP Service TimeWait DHCPv6 Option

The description of the fields of this option is as follows:

- o Option-code: OPTION_PCP_SERVICE_T (TBA, see [Section 6](#))
- o Option-length: 4.
- o Method: This field specifies the method to apply on the TimeWait. Two methods MUST be supported by any OPTION_PCP_SERVICE_T implementation:

0: Basic. When this method is used, the PCP Client MUST wait until the expiry of TimeWait seconds before issuing a PCP message.

- 1: Random. When this method is indicated, a RAND() function MUST be used to generate a value between 0 and TimeWait. The PCP Client MUST wait until the expiry of the generated value before issuing a PCP message to a PCP Server.
- o TimeWait: This field specifies a number of seconds to be used when applying the function indicated in the Method field.

3.4. Requirements

If OPTION_PCP_SERVER_D is used to configure the PCP Server, the client MUST issue a AAAA DNS query to resolve an IPv6 address, if the query has failed the PCP Client MUST issue an A DNS query. [[Note: In order to avoid the delay, a field can be added to the option to inform the client about the type of the DNS query to be issued]].

OPTION_PCP_SERVER_D and OPTION_PCP_SERVER_A DHCPv6 option MUST be supported. OPTION_PCP_SERVICE_T DHCPv6 option MAY (SHOULD?) be supported.

4. DHCP PCP Option

The PCP Server DHCP Option can be used to configure an IPv4 address or a DNS FQDN to be used by the PCP Client to contact a PCP Server. It can also be used to indicate a timer to constraint emitting PCP messages. The generic format of this option is illustrated in Figure 4.

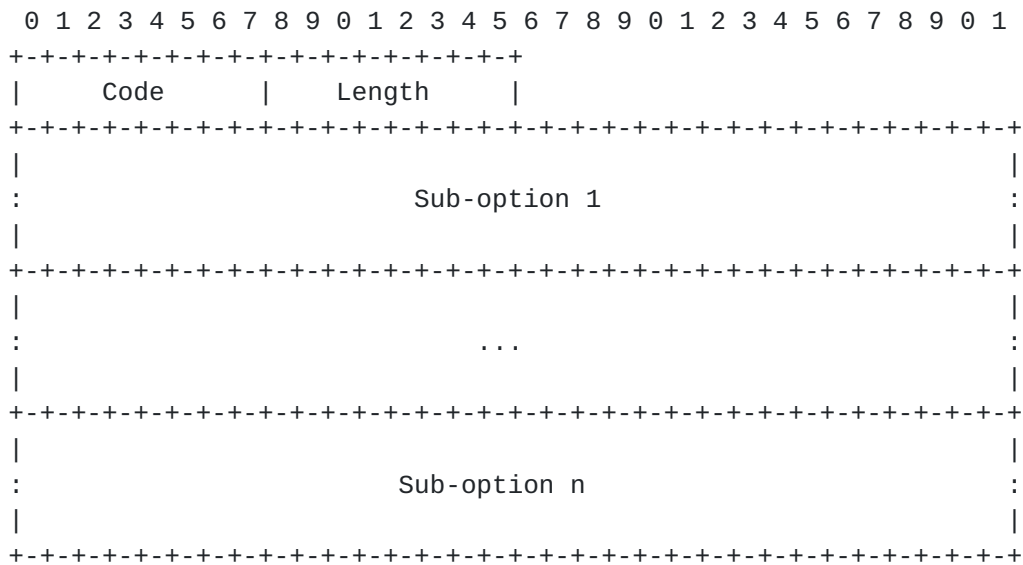


Figure 4: DHCP PCP Option

- o Code: OPTION_PCP_SERVER (TBA, see [Section 6](#));
- o Length: Includes the length of included sub-options;
- o One or several sub-options can be included in a PCP DHCP option. The format of each sub-option follows the structure shown in Figure 5.

Sub-option

```

  Code  Len  Data
+-----+-----+-----+
| code|  n  | Data      |
+-----+-----+-----+

```

Figure 5: PCP Server sub-option

Three sub-options are defined in this document:

- 1: PCP Server Address Sub-option ([Section 4.1](#));
- 2: PCP Domain Name Sub-option ([Section 4.2](#));
- 3: PCP Service Time Wait Sub-option ([Section 4.3](#)).

Both PCP Server Address and PCP Domain Name Sub-options MUST be supported. PCP Service Time Wait Sub-option MAY (SHOULD?) be supported.

PCP Server Address Sub-option and PCP Domain Name Sub-option are exclusive.

PCP Service Time Wait Sub-option MAY be jointly included in the same DHCP message carrying PCP Server Address Sub-option or PCP Domain Name Sub-option.

When a PCP Domain Name Sub-option is used, the PCP client MUST issue A DNS queries to retrieve an IPv4 address.

4.1. PCP Server Address Sub-Option

This sub-option specifies one or a list of IPv4 addresses of the PCP Server to be used by the PCP Client to send PCP messages.

Sub-option									
Code	Len	PCP Server IP Address				PCP Server IP Address			
+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+
1	n	a1	a2	a3	a4	a1	a2
+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+

This format assumes that an IPv4 address is encoded as a1.a2.a3.a4.

Figure 6: PCP Server IPv4 Address DHCP Sub-Option

The fields of the sub-option shown in Figure 6 are:

- o Sub-option Code: 1.
- o Len: Must be a multiple of 4.
- o PCP Server IP Address: contains one or several IPv4 addresses of a PCP Server to be used by a PCP Client. If several addresses are included, they are included in the preference order. A client MUST use the reachable address with the highest preference order. Instead of including several addresses in the DHCP option, it is RECOMMENDED to use PCP Server FQDN Sub-option.

4.2. PCP Server FQDN Sub-Option

This sub-option includes a FQDN of the PCP Server to be used by the PCP Client to send PCP messages. In order to exploit this option, this document assumes that a DNS server is configured on the host client by DHCP or other means.


```

Sub-option
  Code  Len  FQDN of PCP Server
+-----+-----+-----+-----+-----+-----+-----+
|  2  |  n  | s1 | s2 | s3 | s4 | s5 | ...
+-----+-----+-----+-----+-----+-----+-----+

```

Figure 7: PCP Server FQDN DHCP Sub-option

The fields of the sub-option shown in Figure 7 are:

- o Sub-option Code: 2.
- o Len: Length of the "PCP Server Domain Name" field in octets. This length is variable.
- o PCP Server Domain Name: The domain name of the PCP Server to be used by the PCP Client. The encoding of the domain name is described [[RFC2131](#)].

4.3. PCP Service Time Wait DHCP Sub-Option

[NOTE: This section will be removed if the avalanche restart concern is handled by a generic initiative such as HomeGate]

This sub-option is used to indicate to a host, the time to wait before issuing a PCP message. The purpose of this option is to prevent overload phenomena. This sub-option SHOULD be used only with a non-null TimeWait value.

The format of the PCP Service Time Wait DHCP Sub-option is shown in Figure 8.

```

Sub-option
  Code  Len  Method  TimeWait
+-----+-----+-----+-----+
|  3  |  3  |  M  | TimeWait |
+-----+-----+-----+-----+

```

Figure 8: PCP Service TimeWait DHCP Sub-option

The fields of this sub-option are:

- o Sub-option Code: 3.
- o Len: 3.

- o Method: This field specifies the method to apply on the TimeWait. Two methods MUST be supported:
 - 0: Basic. When this method is indicated, the PCP Client MUST wait until the expiry of TimeWait seconds before issuing a PCP message.
 - 1: Random. When this method is indicated, a RAND() function MUST be used to generate a value between 0 and TimeWait. The PCP Client MUST wait until the expiry of the generated value before issuing a PCP message to a PCP Server.
- o TimeWait: This field specifies a number of seconds to be used when applying the function indicated in the Method field.

5. Security Considerations

The security considerations in [\[RFC2131\]](#), [\[RFC3315\]](#) and [\[I-D.wing-software-port-control-protocol\]](#) are to be considered.

6. IANA Considerations

This document request three DHCPv6 Option codes and one DHCP Option code.

DHCPv6 Option codes:

1. OPTION_PCP_SERVER_A
2. OPTION_PCP_SERVER_D
3. OPTION_PCP_SERVICE_T

DHCP Option code:

1. OPTION_PCP_SERVER

7. Acknowledgements

Many thanks to B. Volz and C. Jacquenet for their review and comments.

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8.1. Normative References

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