Softwire WG
Internet-Draft
Intended status: Standards Track
Expires: May 3, 2012

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October 31, 2011

DHCPv6 Options for Mapping of Address and Port
draft-mdt-softwire-map-dhcp-option-01

Abstract

Generic mechanism for mapping between an IPv4 prefix, address or parts of thereof, and transport layer between ports and an IPv6 prefix or address is specified in [I-D.mdt-softwire-mapping-address-and-port]. This is a companion document that specifies provisioning mechanism of MAP rules. It defines DHCPv6 options which are meant to be used between Customer Edge (CE) devices and DHCPv6 server to obtain necessary parameters to configure MAP rules. Since specification of MAP architecture is still expected to evolve, DHCPv6 options may have to evolve too to fit the revised MAP specification.

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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This Internet-Draft will expire on May 3, 2012.

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1. Introduction

Mapping of Address and Port (MAP) defined in [I-D.mdt-softwire-mapping-address-and-port] is a mechanism for providing IPv4 connectivity service to end users over a service provider's IPv6 network. It defines both MAP Border Relay (BR) router that is located at the edge of a MAP domain and MAP Customer Edge (CE) that typically deployed at customers' location. In a residential broadband deployment, CE is sometimes referred to as a Residential Gateway (RG) or Customer Premises Equipment (CPE). A MAP CE may also be referred to simply as a "CE" within the context of MAP.

A typical MAP CE adopting MAP rules will serve a residential site with one WAN side interface, one or more LAN side interfaces. To operate properly, it requires one or more MAP rules and additional informations. In larger networks it is infeasible to configure such parameters manually. Therefore provisioning mechanism is required. Such mechanism is defined in this document. It leverages existing DHCPv6 [RFC3315] protocol to deliver necessary parameters to CE.

This document defines several DHCPv6 options that allow delivery of required information to configure CE. Configuration of the BR is outside of scope of this document. Definitions of used parameters are provided in [I-D.mdt-softwire-mapping-address-and-port].

Since specification of MAP architecture is still expected to evolve, DHCPv6 options may have to evolve too to fit the revised MAP specification.

Described proposal is not a dynamic port allocation mechanism.

2. Conventions

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].

3. Provisioning mechanism

A typical MAP CE usually acts as a DHCPv6 client and requests options that are being provided by a DHCPv6 server located somewhere in ISP network. It would adopt three kinds of parameters independently:

- MAP mapping rules are defined in Section 4 of [I-D.mdt-softwire-mapping-address-and-port]. There are several mapping rule types defined. Depending on rule type, number of exact parameters may be different. Rule parameters may contain Rule IPv6 prefix (including prefix length), Rule IPv4 prefix (including prefix length), EA-bits length (in bits) and additional values that define Rule Port Parameters. One MAP CE can receive one or more MAP mapping rules from the DHCPv6 server. One of those rules must be the default MAP mapping rule for the initiated CE of its own, followed by other mapping rules within the MAP domain if necessary. (Discussion: We chose to remove the text that states that first rule is the default one. DHCPv6 spec explicitly states that option order is arbitrary and must not affect the way options are processed. There's also practical aspect - some implementations keep options in hash tables, so enforcing any specific order is not feasible. Therefore we need to add rule type field.
- Transport mode indicates encapsulation or translation mode for MAP approach. It should be conducted on interface-by-interface basis.
- Discussion: Qiong Sun also proposed to add deployment mode here. Jacni Qin recommends against it. Deployment mode is to notify whether CE is in Hub and spoke mode or mesh. In Hub and spoke mode, only the first default MAP mapping rule is needed in the following MAP procedure. While in mesh mode, all MAP mapping rules are included to achieve CE-CE traffic optimization. Tomek: I believe that hub and spoke or mesh affects number of rules, so server will provision one (hub and spoke) or many (mesh) rules. CE does not need to explicitly be information about this. It can derive this information in a simple manner: if (number of rules>1)

then mode=mesh else mode=hub_and_spoke.

4. DHCPv6 Options Format

DHCPv6 protocol is used for CE provisioning. Several new options are defined for conveying MAP-specific parameters. Their format and usage is defined in the following sections.

Discussion: As the exact parameters required to configure MAP rules and MAP in general are expected to change, this section is expected to be updated or even rewritten completely.

Discussion: Proposed layout assumes that several simple options are used. Such approach simplifies implementation as it is much easier for implementors to reuse existing code handling such options. This design choice comes at a cost, however. Clients must perform checks if provided set of options is complete. Alternatively, it would be possible to define one complex option that contains all mandatory

parameters.

Discussion: It should be noted that initial concept of 4rd provisioning was presented in DHC working group meeting. It used one complex option to convey all required parameters. Strong suggestion from DHC WG was to use several simpler options. Options (possibly nested) are preferred over conditional option formatting. See DHCP option guidelines document [I-D.ietf-dhc-option-guidelines]).

4.1. MAP Options Cardinality

MAP rule is defined in [I-D.mdt-softwire-mapping-address-and-port], Section 4.

Discussion: If you want additional parameter added to the OPTION_MAP_RULE option, please update [I-D.mdt-softwire-mapping-address-and-port] first.

In each REPLY message, server that supports MAP configuration MUST include exactly one OPTION_MAP_FLAGS option.

MAP_FLAGS option MUST include one or more OPTION_MAP_RULE options.

For proper operation, additional parameters obtained via other options are necessary. In particular, L parameter is equal to a length of a prefix delegated to CE, conveyed in OPTION_IA_PD and IAPREFIX, as defined in [RFC3633]. As there is already defined mechanism to provision this value, it is not mentioned in MAP options. Nevertheless, it is required for proper MAP rule configuration.

4.2. MAP Flags Option

. This option specifies MAP flags. Currently the only defined flag is T - transport mode. Other flags that affect all mapping rules or the whole MAP domain may be specified here at a later date.

Each MAP_FLAGS option MUST contain one or more MAP Rule Options.

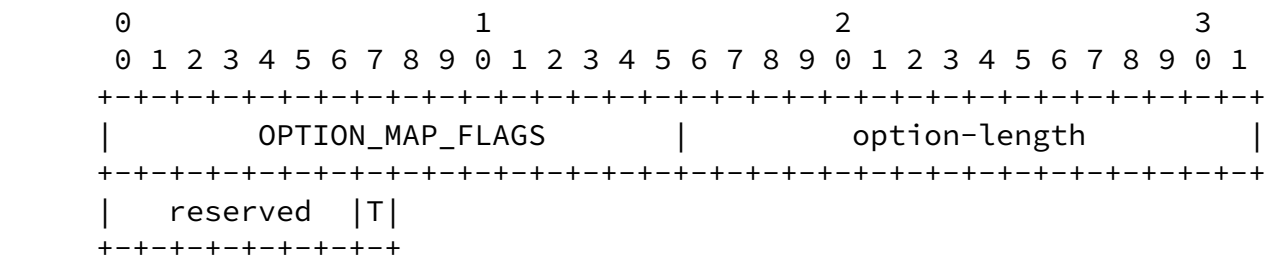


Figure 1: MAP Flags Option

- option-code: OPTION_MAP_FLAGS (TBD1)
- option-length: 1
- reserved: This 7-bits long reserved field is not used and MUST be set to 0 by server. Its value MUST be ignored by clients.
- T: 1 bit field that specifies transport mode: translation (0) or

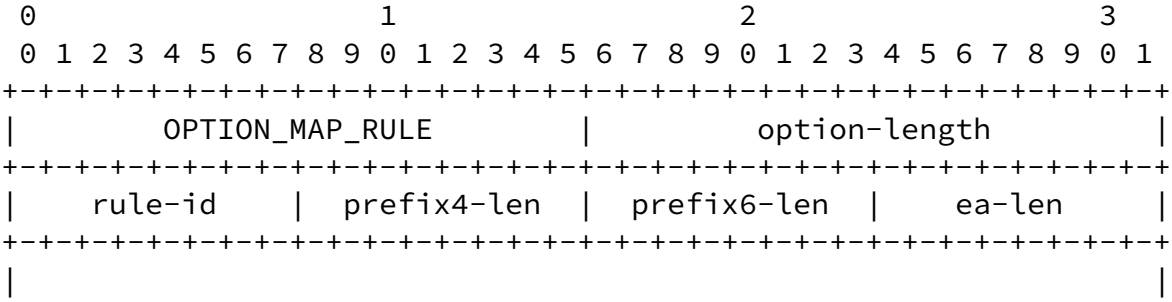
encapsulation (1).

4.3. MAP Rule Option

This option represents a single MAP Rule. Depending on deployment mode, each CE may require one or more MAP Rules to operate properly.

Server includes one or more MAP Rule Options in MAP Flags option.

Server MAY send more than one MAP Rule Option, if it is configured to do so. Clients MUST NOT send MAP Rule Option.



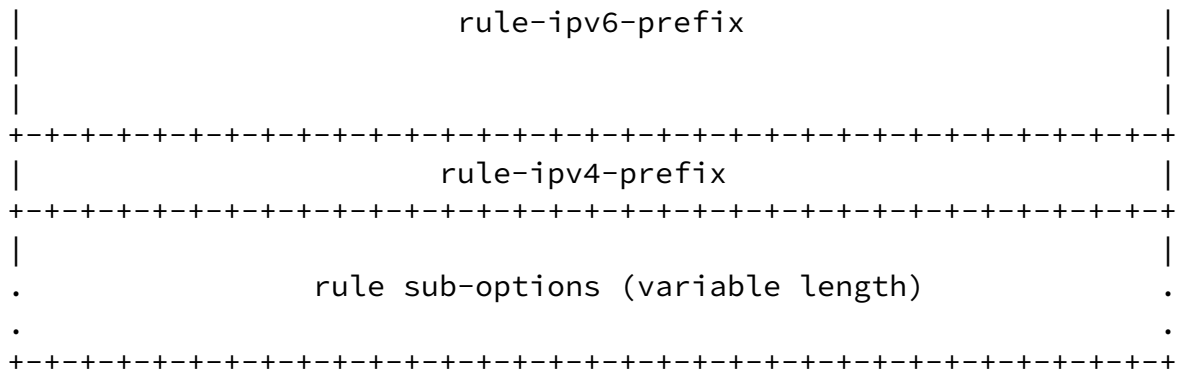


Figure 2: MAP Rule Option

- option-code: OPTION_MAP_RULE (TBD2)
- option-length: TBD octets + size of sub-options
- rule-id: 8-bits long indentifier that uniquely identifies this rule.
- rule-ipv6-prefix: a 128-bits field that specifies an IPv6 prefix that appears in a MAP rule.
- rule-ipv4-prefix: a 32-bits long field that specifies an IPv4 prefix that appears in a MAP rule.
- prefix4-len: length of the IPv6 prefix, specified in the rule-ipv6-prefix field, expressed in bits.
- prefix6-len: length of the IPv6 prefix, specified in the rule-ipv6-prefix field, expressed in bits.
- ea-len: 8-bits long field that specifies Embedded-Address (EA) length, expressed in bits.
- rule sub-options: a variable field that may contains zero or more options that specify additional parameters for this rule. Those options follow standard DHCPv6 option format, as defined in [RFC3315], Section 22.1. Currently there is only one option defined that may appear in rule sub-options field. This option is OPTION_MAP_PORTPARAMS, defined in section Section 4.4. Other options may be defined at a later date.

Each rule is identified with a rule-id. Rule-id MUST be unique within each CE. Rule ID also defines rule type. Rule-id 0 denotes default rule. Each CE configuration providioned by DHCPv6 server

MUST provide exactly one default rule (with rule-id set to 0).

Additional rules MAY be provided as required, but they MUST NOT use rule-id value of 0. Rules with rule-id smaller than 128 are Basic Mapping Rules. Rules with rule-id equal or greater than 128 are Forwarding Mapping Rules.

Note that the default mapping rule is a simplified version of Basic Mapping Rule. While it reuses the same DHCPv6 option format, Default Mapping Rule uses only Rule IPv6 prefix, Rule IPv6 Prefix Length and IPv4 address that denotes BR IPv4 address. All other parameters are ignored for Default Mapping Rule.

Discussion: Remi Despres pointed out that not all of prefix4len + prefix6-len + ea-len + excluded ports + off are needed. Only 4 of these are independent, so one of them will be removed.

4.4. Port Parameters Option

Port Parameters Option specifies Rule Port Paramters. It MAY appear as sub-option in OPTION_MAP_RULE option. It MUST NOT appear directly in a message.

See [I-D.mdt-softwire-mapping-address-and-port], Section 4.1 for detailed description of Port mapping algorithm.

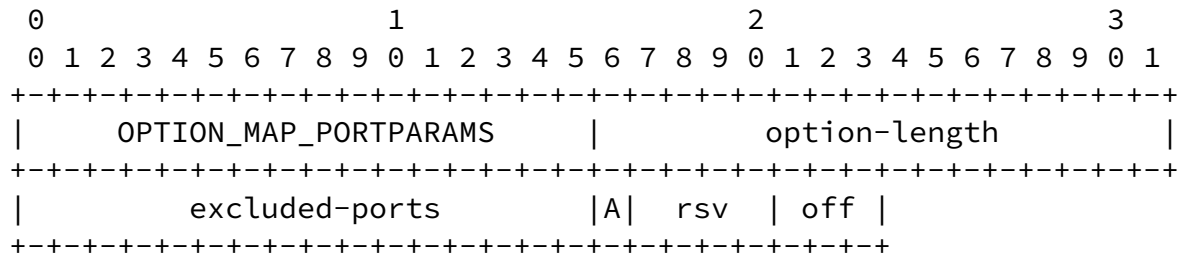


Figure 3: MAP Port Parameters Option

- option-code: OPTION_MAP_PORTPARAMS (TBD3)
- option-length: 3
- excluded-ports: defines upper bound for range of excluded ports. The lower range is 0. For example, for value 2047, excluded range is 0-2047 ports. Value of 0 (range 0-0) means that no ports are excluded.
- A: Specifies if the offset is for a (0) or m (1).
- rsvd: This 4-bits long field is currently not used and MUST be set to 0 by server. Its value MUST be ingored by clients.
- off: specifies offset bits. Currently defined values are 4 and 6.

Map Port Parameters Option is optional. If it is not present, the

following default values are to be assumed:
1. Excluded ports: 0-1023 (excluded-ports field value is 1023)
2. A: offset is for a (A field value is 0)
3. Offset bits: 6 (off field value is 6)
If administrator wants to provision only one or two of those parameters, remaining fields SHOULD be set to their default value.

4.5. MAP Options Example

DHCPv6 server provisioning a single MAP Rule to a CE (DHCPv6 client) will convey the following MAP options in its messages:

```
<MAP_FLAGS>
    <MAP_RULE1 rule-id="0"/>
    <MAP_RULE2 rule-id="1"/>
    <MAP_RULE3 rule-id="2"/>
      <MAP_PORTPARAMS>
    ...
    <MAP_RULEN/>
</MAP_FLAGS>
```

Figure 4: MAP Options Example

TODO: Make this a more detailed. This is more of a placeholder, than a real example.

5. DHCPv6 Server Behavior

RFC 3315 Section 17.2.2 [RFC3315] describes how a DHCPv6 client and server negotiate configuration values using the ORO. As a convenience to the reader, we mention here that a server will not reply with a MAP Rule Option if the client has not explicitly enumerated it on its Option Request Option.

Server conformant to this specification MUST allow configuration of one or more MAP Rule Options.

Server MUST transmist all configured instances of the Mapping Rule Options with all sub-options, if client requested it using OPTION_MAP_RULE in its Option Request Option (ORO). Server MUST transmit MAP Flags Option if client requested OPTION_MAP_FLAGS in its ORO.

Rules assignment is a stateless process from the server's

perspective. Server does not need to maintain a state of rules provisioned to clients, track lifetimes, expire outdated rules etc.

Server SHOULDs assign the same set of rules to all CEs in one MAP Domain, unless there are several classes of CEs defined, e.g. regular and premium users. In such case, each class of CEs is expected to get the same set of rules. Server is not expected to track MAP rules on a per CE basis. Exact assignment of specific rules to a specific CEs is outside of scope of this document.

6. DHCPv6 Client Behavior

Although other use cases are allowed, in typical use case CE will act as DHCPv6 client and will request MAP configuration to be assigned by the DHCPv6 server located in the ISP network. A client that supports MAP CE functionality and conforms to this specfication MUST include OPTION_MAP_RULE and OPTION_MAP_FLAGS in its ORO.

For proper operation, MAP CE client MUST also request IPv6 address (OPTION_IA_NA, defined in [RFC3315]) and prefix delegation (OPTION_IA_PD, defined in [RFC3633]). MAP CE client SHOULD NOT initiate DHCPv4 configuration as all parameters are delivered over DHCPv6.

Client SHOULD request OPTION_MAP_RULE and OPTION_MAP_FLAGS options in SOLICIT, REQUEST, RENEW, REBIND and INFORMATION-REQUEST messages.

If client receives more than one OPTION_MAP_RULE option, it MUST use all received instances. It MUST NOT use only the first one, while discarding remaining ones.

Note that system implementing MAP CE functionality may have multiple network interfaces, and these interfaces may be configured differently; some may be connected to networks that call for MAP, and some may be connected to networks that are using normal dual stack or other means. The MAP CE system should approach this specification on an interface-by-interface basis. For example, if the CE system is attached to multiple networks that provide the MAP Mapping Rule Option, then the CE system MUST configure a MAP connection (i.e. a translation or encapsulation) for each interface separately as each MAP provides IPv4 connectivity for each distinct interface. Means to

bind a MAP configuration to a given interface in a multiple interfaces device are out of scope of this document.

7. IANA Considerations

IANA is kindly requested to allocate DHCPv6 option code referencing this document, delineating OPTION_MAP_RULE and OPTION_MAP_FLAGS.

8. Security Considerations

Implementation of this document does not present any new security issues, but as with all DHCPv6-derived configuration state, it is completely possible that the configuration is being delivered by a third party (Man In The Middle). As such, there is no basis to trust that the access over the MAP can be trusted, and it should not therefore bypass any security mechanisms such as IP firewalls.

Readers concerned with security of MAP provisioning over DHCPv6 are encouraged to familiarize with [I-D.ietf-dhc-secure-dhcpv6].

Section XX of [I-D.mdt-softwire-mapping-address-and-port] discusses security issues of the MAP mechanism.

Section 23 of [RFC3315] discusses DHCPv6-related security issues.

Section 6 of [I-D.murakami-softwire-4rd] discusses 4rd related security issues that are partially applicable to MAP mechanism.

9. IANA Considerations

IANA is requested to allocate DHCPv6 option code TBD1 to the OPTION_MAP_FLAGS,TBD2 to OPTION_MAP_RULE and TBD3 to OPTION_MAP_PORTPARAMS. All three values should be added to the DHCPv6 option code space defined in Section 24.3 of [RFC3315].

10. Contributors

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11. Acknowledgements

Authors would like to thank Xiaohong Deng, Congxiao Bao, Jacni Qin, Qiong Sun for their comments and suggestions.

12. References

12.1. Normative References

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12.2. Informative References

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