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IPv6 over Low-Power Wireless Personal Area Network (6LoWPAN) Paging Dispatch

Abstract

This specification updates RFC 4944 to introduce a new context switch mechanism for IPv6 over Low-Power Wireless Personal Area Network (6LoWPAN) compression, expressed in terms of Pages and signaled by a new Paging Dispatch.

Status of This Memo

This is an Internet Standards Track document.

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1. Introduction

The design of Low-Power and Lossy Networks (LLNs) is generally focused on saving energy, which is often a very constrained resource. Other constraints, such as memory capacity and duty cycle restrictions on LLN devices, usually derive from that primary concern. Energy is often available only from primary batteries that are expected to last for years or is scavenged from the environment in very limited amounts. Any protocol that is intended for use in LLNs must be designed with a primary focus on saving energy, which is a strict requirement.

Controlling the amount of data transmission is one possible means of saving energy. In a number of LLN standards, the frame size is limited to much smaller values than the IPv6 maximum transmission unit (MTU) of 1280 bytes. In particular, an LLN that relies on the classical Physical Layer (PHY) of IEEE 802.15.4 [IEEE.802.15.4] is limited to 127 bytes per frame. The need to compress IPv6 packets over IEEE 802.15.4 led to the 6LoWPAN Header Compression (6LoWPAN-HC) [RFC6282] work.

As more and more protocols need to be compressed, the encoding capabilities of the original dispatch defined in the 6LoWPAN adaptation-layer framework ([RFC4944] and [RFC6282]) becomes saturated. This specification introduces a new context switch mechanism for 6LoWPAN compression, expressed in terms of Pages and signaled by a new Paging Dispatch mechanism.

2. Terminology

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 [RFC2119].

The terminology used in this document is consistent with and incorporates that described in "Terms Used in Routing for Low-Power and Lossy Networks" [RFC7102] and "Terminology for Constrained-Node Networks" [RFC7228].

3. Updating RFC 4944

This document adapts 6LoWPAN while maintaining backward compatibility with IPv6 over IEEE 802.15.4 [RFC4944] by introducing the concept of a "parsing context" in the 6LoWPAN parser, a context being identified by a Page Number. This specification defines 16 Pages.

Pages are delimited in a 6LoWPAN packet by a Paging Dispatch value that indicates the next current Page. The Page Number is encoded in a Paging Dispatch with the Value Bit Pattern of 11 11xxxx, where xxxx is the Page Number, 0 to 15, as described in Figure 1:

```

      0
      0 1 2 3 4 5 6 7
      +--+--+--+--+--+--+
      |1|1|1|1|Page Nb|
      +--+--+--+--+--+--+

```

Figure 1: Paging Dispatch with Page Number Encoding

Values of the Dispatch byte defined in [RFC4944] are considered as belonging to the Page 0 parsing context, which is the default and does not need to be signaled explicitly at the beginning of a 6LoWPAN packet. This ensures backward compatibility with existing implementations of 6LoWPAN.

The Dispatch bits defined in [RFC4944] are used in Page 0 and are free to be reused in Pages 1 to 15. In Section 4, this specification allocates some values in Page 1 and leaves the rest open for future allocations.

Values made available by this specification in Pages 1 to 14 are to be assigned for new protocols whereas Page 15 is reserved for Experimental Use [RFC5226].

Note: This specification does not use the Escape Dispatch, which extends Page 0 to more values, but rather allocates another Dispatch Bit Pattern (11 11xxxx) for a new Paging Dispatch that is present in all Pages, including Page 0 and Pages defined in future specifications, to indicate the next parsing context represented by its Page Number. The rationale for avoiding that approach is that there can be multiple occurrences of a new header indexed by this specification in a single frame and the overhead on an octet each time for the Escape Dispatch would be prohibitive.

A Page (say Page N) is said to be active once the Page N Paging Dispatch is parsed, and it remains active until another Paging Dispatch is parsed.

4. Page 1 Paging Dispatch

This specification defines some special properties for Page 1, detailed below:

The Dispatch bits defined for LOWPAN_IPHC by the "Compression Format for IPv6 Datagrams over IEEE 802.15.4-Based Networks" [RFC6282] are defined with the same values in Page 1, so there is no need to switch context from Page 1 to Page 0 to decode a packet that is encoded per [RFC6282].

Mesh Headers represent Layer 2 information and are processed before any Layer 3 information that is encoded in Page 1. If a 6LoWPAN packet requires a Mesh Header, the Mesh Header MUST always be placed in the packet before the first Page 1 Paging Dispatch, if any.

For the same reason, Fragment Headers as defined in [RFC4944] MUST always be placed in the packet before the first Page 1 Paging Dispatch, if any.

The NALP Dispatch Bit Pattern as defined in [RFC4944] is only defined for the first octet in the packet. Switching back to Page 0 for NALP inside a 6LoWPAN packet does not make sense.

As a result, there is no need to restore the Page 0 parsing context after a context was switched to Page 1, so the value for the Page 0 Paging Dispatch of 11 110000 may not actually occur in those packets that adhere to 6LoWPAN specifications available at the time of writing this specification.

5. Security Considerations

The security considerations of [RFC4944] and [RFC6282] apply.

6. IANA Considerations

6.1. Page Switch Dispatch Types

This document allocates 16 values for "Page switch" from the "Dispatch Type Field" registry that was created by [RFC4944]. The allocated values are from 11 110000 through 11 111111 and represent Page Numbers 0 through 15 as discussed in this document.

6.2. New Column in Dispatch Type Registry

This document extends the "Dispatch Type Field" registry, which was created by [RFC4944] and updated by [RFC6282], by adding a new column called "Page".

This document defines 16 Pages, "Page 0" to "Page 15".

The preexisting registry content is assigned to "Page 0".

This document also associates the Dispatch type field values that are allocated for LOWPAN_IPHC by [RFC6282] to Page 1. These values range from 01 100000 through 01 111111 and have the same definition in Page 1 as they do in Page 0; as a result, Page 0 and Page 1 are grouped together in the registry for this range.

Values ranging from 00 000000 to 11 101111 in Page 15 (that is, all of Page 15 except the space used for Page switch) are reserved for Experimental Use [RFC5226] and shall not be assigned.

Figure 2 represents the updates to the registry as described above. Refer to <http://www.iana.org/assignments/_6lowpan-parameters> for the complete list of updates.

Bit Pattern	Page	Header Type	Reference
	0	NALP	RFC 4944, this document
00 xxxxxx	1-14	Unassigned	
	15	Reserved for Experimental Use	this document
01 000000	0	ESC	RFC 6282, this document
	1-14	Unassigned	
	15	Reserved for Experimental Use	this document
...			
01 1xxxxx	0-1	LOWPAN_IPHC	RFC 6282, this document
	2-14	Unassigned	
	15	Reserved for Experimental Use	this document
...			
11 11xxxx	0-15	Page switch	this document

Figure 2: Integrating the New Page Column

Future assignments in these registries are to be coordinated via IANA under the policy of "Specification Required" [RFC5226]. It is expected that this policy will allow for other (non-IETF) organizations to more easily obtain assignments.

7. References

7.1. Normative References

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