6lowpan ESC Dispatch Code Points and Guidelines

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Abstract

RFC4944 defines the ESC dispatch type to allow for additional dispatch bytes in the 6lowpan header. The value of the ESC byte was updated by RFC6282, however, its usage was not defined either in RFC6282 or in RFC4944. This document updates RFC4944 and RFC6282 by defining the ESC extension byte code points including registration of entries for known use cases at the time of writing of this document.

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1. Introduction

[RFC4944] section 5.1 defines the dispatch header and types. The ESC type is defined for using additional dispatch bytes in the 6lowpan header. RFC 6282 modifies the value of the ESC dispatch type and it is recorded in IANA registry [6LOWPAN-IANA]. However, the bytes and usage following the ESC byte are not defined in either [RFC4944] and [RFC6282]. However, in recent years with 6lowpan deployments, implementations and standards organizations have started using the ESC extension bytes and co-ordination between the respective organizations and IETF/IANA is needed.

The following sections record the ITU-T specification for ESC dispatch byte code points as an existing known usage and propose the definition of ESC extension bytes for future applications. The document also requests IANA actions for the first extension byte following the ESC byte.

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 bytes

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

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

```
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| 0 1 | ESC       | ESC EXT Type  | Extended Dispatch Payload |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 1: Frame Format with ESC Byte

ESC: The left-most byte is the ESC dispatch type containing '0100000'
ESC Extension Type (EET): It is the first byte following the ESC byte. Extension type defines the payload for the additional dispatch bytes. The values are from 0 to 255. Values 0 and 255 are reserved for future use. These values are assigned by IANA. The EET values are similar to dispatch values in the 6lowpan header except they are preceded by the ESC byte. Thus, ESC extension types and dispatch values are using orthogonal code spaces. Though not desirable, multiple ESC bytes 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 each usage of extension type and its corresponding Extension Payload. For the sake of interoperability, specifications of extension bytes MUST NOT redefine the existing ESC Extension Type codes.

Section 5.1 in RFC4944 indicates that the Extension Type field may contain additional dispatch values larger than 63, as corrected by [4944-ERRATA]. 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 RFC4944 implementations

It is expected that RFC4944 existing implementations are not capable of processing ESC extension data bytes as defined in this document. However, implementers have to assume that existing implementation that attempt to process an EET unknown to them will simply drop the packet or ignore the ESC dispatch bytes.

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

Sequence Of dispatch bytes and ESC bytes: Multiple ESC extension bytes may appear in a packet. The ESC bytes can appear as the first, last or middle dispatch bytes. However, a packet will get dropped by any node that does not understand the EET at the beginning of the packet. The closer to the end of the packet are the EET’s, the higher chance there is that a legacy node will recognize and successfully process some dispatch type [RFC4944] before the EET and then ignore the EET instead of dropping the entire packet.
3.2. ESC Extension Bytes Typical Sequence

ESC Extension bytes sequence and order with respect to 6LoWPAN Mesh header and LoWPAN_IPHC header are described below. When LOWPAN_IPHC dispatch type is present, ESC bytes MUST appear before the LOWPAN_IPHC dispatch type in order to maintain backward compatibility with RFC6282 section 3.2. The following diagrams provide examples of ESC extension byte usages:

A LoWPAN encapsulated IPv6 Header compressed packet:

```
+-------+------+--------+--------+-----------------+--------+
|   ESC | EET  | EDP    |Dispatch| LOWPAN_IPHC hdr | Payld  |
+-------+------+--------+--------+-----------------+--------+
```

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

```
+-----+-----+-----+----+------+-------+---------------+------+
|M typ| Mhdr| ESC | EET|EDP   |Disptch|LOWPAN_IPHC hdr| Payld|
+-----+-----+-----+----+------+-------+---------------+------+
```

A Mesh header with ESC bytes

```
+------------------------------------------+
| M Typ | M Hdr | ESC | EET |EDP   |
+------------------------------------------+
```

With Fragment header

```
+------------------------------------------+
| M Typ | M Hdr | F Typ  | F hdr|ESC  | EET |  EDP  |
+------------------------------------------+
```

ESC byte as a LowPAN encapsulation

```
+----------+
| ESC | EET | EDP |
+----------+
```

Figure 2: A 6lowpan packet with ESC Bytes

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 defines command IDs in the [G3-PLC] section 9.4.2.3 which operates...
like ESC Extension type field. The command ID values are 0x01 to 0x1F.

The frame format is defined as follows:

```
| 0 1| ESC       |  Command ID   | Command Payload |
```

Figure 3: G.9903 Frame Format with ESC Byte

### 3.4. NALP and ESC bytes

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

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

### 4. IANA Considerations

This document requests IANA to register the ‘ESC Extension Type’ values per the policy ‘Specification Required’ [RFC5226], following the same policy as in the IANA section of [RFC4944]. For each Extension Type (except the Reserved values) the specification MUST define corresponding Extended Dispatch Payload frame bytes for the receiver implementation to read the ESC bytes in an interoperable fashion.

[RFC5226] section 4.1 also indicates that "Specification Required" implies 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 Bytes" and the typical example 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 bytes will be used along
with 6LOWPAN headers in their use cases.

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

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Reserved for future use</td>
<td>This document</td>
</tr>
<tr>
<td>32-254</td>
<td>Unassigned (Reserved for future IANA Assignment-- Spec Required)</td>
<td>This document</td>
</tr>
<tr>
<td>255</td>
<td>Reserved for future use</td>
<td>This document</td>
</tr>
</tbody>
</table>

Figure 4: Initial Values for IANA Registry

5. Security Considerations

There are no additional security threats due to the assignments of ESC byte 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. Acknowledgements

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7. References
7.1.  Normative References

[4944-ERRATA]


[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,

7.2.  Informative References

[6LOWPAN-IANA]  "https://www.iana.org/assignments/_6lowpan-parameters/_6lowpan-parameters.xhtml".

[6loCHART]  "https://datatracker.ietf.org/wg/6lo/charter".


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