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Dynamic Host Configuration Protocol (DHCP) Options for Port Set  
Assignment  
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Abstract

Due to the exhaustion of global IPv4 address space, there are demands arising for IPv4 address sharing between end users. In such context, different users can employ the same address, but different ports. This document defines two DHCP options for assigning a set of ports to a device. One is used for allocating continuous port set, while the other is designed for non-continuous port set allocation.

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## Table of Contents

<u>1.</u>	Introduction . . . . .	<u>3</u>
<u>2.</u>	Requirements Language . . . . .	<u>4</u>
<u>3.</u>	DHCP Option Format . . . . .	<u>5</u>
<u>3.1.</u>	Continuous Port Set Option . . . . .	<u>5</u>
<u>3.2.</u>	Noncontinuous Port Set Option . . . . .	<u>5</u>
<u>4.</u>	Option Examples . . . . .	<u>8</u>
<u>4.1.</u>	Continuous Port Set Option Example . . . . .	<u>8</u>
<u>4.2.</u>	Noncontinuous Port Set Option Example . . . . .	<u>8</u>
<u>5.</u>	Server Behavior . . . . .	<u>10</u>
<u>6.</u>	Client Behavior . . . . .	<u>11</u>
<u>7.</u>	Security Consideration . . . . .	<u>12</u>
<u>8.</u>	IANA Consideration . . . . .	<u>13</u>
<u>9.</u>	References . . . . .	<u>14</u>
<u>9.1.</u>	Normative References . . . . .	<u>14</u>
<u>9.2.</u>	Informative References . . . . .	<u>14</u>
	Authors' Addresses . . . . .	<u>15</u>

## 1. Introduction

Due to the exhaustion of global IPv4 address space, there are demands arising for IPv4 address sharing between end users, especially in IPv4-over-IPv6 scenarios. With address sharing, different users can employ the same address, but different port space. In such cases, during the address provisioning process, the port numbers a user device can use should be allocated as well.

This document defines two DHCPv4 options to carry the specific parameters for port set assignment. The Continuous Port Set Option is used for allocating continuous port set, while the Noncontinuous Port Set Option is designed for non-continuous port set allocation.

## 2. Requirements Language

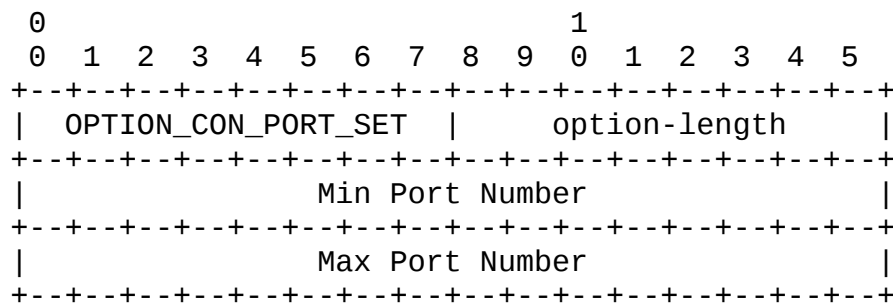
The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [[RFC2119](#)].

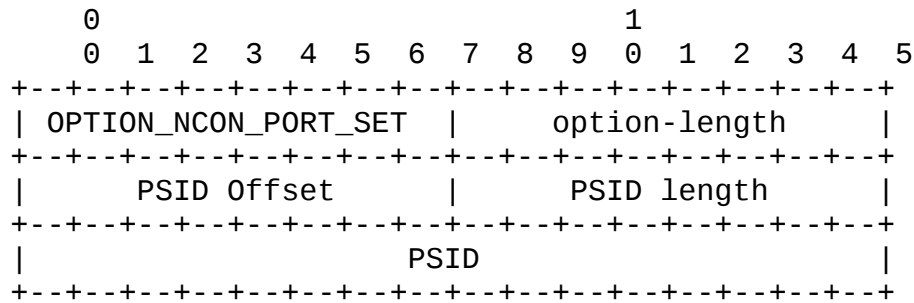
### 3. DHCP Option Format

The format and usage of the two options are defined in the following sections.

#### 3.1. Continuous Port Set Option

This option specifies the min and max port number assigned to a DHCP client, which determines a continuous port range. Figure 1 shows the bit-representation of the option.





### Figure 2 Noncontinuous Port Set Option Format

- o option-code: OPTION\_NCON\_PORT\_SET(TBD2)
- o option-length: An 8-bit field indicating the length of the option excluding the 'Option Code' and the 'Option Length' fields. In this option, the option-length is 4 octets.
- o PSID Offset(a): PSID Offset in MAP (also known as 'a'). The first 'a' bits in the port number are used to exclude the well-known ports, as well as to represent the port range index. If 'a' is larger than 0, ports  $0 \sim 2^{(16-a)}-1$  are reserved from allocation, and a port set has  $2^a-1$  port ranges with different port range index. If 'a' is 0, the whole port range (0~65535) can be assigned by the server, and the port set has only one port range and thus becomes continuous.
- o PSID length(k): The length of PSID in bits(also known as 'k'). After the first 'a' bits, there are k bits in the port number representing value of PSID. Subsequently, the address sharing ratio would be  $2^k$ .
- o PSID: PSID in MAP. The PSID value algorithmically identifies a set of ports assigned to a CE. The first k-bits on the left of this 2-octets field is the PSID value. The remaining (16-k) bits on the right are padding zeros.

In the context of noncontinuous port set, as is defined in [Section 5.1.1](#) of [\[I-D.mdt-softwire-mapping-address-and-port\]](#), the port number consist of Port Range Index ( $A(j)$  in Figure 3, a bits), PSID ( $k$  bits) and Continuous Port Index ( $M(i)$  in Figure 3,  $m$  bits). For the readers' convenience, the format of the port number is included in this draft as well.  $i, j, A(j)$  and  $M(i)$  are the same as the definition in the GMA port mapping algorithm

[\[I-D.mdt-softwire-mapping-address-and-port\]](#)



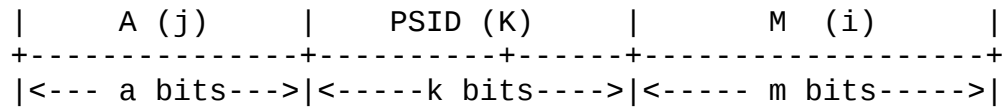


Figure 3 Bit Representation of a GMA port number

If PSID Offset is greater than 0 ( $a > 0$ ),  $j$  MUST be larger than 0, in order to exclude the system ports ([\[I-D.ietf-tsvwg-iana-ports\]](#)) or ports saved by SPs. If  $a = 0$ ,  $j$  may be 0 to allow the provisioning of the reserved ports. With a given sharing ratio ( $2^k$ ) and the PSID value, the ports assigned to a client can be calculated by increasing  $i$  and  $j$  continuously. [Section 4.2](#) explains the algorithm further with an example.

#### 4. Option Examples

##### 4.1. Continuous Port Set Option Example

A Continuous Port Set Option example with the assigned port range 4096~8191 is as follows. There is no specific requirement on the port number format.

```

      0                               1
      0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|  OPTION_CON_PORT_SET  |                               4  |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|                               4096                        |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|                               8191                        |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+

```

Example 1 Continuous Port Set Option Example

##### 4.2. Noncontinuous Port Set Option Example

Here is an example of Noncontinuous Port Set Option, with PSID offset 4, PSID length 10 and PSID value 1021 (i.e. a = 4, k = 10 and PSID = 1021):

```

      0                               1
      0  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|  OPTION_NCON_PORT_SET  |                               4  |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|           4           |           10           |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
| 1  1  1  1  1  1  1  1  0  1  0  0  0  0  0  0 |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+

```

Example 2 Noncontinuous Port Set Option Example (a = 4, k = 10, PSID = 1021)

The first 10 bits of the last two octets(11 1111 1101) are the value of PSID. And the allocated port ranges are:

```

      Port-range-1                      Port-range-2
PSID=1021| 8180, 8181, 8182, 8183, | 12276, 12277, 12278, 12279, | ...

```

All these port ranges form the full port set.



The port set calculation procedure of a client when receiving the parameters of (a,k,PSID) follows the GMA algorithm proposed in section 5.1 of [[I-D.mdt-softwire-mapping-address-and-port](#)]. Two examples in [[I-D.mdt-softwire-mapping-address-and-port](#)] are illustrated here for the readers' convenience.

For sharing ratio 1024, PSID offset a = 4 and PSID length k = 10

	Port-range-1	Port-range-2
PSID=0	4096, 4097, 4098, 4099,	8192, 8193, 8194, 8195,   ...
PSID=1	4100, 4101, 4102, 4103,	8196, 8197, 8198, 8199,   ...
PSID=2	4104, 4105, 4106, 4107,	8200, 8201, 8202, 8203,   ...
PSID=3	4108, 4109, 4110, 4111,	8204, 8205, 8206, 8207,   ...
...		
PSID=1023	8188, 8189, 8190, 8191,	12284, 12285, 12286, 12287,   ...

Example 3: GMA calculation with a = 4, k = 10

For sharing ratio 64, PSID offset a = 0 and PSID length k = 6

	Port-set
PSID=0	[ 0 - 1023]
PSID=1	[1024 - 2047]
PSID=2	[2048 - 3071]
PSID=3	[3072 - 4095]
...	
PSID=63	[64512 - 65535]

Example 4: GMA calculation with a = 0, k = 6

## 5. Server Behavior

The server will not reply with either of the two options until the client has explicitly listed one of them in the Parameter Request List (Option 55).

Server MUST reply with Continuous Port Set Option if the client requested `OPTION_CON_PORT_SET` in its Parameter Request List. Server MUST reply with Noncontinuous Port Set Option if the client requested `OPTION_NCON_PORT_SET` in its Parameter Request List. The server MUST run an address & port-set pool which plays the same role as address pool in regular DHCP server. If the server supports Noncontinuous Port Set Option, address & port-set pool MUST follow the GMA-format port-set.

The port-set assignment SHOULD be coupled with the address assignment process. Therefore server SHOULD assign the address and port set in the same DHCP messages. and the lease information for the address is applicable to the port-set as well.

## 6. Client Behavior

The DHCP client applying for the a port-set MUST include either the OPTION\_CON\_PORT\_SET or OPTION\_NCON\_PORT\_SET code in the Parameter Request List (Option 55). If the client requests the OPTION\_CON\_PORT\_SET, it will retrieve a Continuous Port Set Option and use the ports ranging from Min port number to Max port number. If the client requests OPTION\_NCON\_PORT\_SET and retrieves a Noncontinuous Port Set Option, its port set follows the specific port number format defined in [section 5.1.1](#) of MAP draft [\[I-D.mdt-software-mapping-address-and-port\]](#). The client derives the PSID offset (a bits), PSID length (k bits) and the PSID from the option, and performs GMA to get the precise port set. The client renews or releases the DHCP lease with the port set.

## [7.](#) Security Consideration

This specification raises no particular security issues to the DHCPv4 protocol model.

## 8. IANA Consideration

IANA is kindly requested to allocate DHCP option codes to the `OPTION_CON_PORT_SET` and `OPTION_NCON_PORT_SET`. Both codes should be added to the DHCP option code space.

## 9. References

### 9.1. Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.
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### 9.2. Informative References

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Cotton, M., Eggert, L., Touch, J., Westerlund, M., and S. Cheshire, "Internet Assigned Numbers Authority (IANA) Procedures for the Management of the Service Name and Transport Protocol Port Number Registry", [draft-ietf-tsvwg-iana-ports-10](#) (work in progress), February 2011.
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Bao, C., Troan, O., Matsushima, S., Murakami, T., and X. Li, "Mapping of Address and Port (MAP)", [draft-mdt-softwire-mapping-address-and-port-03](#) (work in progress), January 2012.

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