Network Working Group
Internet-Draft
Intended status: Standards Track
Expires: August 16, 2021

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February 12, 2021

# IPv6 Neighbor Discovery Overlay Multilink Network Interface (OMNI) Option
# draft-templin-6man-omni-option-09

## Abstract

This document defines a new IPv6 Neighbor Discovery (ND) option termed the "Overlay Multilink Network Interface (OMNI) Option". The OMNI option may appear in any IPv6 ND message type; it is processed by interface types that recognize the option and ignored by all other interface types. The option supports functions such as prefix registration and multilink coordination, and is extensible to support additional functions in the future.

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Table of Contents

1. Introduction . . . . . 2
2. Terminology . . . . . 2
3. The Overlay Multilink Network Interface (OMNI) IPv6 ND Option 3
3.1. Sub-Options . . . . . 4
3.1.1. Pad1 . . . . . 5
3.1.2. PadN . . . . . 6
3.1.3. Interface Attributes (Type 1) . . . . . 6
3.1.4. Sub-Type Extension . . . . . 8
4. IANA Considerations . . . . . 9
5. Security Considerations . . . . . 9
6. Acknowledgements . . . . . 9
7. References . . . . . 9
7.1. Normative References . . . . . 9
7.2. Informative References . . . . . 10
Authors' Addresses . . . . . 11

## 1. Introduction

This document defines a new IPv6 Neighbor Discovery (ND) option termed the "Overlay Multilink Network Interface (OMNI) Option". The OMNI option may appear in any IPv6 ND message type; it is processed by interface types that recognize the option and ignored by all other interface types. The option supports functions such as prefix registration and multilink coordination for interface types such as the OMNI interface [I-D.templin-6man-omni-interface], and is extensible to support additional functions in the future.

The following sections discuss the OMNI option format and contents. Use cases appear in IPv6 over specific link layer documents such as [I-D.templin-6man-omni-interface], where the International Civil Aviation Organization (ICAO) has expressed interest in the option in support of their Document 9896 [ATN][ATN-IPS]. An IPv6 ND option Type number assignment is requested in the IANA Considerations section.

## 2. Terminology

The terminology in the normative references applies. The term "underlying interface" refers to one of potentially multiple Layer-2 interfaces over which a Layer-3 (virtual) interface is configured.

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119][RFC8174] when, and only when, they appear in all capitals, as shown here.

## 3. The Overlay Multilink Network Interface (OMNI) IPv6 ND Option

An Overlay Multilink Network Interface (OMNI) IPv6 ND option is defined. The option (known as the "OMNI option") is formatted as shown in Figure 1:

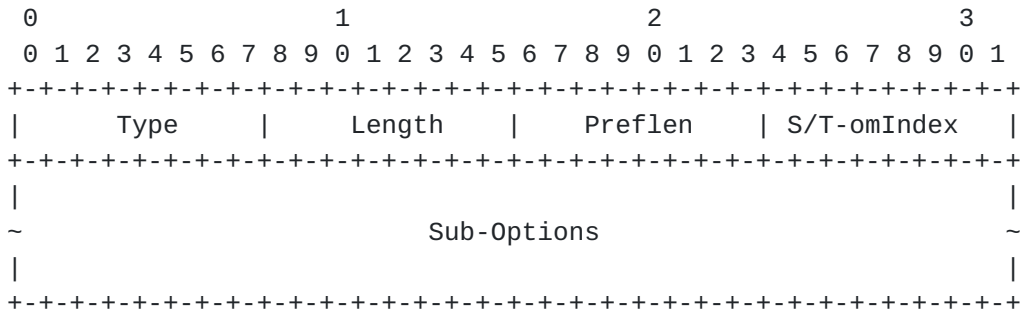


Figure 1: OMNI Option Format

In this format:

- Type is set to TBD1.
- Length is set to the number of 8 octet blocks in the option.
- Preflen is an 8 bit field that determines the length of prefix associated with an IPv6 address of the IPv6 ND message. Values 0 through 128 specify a valid prefix length (all other values are invalid). For IPv6 ND messages sent from the source to a target node, Preflen applies to the IPv6 source address and provides the length that the source is requesting or asserting. For IPv6 ND messages replies from the target to the original source, Preflen applies to the IPv6 destination address and indicates the length that the target is granting.
- S/T-omIndex is a 1-octet field that encodes a value between 0 and 255 identifying the source or target underlying interface for the IPv6 ND message. For RS and NS messages S/T-omIndex refers to the "Source" underlying interface over which the message is sent, while for RA and NA messages S/T-omIndex refers to the "Target" underlying interface that will receive the message.

- Sub-Options is a Variable-length field, of length such that the complete OMNI Option is an integer multiple of 8 octets long. Contains one or more Sub-Options, as described in Section 3.1.

The OMNI option may appear in any IPv6 ND message type; it is processed by interfaces that recognize the option and ignored by all other interfaces. If multiple OMNI option instances appear in the same IPv6 ND message, the interface processes the Preflen and S/T-omIndex fields in the first instance and ignores those fields in all other instances. The interface processes the Sub-Options of all OMNI option instances in the same IPv6 ND message in the consecutive order in which they occur.

The OMNI option(s) in each IPv6 ND message may include full or partial information for the neighbor. The union of the information in the most recently received OMNI options is therefore retained, and the information is aged/removed in conjunction with the corresponding neighbor cache entry.

## 3.1. Sub-Options

The OMNI option includes zero or more Sub-Options. Each consecutive Sub-Option is concatenated immediately after its predecessor. All Sub-Options except Pad1 (see below) are in type-length-value (TLV) encoded in the following format:

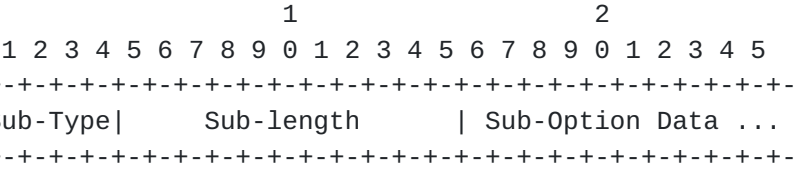


Figure 2: Sub-Option Format

- Sub-Type is a 5-bit field that encodes the Sub-Option type. Sub-Options defined in this document are:

| Option Name | Sub-Type |
|---|---|
| Pad1 | 0 |
| PadN | 1 |
| Interface Attributes (Type 1) | 2 |
| Sub-Type Extension | 30 |

Figure 3

Sub-Types 3-29 are available for future assignment for major protocol functions. Sub-Type 31 is reserved by IANA.

- Sub-Length is an 11-bit field that encodes the length of the Sub-Option Data (i.e., ranging from 0 to 2034 octets).

- Sub-Option Data is a block of data with format determined by Sub-Type and length determined by Sub-Length.

During transmission, the OMNI interface codes Sub-Type and Sub-Length together in network byte order in 2 consecutive octets, where Sub-Option Data may be up to 2034 octets in length. This allows ample space for coding large objects (e.g., ascii character strings, protocol messages, security codes, etc.), while a single OMNI option is limited to 2040 octets the same as for any IPv6 ND option. If the Sub-Options to be coded would cause an OMNI option to exceed 2040 octets, the OMNI interface codes any remaining Sub-Options in additional OMNI option instances in the intended order of processing in the same IPv6 ND message. Implementations must therefore observe size limitations, and must refrain from sending IPv6 ND messages larger than the OMNI interface MTU.

During reception, the OMNI interface processes each OMNI option Sub-Option while skipping over and ignoring any unrecognized Sub-Options. The OMNI interface processes the Sub-Options of all OMNI option instances in the consecutive order in which they appear in the IPv6 ND message, beginning with the first instance and continuing through any additional instances to the end of the message. If a Sub-Option length would cause the running total for that OMNI option to exceed the length coded in the option header, the interface accepts any Sub-Options already processed and ignores the remainder of that OMNI option. The interface then processes any remaining OMNI options in the same fashion to the end of the IPv6 ND message.

Note: large objects that exceed the Sub-Option Data limit of 2034 octets are not supported under the current specification; if this proves to be limiting in practice, future specifications may define support for fragmenting large objects across multiple OMNI options within the same IPv6 ND message.

The following Sub-Option types and formats are defined in this document (note that other documents that are active at the time of this writing will define additional Sub-Option types in the near future):

#### 3.1.1. Pad1

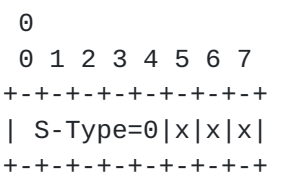


Figure 4: Pad1

- Sub-Type is set to 0. If multiple instances appear in OMNI options of the same message all are processed.

- Sub-Type is followed by three 'x' bits, set randomly on transmission and ignored on receipt. Pad1 therefore consists of a whole single octet with the most significant 5 bits set to 0, and with no Sub-Length or Sub-Option Data fields following.

### 3.1.2. PadN

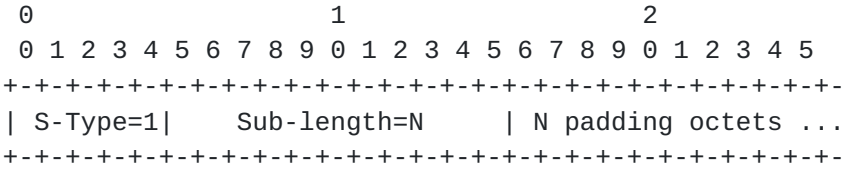


Figure 5: PadN

- Sub-Type is set to 1. If multiple instances appear in OMNI options of the same message all are processed.

- Sub-Length is set to N (from 0 to 2047) being the number of padding octets that follow.

- Sub-Option Data consists of N padding octets that are typically zero-valued (any non-zero values that may appear in the padding octets are not to be interpreted in any way other than as simple padding).

### 3.1.3. Interface Attributes (Type 1)

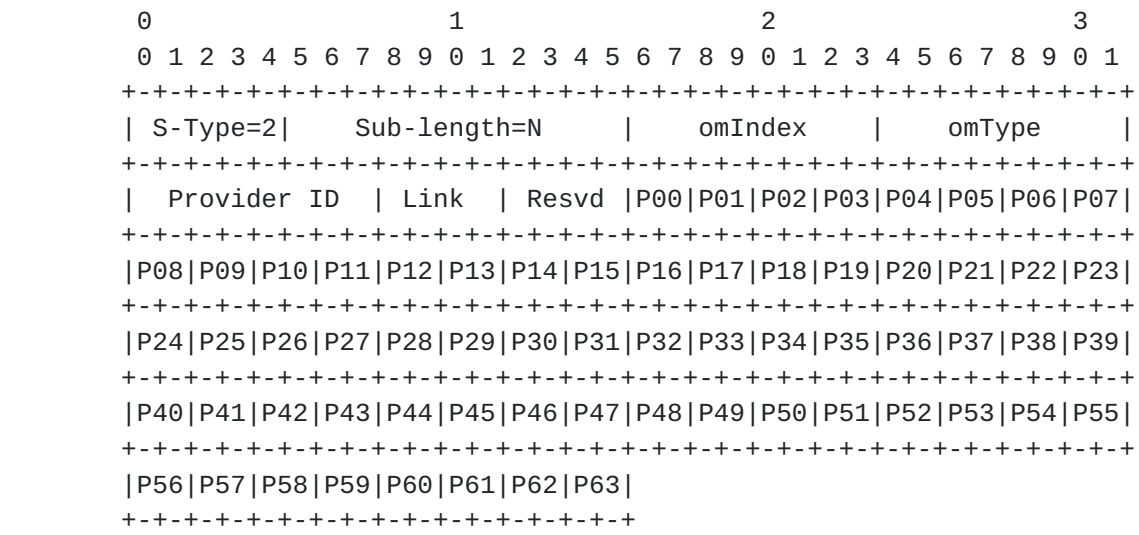


Figure 6: Interface Attributes (Type 1)

- Sub-Type is set to 2. If multiple instances with different omIndex values appear in OMNI options of the same message all are processed; if multiple instances with the same omIndex value appear, the first is processed and all others are ignored.

- Sub-Length is set to N (from 1 to 2047) that encodes the number of Sub-Option Data octets that follow.

- omIndex is a 1-octet field containing a value from 0 to 255 identifying the underlying interface for which the interface attributes apply.

- omType is a 1-octet field containing a value from 0 to 255 corresponding to the underlying interface identified by omIndex.

- Provider ID is a 1-octet field containing a value from 0 to 255 corresponding to the underlying interface identified by omIndex.

- Link encodes a 4-bit link metric. The value '0' means the link is DOWN, and the remaining values mean the link is UP with metric ranging from '1' ("lowest") to '15' ("highest").

- Resvd is reserved for future use.

- A 16-octet ""Preferences" field immediately follows 'Resvd', with values P[00] through P[63] corresponding to the 64 Differentiated Service Code Point (DSCP) values [RFC2474]. Each 2-bit P[*] field is set to the value '0' ("disabled"), '1' ("low"), '2' ("medium") or '3' ("high") to indicate a QoS preference for underlying interface selection purposes.

### 3.1.4. Sub-Type Extension

Since the Sub-Type field is only 5 bits in length, future specifications of major protocol functions may exhaust the remaining Sub-Type values available for assignment. This document therefore defines Sub-Type 30 as an "extension", meaning that the actual sub-option type is determined by examining a 1 octet "Extension-Type" field immediately following the Sub-Length field. The Sub-Type Extension is formatted as shown in Figure 7:

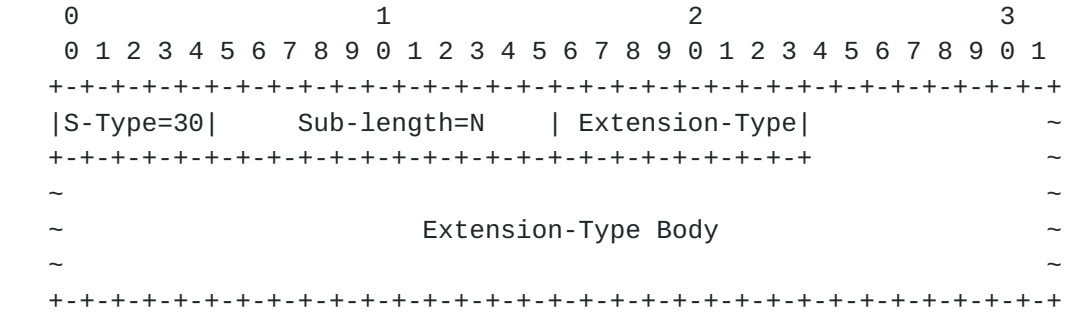


Figure 7: Sub-Type Extension

- Sub-Type is set to 30. If multiple instances appear in OMNI options of the same message all are processed, where each individual extension defines its own policy for processing multiple of that type.

- Sub-Length is set to N (from 1 to 2034) that encodes the number of Sub-Option Data octets that follow. The Extension-Type field is always present; hence, the maximum Extension-Type Body length is 2033 octets.

- Extension-Type contains a 1 octet Sub-Type Extension value between 0 and 255.

- Extension-Type Body contains an N-1 octet block with format defined by the given extension specification.

Extension-Type values 0 through 252 are available for assignment by future specifications, which must also define the format of the Extension-Type Body and its processing rules. Extension-Type values 253 and 254 are reserved for experimentation, as recommended in [RFC3692], and value 255 is reserved by IANA.

## 4. IANA Considerations

The IANA is instructed to allocate a Type number TBD1 from the registry "IPv6 Neighbor Discovery Option Formats" for the OMNI option (see: Section 13 of [RFC4861]) as a provisional registration in accordance with Section 4.13 of [RFC8126].

The OMNI option defines a 5-bit Sub-Type field, for which IANA is instructed to create and maintain a new registry entitled "OMNI option Sub-Type values". Initial values for the OMNI option Sub-Type values registry are given below; future assignments are to be made through Expert Review [RFC8126].

| Value | Sub-Type name | Reference |
|---|---|---|
| 0 | Pad1 | [RFCXXXX] |
| 1 | PadN | [RFCXXXX] |
| 2 | Interface Attributes (Type 1) | [RFCXXXX] |
| 3-29 | Unassigned | |
| 30 | Sub-Type Extension | [RFCXXXX] |
| 31 | Reserved | [RFCXXXX] |

Figure 8: OMNI Option Sub-Type Values

## 5. Security Considerations

Security considerations for IPv6 [RFC8200] and IPv6 Neighbor Discovery [RFC4861] apply.

## 6. Acknowledgements

This document is aligned with the International Civil Aviation Organization (ICAO) Aeronautical Telecommunications Network (ATN) with Internet Protocol Services (ATN/IPS) development program.

This document is aligned with the IETF 6man (IPv6) working group.

## 7. References

### 7.1. Normative References

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