Internet Engineering Task Force (IETF)
Request for Comments: 8066
Updates: 4944, 6282
Category: Standards Track
ISSN: 2070-1721

S. Chakrabarti

G. Montenegro
Microsoft
R. Droms

J. Woodyatt
Google

February 2017

IPv6 over Low-Power Wireless Personal Area Network (6LoWPAN) ESC Dispatch Code Points and Guidelines

Abstract

RFC 4944 defines the ESC dispatch type to allow additional dispatch octets in the 6LoWPAN header. The value of the ESC dispatch type was updated by RFC 6282; however, its usage was not defined in either RFC 6282 or RFC 4944. This document updates RFC 4944 and RFC 6282 by defining the ESC extension octet code points and listing registration entries for known use cases at the time of writing of this document.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 7841.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at http://www.rfc-editor.org/info/rfc8066.

Table of Contents

1. Introduction

Section 5.1 of [RFC4944] defines the dispatch header and types. The ESC type is defined to use additional dispatch octets in the 6LoWPAN header. RFC 6282 modifies the value of the ESC dispatch type and that value is recorded in IANA registry [IANA-6LoWPAN]. However, the octets and usage following the ESC dispatch type are not defined in either [RFC4944] or [RFC6282]. In recent years with 6LoWPAN deployments, implementations and standards organizations have started using the ESC extension octets. This highlights the need for an updated IANA registration policy.

This document defines the new "ESC Extension Types" registry and the ESC extension octets for future applications. In addition, this document records the ITU-T specification for ESC dispatch octet code points as an existing known usage.

2. Terminology

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. Usage of ESC Dispatch Octets

RFC 4944 [RFC4944] first introduces this "ESC" dispatch header type for extension of dispatch octets. RFC 6282 [RFC6282] subsequently modified its value to [01 000000].

This document specifies that the first octet following the ESC dispatch type be used for extension type (extended dispatch values). Subsequent octets are left unstructured for the specific use of the extension type:

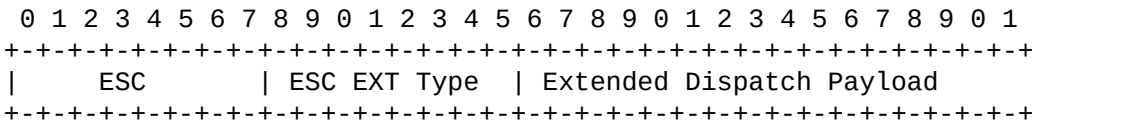


Figure 1: Frame Format with ESC Dispatch Type

ESC: The left-most octet is the ESC dispatch type containing '01000000'.

ESC Extension Type (EET): It is the first octet following the ESC dispatch type. Extension type defines the payload for the additional dispatch octets. The values are from 0 to 255. Values 0 and 255 are reserved for future use. The remaining values from 1 to 254 are

assigned by IANA. The EET values are similar to dispatch values in the 6LoWPAN header except they are preceded by the ESC dispatch type. Thus, ESC extension types and dispatch values are using orthogonal code spaces. Though not desirable, multiple ESC dispatch types MAY appear in a 6LoWPAN header. Section 3.1 describes how to handle an unknown ESC dispatch type.

Extended Dispatch Payload (EDP): This part of the frame format must be defined by the corresponding extension type. A specification is required to define the usage of each extension type and its corresponding Extension Payload. For the sake of interoperability, specifications of extension octets MUST NOT redefine the existing ESC Extension Type codes.

Section 5.1 of RFC 4944 indicates that the Extension Type field may contain additional dispatch values larger than 63, as corrected by [Err4359]. For the sake of interoperability, the new dispatch type (EET) MUST NOT modify the behavior of existing dispatch types [RFC4944].

3.1. Interaction with Other RFC 4944 Implementations

It is expected that existing implementations of RFC 4944 are not capable of processing ESC extension data octets as defined in this document. However, implementers have to assume that an existing implementation that attempts to process an EET that is unknown to them will simply drop the packet or ignore the ESC dispatch octets.

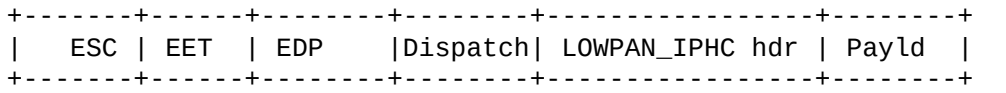
If an implementation following this document, during processing of the received packet, reaches an ESC dispatch type for which it does not understand the ESC Extension Type (EET) octets, it MUST drop that packet. However, it is important to clarify that a router node SHOULD forward a 6LoWPAN packet with the EET octets as long as it does not attempt to process any unknown ESC extension octets.

Multiple ESC extension octets may appear in a packet. The ESC dispatch types can appear as the first, last, or middle dispatch octets. However, a packet will get dropped by any node that does not understand the EET at the beginning of the packet. Placing an EET toward the front of the packet has a greater probability of causing the packet to be dropped than placing the same EET later in the packet. Placement of an EET later in the packet increases the chance that a legacy device will recognize and successfully process some dispatch type [RFC4944] before the EET. In this case, the legacy device will ignore the EET instead of dropping the entire packet.

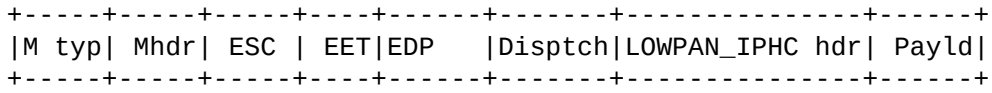
3.2. ESC Extension Octets Typical Sequence

The sequence and order of ESC extension octets with respect to the 6LoWPAN Mesh header and LOWPAN_IPHC header are described below. When the LOWPAN_IPHC dispatch type is present, ESC dispatch types MUST appear before the LOWPAN_IPHC dispatch type in order to maintain backward compatibility with Section 3.2 of RFC 6282. The following diagrams provide examples of ESC extension octet usages:

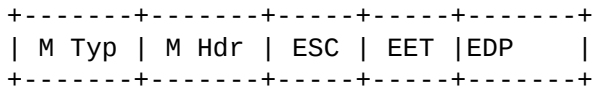
A LoWPAN encapsulated IPv6 Header compressed packet:



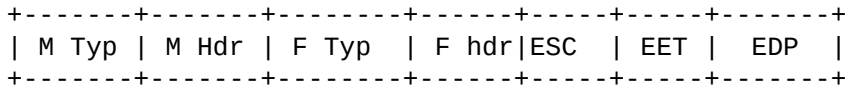
A LoWPAN_IPHC Header, Mesh header and an ESC extension octet:



A Mesh header with ESC dispatch types:



With Fragment header:



ESC dispatch type as a LowPAN encapsulation:

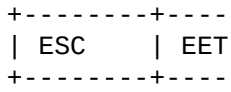


Figure 2: A 6LoWPAN Packet with ESC Dispatch Types

3.3. ITU-T G.9903 ESC Type Usage

The ESC dispatch type is used in [G3-PLC] to provide native mesh routing and bootstrapping functionalities. The ITU-T recommendation [G3-PLC] (see Section 9.4.2.3) defines commands that are formatted like ESC Extension Type fields. The command ID values are 0x01 to 0x1F.

The frame format is defined as follows:

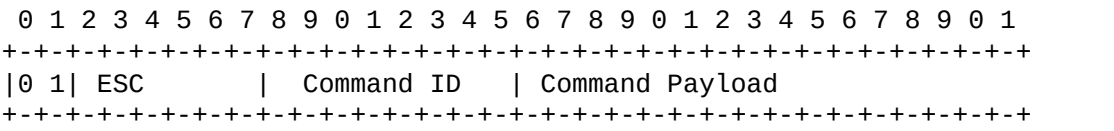


Figure 3: G.9903 Frame Format with ESC Dispatch Type

3.4. NALP and ESC Dispatch Types

According to Section 5.1 of RFC 4944 [RFC4944], NALP dispatch octets are reserved for use as a kind of escape code for identification of non-6LoWPAN payloads. Since ESC dispatch types are part of 6LoWPAN dispatch types (extended), they are orthogonal to NALP octets.

This document clarifies that NALP dispatch codes only provide an escape method for non-6LoWPAN payloads when they appear as the initial octet of a LoWPAN encapsulation, and that the potential meaning of their appearance in any other location is reserved for future use.

4. IANA Considerations

IANA has registered the 'ESC Extension Types' values per the policy 'Specification Required' [RFC5226], following the same policy as in the IANA Considerations section of [RFC4944]. For each Extension Type (except the Reserved values), the specification MUST define corresponding Extended Dispatch Payload frame octets for the receiver implementation to read the ESC dispatch types in an interoperable fashion.

Section 4.1 of [RFC5226] indicates that "Specification Required" calls for a Designated Expert review of the public specification requesting registration of the ESC Extension Type values.

The allocation of code points should follow the guidelines on "Usage of ESC Dispatch Octets" (Section 3) and the typical example (Section 3.2) sections. ESC Extension Type code points MUST be used in conjunction with 6lo protocols following [RFC4944] or its

derivatives. The requesting document MUST specify how the ESC dispatch octets will be used along with 6LoWPAN headers in their use cases.

The initial values for the 'ESC Extension Type' fields are as follows:

Value	Description	Reference
0	Reserved	This document
1-31	Used by ITU-T G.9903 and G.9905 Command IDs	ITU-T G.9903 & ITU-T G.9905
32-254	Unassigned	
255	Reserved	This document

Figure 4: Initial Values for the ESC Extension Types Registry

5. Security Considerations

There are no additional security threats due to the assignments of ESC dispatch type usage described in this document. Furthermore, this document forbids defining any extended dispatch values or extension types that modify the behavior of existing dispatch types.

6. References

6.1. Normative References

[Err4359] RFC Errata, Erratum ID 4359, RFC 4944, <https://www.rfc-editor.org/errata_search.php?eid=4359>.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <http://www.rfc-editor.org/info/rfc2119>.

[RFC4944] Montenegro, G., Kushalnagar, N., Hui, J., and D. Culler, "Transmission of IPv6 Packets over IEEE 802.15.4 Networks", RFC 4944, DOI 10.17487/RFC4944, September 2007, <http://www.rfc-editor.org/info/rfc4944>.

[RFC6282] Hui, J., Ed. and P. Thubert, "Compression Format for IPv6 Datagrams over IEEE 802.15.4-Based Networks", RFC 6282, DOI 10.17487/RFC6282, September 2011, <http://www.rfc-editor.org/info/rfc6282>.

6.2. Informative References

[G3-PLC] International Telecommunications Union, "G.9903 : Narrowband orthogonal frequency division multiplexing power line communication transceivers for G3-PLC networks", February 2014, <http://www.itu.int/rec/T-REC-G.9903-201402-I>.

[IANA-6LoWPAN] IANA, "IPv6 Low Power Personal Area Network Parameters", <https://www.iana.org/assignments/_6lowpan-parameters>.

[RFC5226] Narten, T. and H. Alvestrand, "Guidelines for Writing an IANA Considerations Section in RFCs", BCP 26, RFC 5226, DOI 10.17487/RFC5226, May 2008, <http://www.rfc-editor.org/info/rfc5226>.

Acknowledgements

The authors would like to thank the members of the 6lo WG for their comments. Many thanks to Carsten Bormann, Ralph Droms, Thierry Lys, Cedric Lavenu, and Pascal Thubert for discussions regarding the bits allocation issues, which led to this document. Jonathan Hui and Robert Cragie provided extensive reviews and guidance for interoperability. The authors acknowledge the comments from the following people that helped shape this document: Paul Duffy, Don Sturek, Michael Richardson, Xavier Vilajosana, Scott Mansfield, Dale Worley, and Russ Housley. Thanks to Brian Haberman, our document shepherd, for guidance in the IANA Considerations section.

Authors' Addresses

Samita Chakrabarti
San Jose, CA
United States of America

Email: samitac.ietf@gmail.com

Gabriel Montenegro
Microsoft
United States of America

Email: gabriel.montenegro@microsoft.com

Ralph Droms
United States of America

Email: rdroms.ietf@gmail.com

James Woodyatt
Google
Mountain View, CA
United States of America

Email: jhw@google.com