

Optimized 6LoWPAN Fragmentation Header for LPWAN

draft-gomez-lpwan-fragmentation-header-01

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Motivation (I/II)

- 6LoWPAN fragmentation (RFC 4944)
 - IPv6 MTU requirement (1280 bytes)
 - IEEE 802.15.4 (maximum frame size of 127 bytes)
 - 4-byte header (1st fragment)
 - 5-byte header (subsequent fragments)
- However, some LPWAN technologies:
 - Lack of L2 fragmentation support
 - Maximum payload size one order of magnitude less
 - Bit rate several orders of magnitude less
 - Further limited message rate
 - E.g. due to regulatory constraints on the duty cycle

Motivation (II/II)

- RFC 4944 fragmentation header
 - May represent high overhead for LPWAN
- Furthermore, the RFC 4944 offset field is expressed in increments of 8 octets
 - Only supports L2 payload size ≥ 13 bytes
 - However, there are LPWAN technologies with a shorter maximum payload size

Proposed new format

- 6LoWPAN Fragmentation Header for LPWANs (6LoFHL)
- First fragment

```

                                1                                2
      0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|1 1 0 0 1|      datagram_size      | datagram_tag |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

- Subsequent fragments

```

                                1                                2
      0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|1 1 0 1 0|    datagram_offset    | datagram_tag |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

Changes from RFC 4944 and rationale

- datagram_size field only included in the first fragment
 - Reordering is less likely in (star topology) LPWAN than in a mesh network
 - The format still supports reordering...
- datagram_tag field size reduced to 1 byte
 - Ambiguities due to wrapping not expected
 - Low message rate in LPWAN
- datagram_offset increased from 8 bits to 11 bits
 - Allows to express the offset in 1-byte increments

Benefits of 6LoFHL (I/II)

- Simple, byte-exact, short format
 - Supports maximum L2 payloads ≥ 4 bytes
- Overhead (L2 data units)

IPv6 datagram size (bytes)									
11		40		100		1280			
L2 payload (bytes)	4944	6LoFHL	4944	6LoFHL	4944	6LoFHL	4944	6LoFHL	
10	----	2	----	6	----	15	----	183	
15	1	1	5	4	13	9	160	107	
20	1	1	4	3	12	6	159	76	
25	1	1	3	2	7	5	80	59	
30	1	1	2	2	5	4	54	48	

Benefits of 6LoFHL (II/II)

- Overhead (adaptation layer fragmentation header bytes)

	IPv6 datagram size (bytes)							
	11		40		100		1280	
L2 payload (bytes)	4944	6LoFHL	4944	6LoFHL	4944	6LoFHL	4944	6LoFHL
10	----	6	----	18	----	45	----	768
15	0	0	24	12	64	27	799	321
20	0	0	19	9	59	18	794	228
25	0	0	14	6	34	15	399	177
30	0	0	9	6	24	12	269	144

Several considerations

- IANA: 6LoFHL allocates 16 Dispatch values:
 - 11001 000 through 11001 111
 - 11010 000 through 11010 111
- Security considerations
 - TBD

Thanks!

Questions?

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Back-up slide: RFC 4944 fragmentation header format

- First fragment

```

                                1                                2                                3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|1 1 0 0 0|    datagram_size    |          datagram_tag          |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

- Subsequent fragments

```

                                1                                2                                3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|1 1 1 0 0|    datagram_size    |          datagram_tag          |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|datagram_offset|
+--+--+--+--+--+--+--+--+--+
```