6lo Fragmentation DT

Announcement and Problem Statement

Thomas Watteyne (Chair)
Carsten Bormann
Rahul Jadhav
Gorry Fairhurst
Pascal Thubert
Gabriel Montenegro
Outline

• Per-hop reassembly solutions
  • RFC4944
  • RFC6282

• Problem statement

• Fragment forwarding solutions
  • Carsten’s book
  • draft-bormann-lwig-6lowpan-virtual-reassembly-00
  • draft-watteyne-6lo-minimal-fragment (unpublished)
  • draft-thubert-6lo-forwarding-fragments-08

• Use cases and open discussion
RFC4944

• Link-layer fragmentation only in route-over → reassembly at each hop
• Fragment header
  • Fragment header
  • Reassembly timer:
    • Starts when node receives first fragment
    • Timeout value MUST be <60s
    • When times out, buffer cleared, packet dropped
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 $\rightarrow$ limited number of buffers (1-2?) $\rightarrow$ 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
2.5.2 L3 routing ("Route-Over")

Layer-3 Route-Over forwarding is illustrated in Figure 2.6. In contrast to layer-2 mesh forwarding, layer-3 Route-Over forwarding does not require any special support from the adaptation layer format. Before the layer-3 forwarding engine sees the packet, the adaptation layer has done its work and decapsulated the packet – at least conceptually (implementations may be able to perform some optimizations by keeping the encapsulated form if they know how to rewrite it into the proper encapsulated form for the next layer-3 hop).

Note that this in particular means that fragmentation and reassembly are performed at each hop in Route-Over forwarding – it is hard to imagine otherwise, as the layer-3 addresses are part of the initial bytes of the IPv6 header, which is present only in the first fragment of a larger packet. Again, implementations may be able to optimize this process by keeping virtual reassembly buffers that remember just the IPv6 header including the relevant addresses (and the contents of any fragments that arrived out of order before the addresses).

→ being published as a combination of draft-bormann-lwig-6lowpan-virtual-reassembly-00 and draft-watteyne-6lo-minimal-fragment (WIP)
→ being simulated by Yatch on the 6TiSCH simulator
Has experienced congestion at one of the hops

Locally unique label, swapped at each hop

ACK requested by source

ACK travels reverse LSP

Fragment recovery

bitmap in RFRAG-ACK, one bit per fragment

Flow control capabilities

Different size per frag

Fragment forwarding

ACK requested by source for any fragment

ACK travels reverse LSP

ACK requested by source for any fragment

ACK travels reverse LSP

Fragment recovery

bitmap in RFRAG-ACK, one bit per fragment

Flow control capabilities

Different size per frag

Index of fragment

Bytes (frags can have different sizes)

or size of packet when seq=0

or abort is seq>0 and offset=0

Locally unique and swapped
6lo Frag. DT – Problem Statement (Proposal)

• Produce 2 documents (to be submitted to 6lo WG):
  • informational document
    • summarize fragmentation as standardized now
    • describes Carsten's virtual reassembly buffer implementation
    • discusses its limits
  • standards-track document
    • builds upon the first one
    • adds fragment recovery
    • *(can either be a replacement of draft-thubert-6lo-forwarding-fragments, or a rework)*

• Philosophy
  • keep activity as swift as possible
  • ideally close the DT after London
  • small DT, but regular information to WGs