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PCP Flow Examples
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Abstract

This document provides a set of examples to illustrate PCP operations. It is a companion document to the base PCP specification.

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[1.](#) Introduction

As a companion document to [[I-D.wing-software-port-control-protocol](#)], this document provides examples to help understanding the PCP machinery and exchanged PCP messages in various usage contexts.

For more details about PCP protocol specification, the reader is invited to refer to [[I-D.wing-software-port-control-protocol](#)].

Examples included in this document make use of the IPv4 and IPv6 address blocks defined in [[RFC5737](#)] and [[RFC3849](#)] for documentation purposes.

[1.1.](#) PCP Server Mapping Table

The structure of the PCP Server mapping table when controlling a stateful NAT44 or NAT64 [[I-D.ietf-behave-v6v4-xlate-stateful](#)] is shown below. Some information such as DSCP may not be supported. Internal IP addresses can be IPv4 or IPv6 addresses.

	Entry Index
Client-ID	
Transport Protocol	
Internal IP Address	
Internal Port Number	
External IP Address	
External Port Number	
Internal DSCP	
External DSCP	
Lifetime	

As for the DS-Lite [[I-D.ietf-software-dual-stack-lite](#)], the mapping table would be as follows:

		Entry Index
Client-ID		
Tunnel-ID		
Transport Protocol		
Internal IP Address		
Internal Port Number		
External IP Address		
External Port Number		
Internal DSCP		
External DSCP		
Lifetime		

Tunnel-ID is an IPv6 address (e.g., 2001:DB8:0:0:1::1) of the B4 element.

Decimal and dotted-decimal values are used in the examples listed in the following sections.

2. Create Mapping

The following figure illustrates the messages which are exchanged to create a mapping in a PCP-controlled device.



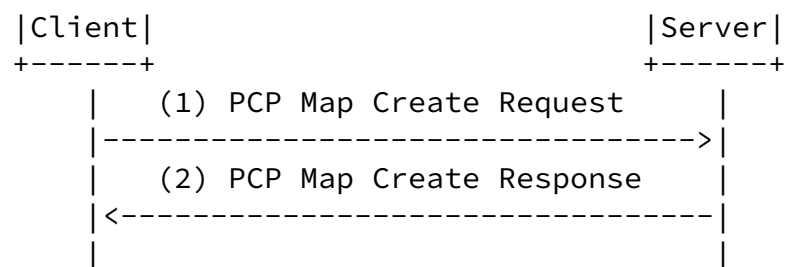


Figure 1: Example of creating a mapping

The following sub-sections provide several examples depending on the included IEs in the PCP Map Create Request.

[2.1.](#) Create a Mapping with Mandatory IEs

This example illustrates the content of exchanged PCP messages when the PCP Client includes only mandatory IEs: Client-ID, Transport protocol (TCP), Internal Port Number and Internal IP Address.

1. PCP Map Create Request

Client-ID IE (ID)

Transport Protocol IE (2)

Internal Port Number IE (11234)

Internal IP Address IE (198.51.100.1)

2. PCP Map Create Response

Client-ID IE (ID)

Transport Protocol IE (2)

Internal Port Number IE (11234)

Internal IP Address IE (198.51.100.1)

External IP Address IE (192.0.2.1)

External Port Number IE (32654)

Assigned Mapping Lifetime IE (3600)

As a result, the following entry is added to the PCP Server mapping table:

Entry 1	
Client-ID	ID
Transport Protocol	TCP
Internal IP Address	198.51.100.1
Internal Port Number	11234
External IP Address	192.0.2.1
External Port Number	32654
Internal DSCP	--
External DSCP	--
Lifetime	3600

[2.2.](#) Create Mapping with a Hinted External Port Number

In this example, the PCP Client includes all mandatory IEs and a preferred external port number.

1. PCP Map Create Request

Client-ID IE (ID)

Transport Protocol IE (2)

Internal Port Number IE (10001)

Internal IP Address IE (198.51.100.1)

Hinted External Port Number IE (15632)

2. PCP Map Create Response

Client-ID IE (ID)

Transport Protocol IE (2)
 Internal Port Number IE (10001)
 Internal IP Address IE (198.51.100.1)
 External IP Address IE (192.0.2.1)
 External Port Number IE (13568)
 Assigned Mapping Lifetime IE (3600)

As a result, the following entry is added to the PCP Server mapping table:

	Entry i	Entry i+1
Client-ID	...	ID
Transport Protocol	..	TCP
Internal IP Address	..	198.51.100.1
Internal Port Number	..	10001
External IP Address	..	192.0.2.1
External Port Number	..	13568
Internal DSCP	..	--
External DSCP	..	--
Lifetime	..	3600

[2.3.](#) Create Mapping with a Hinted External Port Number

In this example the PCP Server assigns the hinted port number to the requesting PCP Client.

1. PCP Map Create Request

Client-ID IE (ID)

Transport Protocol IE (2)

Internal Port Number IE (9568)

Internal IP Address IE (198.51.100.1)

Hinted External Port Number IE (15632)

2. PCP Map Create Response

Client-ID IE (ID)

Transport Protocol IE (2)

Internal Port Number IE (9568)

Internal IP Address IE (198.51.100.1)

External IP Address IE (192.0.2.1)

External Port Number IE (15632)

Assigned Mapping Lifetime IE (3600)

As a result, the following entry is added to the PCP Server mapping table:

	Entry i	Entry i+1
Client-ID	...	ID
Transport Protocol	..	TCP
Internal IP Address	..	198.51.100.1
Internal Port Number	..	9568
External IP Address	..	192.0.2.1
External Port Number	..	15632
Internal DSCP	..	--
External DSCP	..	--

Lifetime	..	3600
----------	----	------

+-----+-----+-----+

[2.4.](#) Create Mapping with a Preferred Lifetime

In this example, the PCP Client includes all mandatory IEs, a preferred external port number and a preferred mapping lifetime. The PCP Server returns a mapping using values it assigns according to its configured policies and port numbers availability.

1. PCP Map Create Request

Client-ID IE (ID)
Transport Protocol IE (2)
Internal Port Number IE (16254)
Internal IP Address IE (198.51.100.1)
Hinted External Port Number IE (25685)
Requested Mapping Lifetime IE (1800)

2. PCP Map Create Response

Client-ID IE (ID)
Transport Protocol IE (2)
Internal Port Number IE (16254)
Internal IP Address IE (198.51.100.1)
External IP Address IE (192.0.2.1)
External Port Number IE (16532)
Assigned Mapping Lifetime IE (1800)

As a result, the following entry is added to the PCP Server mapping table:

	Entry i	Entry i+1
Client-ID	...	ID
Transport Protocol	..	TCP
Internal IP Address	..	198.51.100.1
Internal Port Number	..	16254
External IP Address	..	192.0.2.1
External Port Number	..	16532
Internal DSCP	..	--
External DSCP	..	--
Lifetime	..	1800

[2.5.](#) Create Mapping with all Various Optional IEs

This flow shows an example of the content of PCP messages that will be exchanged to create a mapping in a PCP-controlled device. In this example, the PCP Client indicates a requested external UDP port number and also a DSCP marking policy (Internal DSCP \Leftrightarrow External DSCP).

In reference to Figure 1, the content of exchanged PCP messages is as follows:

1. PCP Map Create Request

Client-ID IE (Client-ID=ID)

Transport Protocol IE (1)

Internal Port Number IE (15968)

Internal IP Address IE (192.168.0.1)

Hinted External Port Number IE (15648)

Internal DSCP IE (45)

External DSCP IE (32)

Requested Mapping Lifetime IE (8965)

2. PCP Map Create Response

Client-ID IE (ID)

Transport Protocol IE (1)

Internal Port Number IE (15968)

Internal IP Address IE (192.168.0.1)

External IP Address IE (192.0.2.1)

External Port Number IE (18759)

Internal DSCP IE (45)

External DSCP IE (32)

Assigned Mapping Lifetime IE (3600)

As a result, the following entry is added to the PCP Server mapping table:

	Entry i	Entry i+1
Client-ID	...	ID
Transport Protocol	..	UDP
Internal IP Address	..	198.51.100.1
Internal Port Number	..	15968
External IP Address	..	192.0.2.1
External Port Number	..	18759
Internal DSCP	..	45
External DSCP	..	32
Lifetime	..	3600

[2.6.](#) Create a Mapping with a Port Reservation Option

The following example depicts a scenario where the PCP Client indicates its UDP port parity preference (using Port Reservation Option IE). The PCP Server, if it supports such option, may assign an external port number according to the requested policy.

1. PCP Map Create Request

Client-ID IE (ID)

Transport Protocol IE (1)

Internal Port Number IE (8759)

Internal IP Address IE (198.51.100.1)

Hinted External Port Number IE (11233)

Port Reservation Option IE (Preserve parity)

Requested Mapping Lifetime IE (3600)

2. PCP Map Create Response

Client-ID IE (ID)

Transport Protocol IE (1)

Internal Port Number IE (8759)

Internal IP Address IE (198.51.100.1)

External IP Address IE (192.0.2.1)

External Port Number IE (13565)

Assigned Mapping Lifetime IE (3600)

As a result, the following entry is added to the PCP Server mapping table:

+-----+-----+-----+			
		Entry i	Entry i+1
+-----+-----+-----+			
Client-ID		...	ID
Transport Protocol		..	UDP

Internal IP Address	..	198.51.100.1
Internal Port Number	..	8759
External IP Address	..	192.0.2.1
External Port Number	..	13565
Internal DSCP	..	--
External DSCP	..	--
Lifetime	..	3600

2.7. Error Encountered when Creating a Mapping (1st Example)

This example shows the exchange that occurs when the PCP Server is unable to meet the PCP Client's request: DSCP re-marking is not supported.

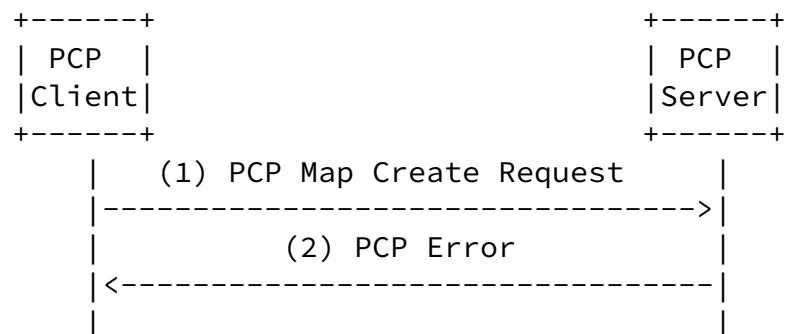


Figure 2: Error when creating a mapping

1. PCP Map Create Request

Client-ID IE (ID)

Transport Protocol IE (2)

Internal Port Number IE

Internal IP Address IE

Hinted External Port Number IE

Internal DSCP IE

External DSCP IE

Requested Mapping Lifetime IE

2. PCP Error

Client-ID IE (ID)

Error Code IE

UTF-8 Encoded Error IE (DSCP re-marking is not supported)

[2.8.](#) Error Encountered when Creating Mapping (2nd Example)

This example shows the exchange that occurs when the PCP Server is unable to meet the PCP Client's request: per-subscriber limit is reached.

1. PCP Map Create Request

Client-ID IE (ID)

Transport Protocol IE (1)

Internal Port Number IE

Internal IP Address IE

Hinted External Port Number IE

Requested Mapping Lifetime IE

2. PCP Error

Client-ID IE (ID)

Error Code IE (code=7, sub-code=1)

[2.9.](#) Error Encountered when Creating Mapping (3rd Example)

This example shows the exchange that occurs when the PCP Server is unable to meet the PCP Client's request: Unsupported transport protocol.

1. PCP Map Create Request

Client-ID IE (ID)
Transport Protocol IE (3)
Internal Port Number IE
Internal IP Address IE
Hinted External Port Number IE
Requested Mapping Lifetime IE

2. PCP Error

Client-ID IE (ID)
Error Code IE (code=6, sub-code=1)
UTF-8 Encoded Error IE (Unsupported transport protocol)

[2.10.](#) Create Mapping with Distinct External IP Addresses

Figure 3 shows a PCP Server with a pool of public IPv4 addresses (192.0.2/24) and two PCP Clients associated with different subscribers. The PCP Clients each make a port mapping request to the PCP Server which creates the mapping from its 192.0.2/24 pool.

```
+-----+  
|  PCP  |  
|Client 1|  
+-----+
```

```
+-----+  
|  PCP  |  
|Server |  
+-----+
```

```
+-----+  
|  PCP  |  
|Client 2|  
+-----+
```

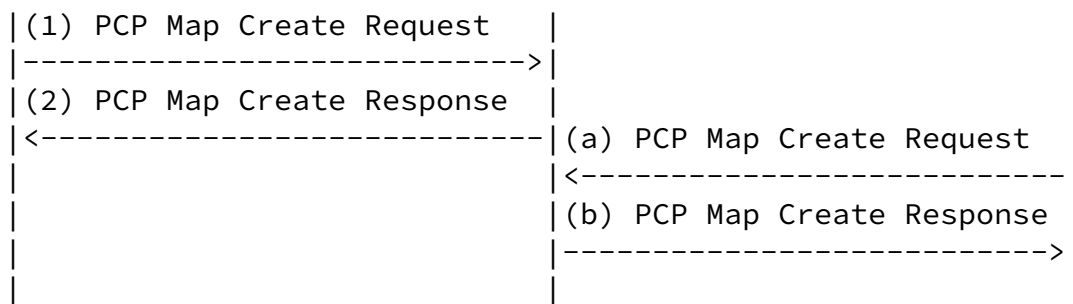


Figure 3: Example of creating mappings with distinct external IP addresses

In this example, the PCP Clients were mapped to different public addresses as illustrated in the content of the PCP messages listed below.

The content of PCP messages exchanged between PCP Client 1 and the PCP Server is as follows:

1. PCP Map Create Request

Client-ID IE (ID)
Transport Protocol IE (1)
Internal Port Number IE (25655)
Internal IP Address IE (198.51.100.1)

2. PCP Map Create Response

Client-ID IE (ID)
Transport Protocol IE (1)

Internal Port Number IE (25655)
Internal IP Address IE (198.51.100.1)

External IP Address IE (192.0.2.1)

External Port Number IE (15659)

Assigned Mapping Lifetime IE (3600)

The content of PCP messages exchanged between PCP Client 2 and the PCP Server is as follows:

1. PCP Map Create Request

Client-ID IE (ID2)

Transport Protocol IE (1)

Internal Port Number IE (19856)

Internal IP Address IE (198.51.100.2)

2. PCP Map Create Response

Client-ID IE (ID2)

Transport Protocol IE (1)

Internal Port Number IE (19856)

Internal IP Address IE (198.51.100.2)

External IP Address IE (192.0.2.2)

External Port Number IE (32654)

Assigned Mapping Lifetime IE (3600)

At the end of this exchange, the following entries are instructed in the PCP Server.

	Entry i	Entry i+1
Client-ID	ID1	ID2
Transport Protocol	UDP	UDP
Internal IP Address	198.51.100.1	198.51.100.2
Internal Port Number	25655	19856
External IP Address	192.0.2.1	192.0.2.2
External Port Number	15659	32654
Lifetime	3600	3600

3. List Mappings

In order to retrieve a list of active mappings, Figure 4 illustrates the PCP messages exchange that occurs. The following sub-sections describes various cases according to the IEs as included by the PCP Client in the PCP Map List Request.

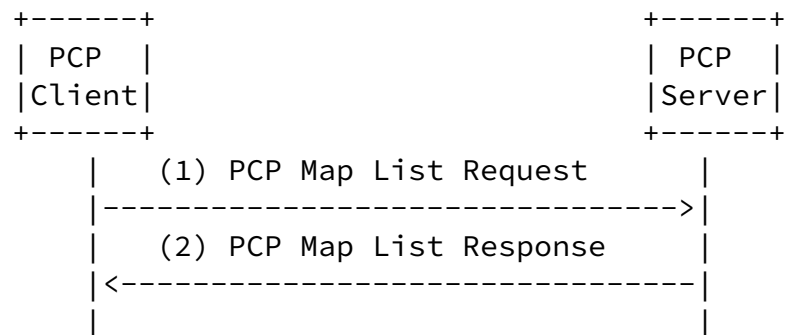


Figure 4: Example of PCP Map List

3.1. List all Mappings Associated with a Client/Subscriber

This example shows the PCP exchange that occurs in order to retrieve all mappings associated with a given PCP Client (or a subscriber). The value of the transport protocol is positioned to 0 (i.e., all transport protocols) to indicate to the PCP Server that all mappings associated with a client/subscriber are to be returned whatever their associated transport protocol.

1. PCP Map List Request

Client-ID IE (ID)

Transport Protocol IE (0)

2. PCP Map List Response

Client-ID IE (ID)

Forwarding IE

Transport Protocol IE (2)

Internal Port Number IE (11234)

Internal IP Address IE (198.51.100.1)

External IP Address IE (192.0.2.1)

External Port Number IE (32654)

Remaining Mapping Lifetime IE (1254)

Forwarding IE

Transport Protocol IE (2)

Internal Port Number IE (10001)

Internal IP Address IE (198.51.100.1)

External IP Address IE (192.0.2.1)

External Port Number IE (13568)

Remaining Mapping Lifetime IE (2500)

Forwarding IE

Transport Protocol IE (2)

Internal Port Number IE (9568)

Internal IP Address IE (198.51.100.1)

External IP Address IE (192.0.2.1)

External Port Number IE (15632)

Remaining Mapping Lifetime IE (2800)

Forwarding IE

Transport Protocol IE (2)

Internal Port Number IE (16254)

Internal IP Address IE (198.51.100.1)

External IP Address IE (192.0.2.1)

External Port Number IE (16532)

Remaining Mapping Lifetime IE (2900)

Forwarding IE

Transport Protocol IE (1)

Internal Port Number IE (15968)

Internal IP Address IE (198.51.100.1)

External IP Address IE (192.0.2.1)

External Port Number IE (18759)

Internal DSCP IE (45)

External DSCP IE (32)

Remaining Mapping Lifetime IE (3000)

Forwarding IE

Transport Protocol IE (1)
Internal Port Number IE (8759)
Internal IP Address IE (198.51.100.1)
External IP Address IE (192.0.2.1)
External Port Number IE (13565)
Remaining Mapping Lifetime IE (3200)

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Forwarding IE

Transport Protocol IE (1)
Internal Port Number IE (25655)
Internal IP Address IE (198.51.100.1)
External IP Address IE (192.0.2.1)
External Port Number IE (32654)
Remaining Mapping Lifetime IE (3300)

[3.2.](#) List all Mappings Associated with an IPv4 Address

This example shows the PCP exchange that occurs in order to retrieve all mappings associated with a given PCP Client (subscriber) and a given internal IP address:

1. PCP Map List Request

Client-ID IE (ID)

Transport Protocol IE (0)

Internal IP Address IE (198.51.100.1)

2. PCP Map List Response

Client-ID IE (ID)

Forwarding IE

Transport Protocol IE (2)

Internal Port Number IE (11234)

Internal IP Address IE (198.51.100.1)

External IP Address IE (192.0.2.1)

External Port Number IE (32654)

Remaining Mapping Lifetime IE (1254)

Forwarding IE

Transport Protocol IE (2)

Internal Port Number IE (10001)

Internal IP Address IE (198.51.100.1)

External IP Address IE (192.0.2.1)

External Port Number IE (13568)

Remaining Mapping Lifetime IE (2500)

Forwarding IE

Transport Protocol IE (2)

Internal Port Number IE (9568)

Internal IP Address IE (198.51.100.1)

External IP Address IE (192.0.2.1)

External Port Number IE (15632)

Remaining Mapping Lifetime IE (2800)

Forwarding IE

Transport Protocol IE (2)

Internal Port Number IE (16254)

Internal IP Address IE (198.51.100.1)

External IP Address IE (192.0.2.1)

External Port Number IE (16532)

Remaining Mapping Lifetime IE (2900)

Forwarding IE

Transport Protocol IE (1)

Internal Port Number IE (15968)

Internal IP Address IE (198.51.100.1)

External IP Address IE (192.0.2.1)

External Port Number IE (18759)

Internal DSCP IE (45)

External DSCP IE (32)

Remaining Mapping Lifetime IE (3000)

Forwarding IE

Transport Protocol IE (1)
Internal Port Number IE (8759)
Internal IP Address IE (198.51.100.1)
External IP Address IE (192.0.2.1)
External Port Number IE (13565)
Remaining Mapping Lifetime IE (3200)

Forwarding IE

Transport Protocol IE (1)
Internal Port Number IE (25655)
Internal IP Address IE (198.51.100.1)
External IP Address IE (192.0.2.1)
External Port Number IE (32654)
Remaining Mapping Lifetime IE (3300)

[3.3.](#) Listing All Mappings Associated with an IPv4 Address and a Given Transport Protocol

This example shows the PCP exchange that occurs in order retrieve all mappings associated with a given internal IP address and a transport protocol (e.g., TCP).

1. PCP Map List Request

Client-ID IE (ID)
Transport Protocol IE (2)

Internal IP Address IE

2. PCP Map List Response

Client-ID IE (ID)

Forwarding IE

Transport Protocol IE (2)

Internal Port Number IE (11234)

Internal IP Address IE (198.51.100.1)

External IP Address IE (192.0.2.1)

External Port Number IE (32654)

Remaining Mapping Lifetime IE (1254)

Forwarding IE

Transport Protocol IE (2)

Internal Port Number IE (10001)

Internal IP Address IE (198.51.100.1)

External IP Address IE (192.0.2.1)

External Port Number IE (13568)

Remaining Mapping Lifetime IE (2500)

Forwarding IE

Transport Protocol IE (2)

Internal Port Number IE (9568)

Internal IP Address IE (198.51.100.1)

External IP Address IE (192.0.2.1)

External Port Number IE (15632)

Remaining Mapping Lifetime IE (2800)

Forwarding IE

Transport Protocol IE (2)

Internal Port Number IE (16254)

Internal IP Address IE (198.51.100.1)

External IP Address IE (192.0.2.1)

External Port Number IE (16532)

Remaining Mapping Lifetime IE (2900)

[3.4.](#) Listing All Mappings Associated with an IPv4 Address, a Transport Protocol and a DSCP Code

This example shows the PCP exchange that occurs when retrieving all mappings associated with a given internal IP address, a transport protocol (e.g., TCP) and an internal DSCP code.

1. PCP Map List Request

Client-ID IE (ID)

Transport Protocol IE (1)

Internal IP Address IE

Internal DSCP IE

2. PCP Map List Response

Client-ID IE (ID)

Transport Protocol IE (1)

Internal Port Number IE (15968)

Internal IP Address IE (198.51.100.1)

External IP Address IE (192.0.2.1)

External Port Number IE (18759)

Internal DSCP IE (45)

External DSCP IE (32)

Remaining Mapping Lifetime IE (3000)

[3.5.](#) No Existing Mapping

This example shows the content of PCP messages when no mapping matching the requested criteria is found.

1. PCP Map List Request

Client-ID IE (ID)

Transport Protocol IE (1)

Internal IP Address IE (198.51.100.1)

Internal DSCP IE (56)

2. PCP Map List Response (ID)

Client-ID IE (ID)

[4.](#) Delete Operation

In order to delete a mapping, Figure 5 illustrates the PCP messages exchange that occurs. The following sub-sections describe various cases according to the IEs included by the PCP Client in the PCP Map Delete Request.

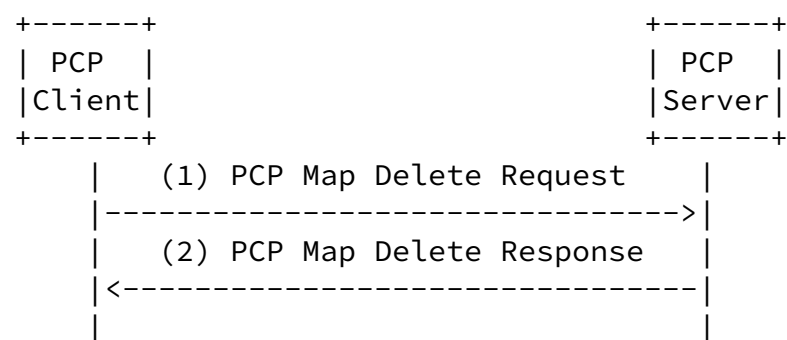


Figure 5: Delete mapping

[4.1.](#) Delete All Mappings

This example shows the PCP exchange that occurs in order to delete all mappings associated with a given PCP Client (subscriber). The value of the transport protocol is positioned to "0" to indicate to the PCP Server that all mappings are to be deleted whatever their associated transport protocol.

1. PCP Map Delete Request

Client-ID IE (ID)

Transport Protocol IE (0)

2. PCP Map Delete Response (ID)

Client-ID IE (ID)

[4.2.](#) Delete all Mappings Associated with a Transport Protocol

This example shows the PCP exchange that occurs in order to delete all mappings associated with a given PCP Client (subscriber) and a

given transport protocol.

1. PCP Map Delete Request

Client-ID IE (ID)

Transport Protocol IE (1)

2. PCP Map Delete Response

Client-ID IE (ID)

[4.3.](#) Delete Mappings Associated with an IP Address

This example shows the PCP exchange that occurs in order to delete all mappings associated with an internal IP address (same PCP Client).

1. PCP Map Delete Request

Client-ID IE (ID)

Transport Protocol IE (0)

Internal IP Address IE (198.51.100.1)

2. PCP Map Delete Response

Client-ID IE (ID)

[4.4.](#) Delete all Mappings Associated with a Given Transport Protocol and IP Address

This example shows the PCP exchange that occurs in order to delete all mappings associated with an internal IP address (same PCP Client) and a given transport protocol.

1. PCP Map Delete Request

Client-ID IE (ID)

Transport Protocol IE (2)

Internal IP Address IE (198.51.100.1)

2. PCP Map Delete Response

Client-ID IE (ID)

[4.5.](#) Delete an Explicit Mapping

This example shows the PCP exchange that occurs when requesting to delete all mappings associated with an internal IP address and a given transport protocol (same PCP Client).

1. PCP Map Delete Request

Client-ID IE (ID)

Transport Protocol IE (1)

Internal Port Number IE (8759)

Internal IP Address IE (198.51.100.1)

2. PCP Map Delete Response

Client-ID IE (ID)

[4.6.](#) Failed Delete Operation

This example shows the PCP exchange that occurs when requesting to delete a mapping which does not exist in the server side.

[[Note to the base PCP doc: Why not returning a PCP Error with an Error Code IE set to "this mapping does not exist". Upon receipt of this message, the PCP Client updates its local states. The current PCP base document states that a response is sent back to the PCP Client asking to delete a mapping which does not exist. The motivation is that a previous delete request has been sent by the PCP

Client but the response from the PCP Server has been lost.]]

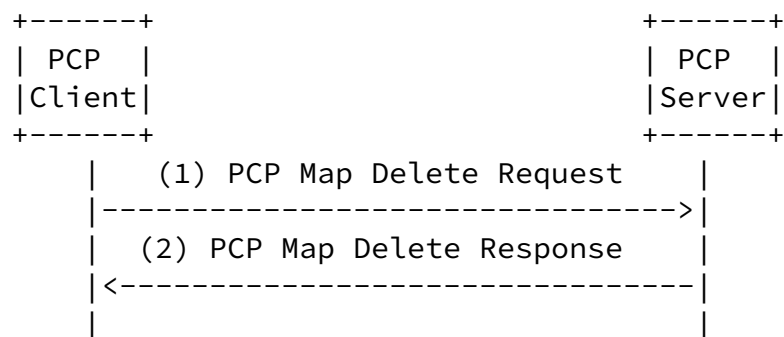


Figure 6: Error when deleting a mapping

1. PCP Map Delete Request

Client-ID IE (ID)

Transport Protocol IE (1)

Internal Port Number IE (8759)

Internal IP Address IE (198.51.100.1)

2. PCP Map Delete Response

Client-ID IE (ID)

5. Modify an Existing Mapping

To update an existing mapping, the exchange illustrated in Figure 7 is observed.



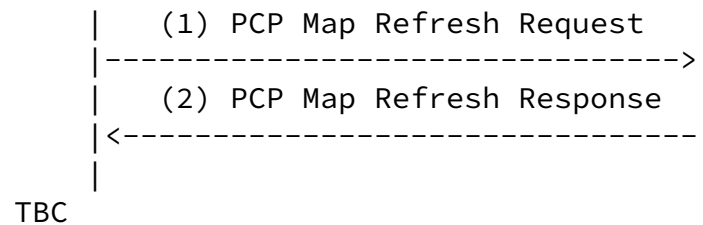


Figure 7: Modify an existing mapping

[5.1.](#) Change of the Client-ID

The content of exchanged PCP messages is as follows:

1. PCP Map Refresh Request

Client-ID IE (ID)

New Client-ID IE (ID1)

2. PCP Map Refresh Response

Client-ID IE (ID1)

[5.2.](#) Change of the Internal IP Address

The content of exchanged PCP messages is as follows:

1. PCP Map Refresh Request

Client-ID IE (ID)

New Internal IP Address (198.51.100.2)

2. PCP Map Refresh Response

Client-ID IE (ID)

[6.](#) Retrieve the External IP Address

6.1. Retrieve the External IP Address

In order to retrieve the IP address used on the external side of the PCP-controlled device (Figure 8), a PCP Client issues a PCP PING message. Once received by the PCP Server, a PCP PONG message is sent by the PCP Server in return. This message conveys only the External IP Address IE. This IE includes the external IP address used by the PCP-controlled device for all outbound communications established by the subscriber.

An External IP Address IE is included in the PCP PONG response only if the PCP PING message included an Internal IP Address IE.

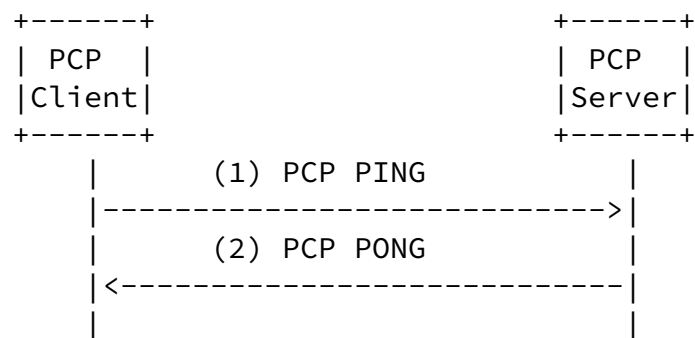


Figure 8: Flow Example of a PING/PONG exchange: Get the external IP address

1. PCP PING

Client-ID IE (ID)

Internal IP Address IE (198.51.100.1)

2. PCP PONG

Client-ID IE (ID)

Internal IP Address IE (198.51.100.1)

External IP Address IE (192.0.2.1)

[6.2.](#) Assess the Reachability of the PCP Server

In this example, the PCP Client issues a PCP PING with no IEs to an IP address of a PCP Server. Once received by the PCP Server, since it is configured to reply to such request, it sends back a PCP PONG including a Capability IE.

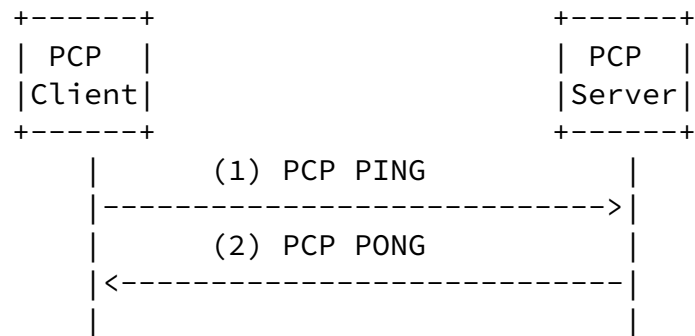


Figure 9: Flow Example of a PING/PONG exchange: Check the availability of the PCP Server

1. PCP PING

2. PCP PONG

Capability IE

[7.](#) Security Considerations

This document does not define any protocol nor architecture. No security issue is introduced in this document.

[8.](#) IANA Considerations

This document has no IANA actions.

[9.](#) Acknowledgements

Many thanks to C. Jacquenet for his review.

[10.](#) Normative References

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