draft-ietf-6lo-minimal-fragment-01

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RFC4944

- Link-layer fragmentation only in route-over → reassembly at ea op
- Fragment header

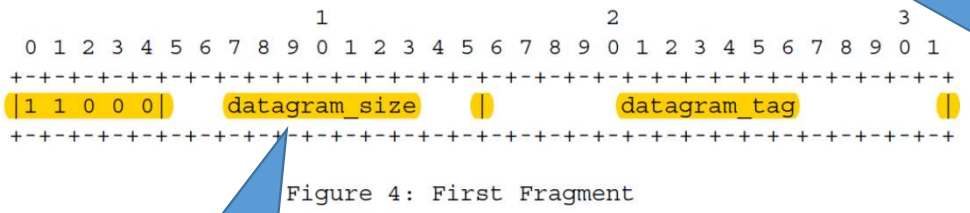


Figure 4: First Fragment

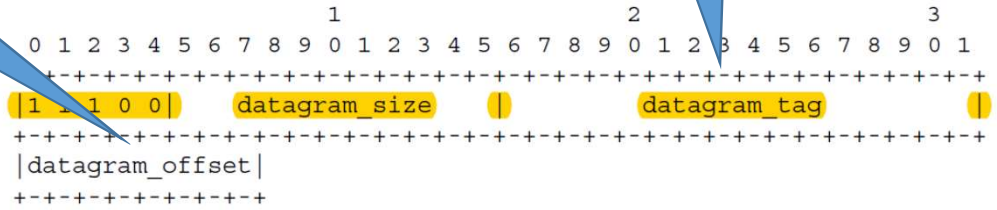


Figure 5: Subsequent Fragments

Units of 8 octets

bytes

- +1 on each new frag
- No initial value specified

- Reassembly timer:
  - Starts when node receives first fragment
  - Timeout value MUST be <60s
  - When times out, buffer cleared, packet dropped

Pattern	Header Type	
00 xxxxxx	NALP	- Not a LoWPAN frame
01 000001	IPv6	- Uncompressed IPv6 Addresses
01 000010	LOWPAN_HC1	- LOWPAN_HC1 compressed IPv6
01 000011	reserved	- Reserved for future use
...	reserved	- Reserved for future use
01 001111	reserved	- Reserved for future use
01 010000	LOWPAN_BC0	- LOWPAN_BC0 broadcast
01 010001	reserved	- Reserved for future use
...	reserved	- Reserved for future use
01 111110	reserved	- Reserved for future use
01 111111	ESC	- Additional Dispatch byte follows
10 xxxxxx	MESH	- Mesh Header
11 000xxx	FRAG1	- Fragmentation Header (first)
11 001000	reserved	- Reserved for future use
...	reserved	- Reserved for future use
11 011111	reserved	- Reserved for future use
11 100xxx	FRAGN	- Fragmentation Header (subsequent)
11 101000	reserved	- Reserved for future use
...	reserved	- Reserved for future use
11 111111	reserved	- Reserved for future use

Figure 2: Dispatch Value Bit Pattern

RFC6282

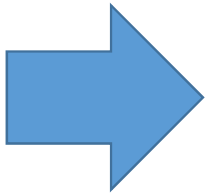
Section 5.3 of [RFC4944] also defines how to fragment compressed IPv6 datagrams that do not fit within a single link frame. Section 5.3 of [RFC4944] defines the fragment header's datagram_size and datagram_offset values as the size and offset of the IPv6 datagram before compression. As a result, all fragment payload outside the first fragment must carry their respective portions of the IPv6 datagram before compression. This document does not change that requirement. When using the fragmentation mechanism described in Section 5.3 of [RFC4944], any header that cannot fit within the first fragment MUST NOT be compressed.

Problem statement

- Per-hop fragmentation and reassembly has 2 issues:
  - Latency:
    - Increases end-to-end latency as you need to wait for each fragment at each hop
  - Reliability:
    - Limited memory → limited number of buffers (1-2?) → packet dropped when new frag received and old not fully reassembled yet
    - No frag recovery: 1 frag loss == packet dropped
- Proposed solution:
  - Fragment forwarding:
    - Source fragments
    - Intermediate nodes relays
    - LBR reassembles

→ Creation in IETF101 of 6lo fragmentation DT

Drafts resulting from 6lo fragmentation DT



- draft-ietf-6lo-minimal-fragment
  - provides an overview of 6LoWPAN fragmentation
  - highlights limits of VRB
- draft-ietf-lwig-6lowpan-virtual-reassembly
  - details simple VRB implementation technique which results in fragment forwarding, but without fragment recovery
- draft-ietf-6lo-fragment-recovery
  - Defines a new protocol to do end-to-end ACK'ing and recover fragments

Status

- draft-ietf-6lo-minimal-fragment-01 posted 11 March 2019
- Informational

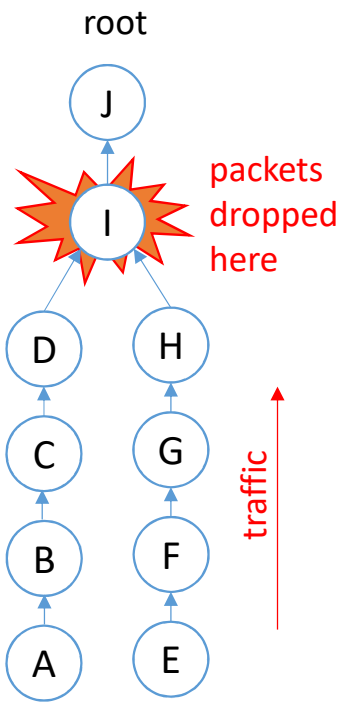
Table of Contents

Change in -01

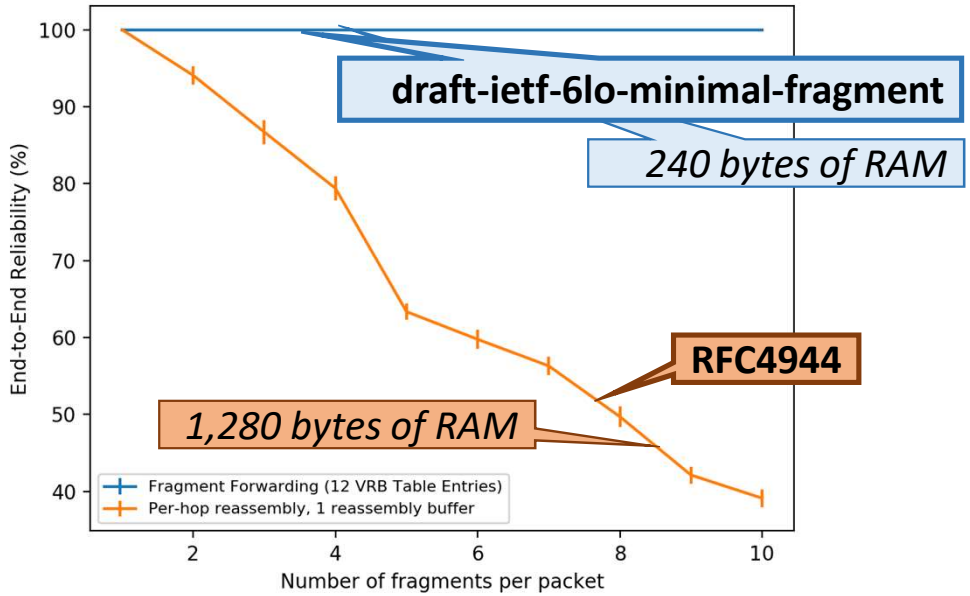
- Fixed typos
- Link to study:
  - Yasuyuki Tanaka, Pascale Minet, Thomas Watteyne, "6LoWPAN Fragment Forwarding", IEEE Communications Standards Magazine, 2019

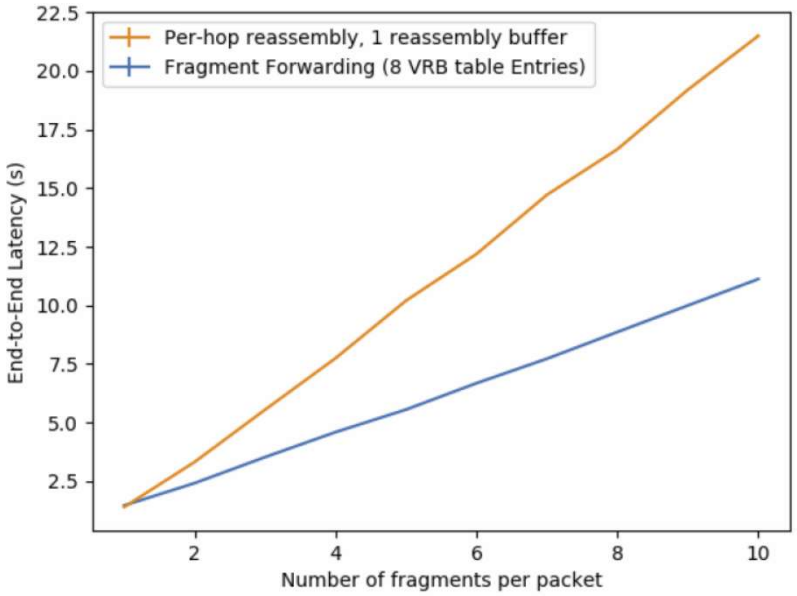
Simulation Study

Yasuyuki Tanaka



- Using 6TiSCH simulator (https://bitbucket.org/6tisch/simulator/src)
- topology shown on the left
- RFC8180 with 101 slot slotframe, sufficient bandwidth, no 6P, no RPL
- all nodes generate data pkPeriod = U[54s,66s]
- One data point = 100 runs
- 95% confidence intervals





Questions to the WG

- Ready for WGLC?

Backup: simulation settings

Table 1: Simulation parameters.

Parameter	Settings
TSCH slotframe length	101 slots
Slot duration	10 ms
Link reliability	100 %
Packet interval	Uniform in [54 s, 66 s]
Cell Allocation	Node A: 1 TX cell Node B: 2 TX cells and 1 RX cell Node C: 3 TX cells and 2 RX cells Node D: 4 TX cells and 3 RX cells Node E: 1 TX cell Node F: 2 TX cells and 1 RX cell Node G: 3 TX cells and 2 RX cells Node H: 4 TX cells and 3 RX cells Node I: 9 TX cells and 8 RX cell Node J: 9 RX cells
(per.hop reas.) # reassembly buffers	1 (1280 B of memory)
(frag. forwad.) # VRBs	8 (160 B of memory)
Num. fragment per packet	between 1 and 10
Number of simulation runs	100
Duration of one simulation run	7000 s