Tunnel Fragmentation

IETF94 Intarea Working Group

November 5, 2015
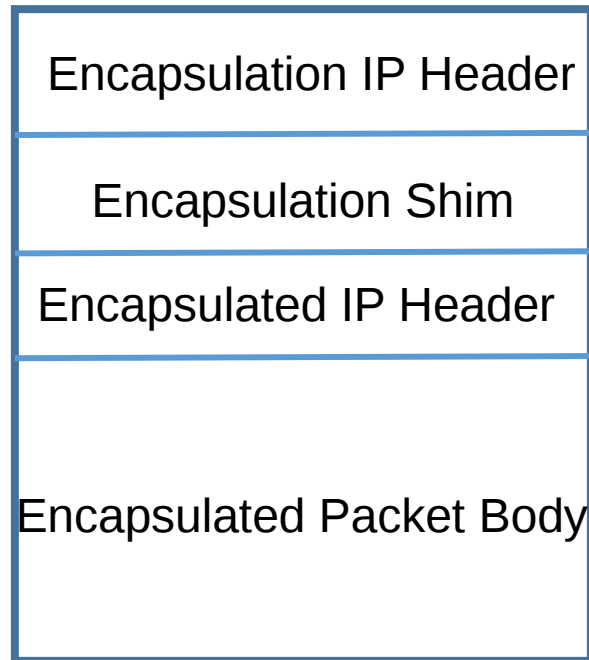
Fred L. Templin (fred.l.templin@boeing.com)

https://datatracker.ietf.org/doc/draft-templin-intarea-grefrag/

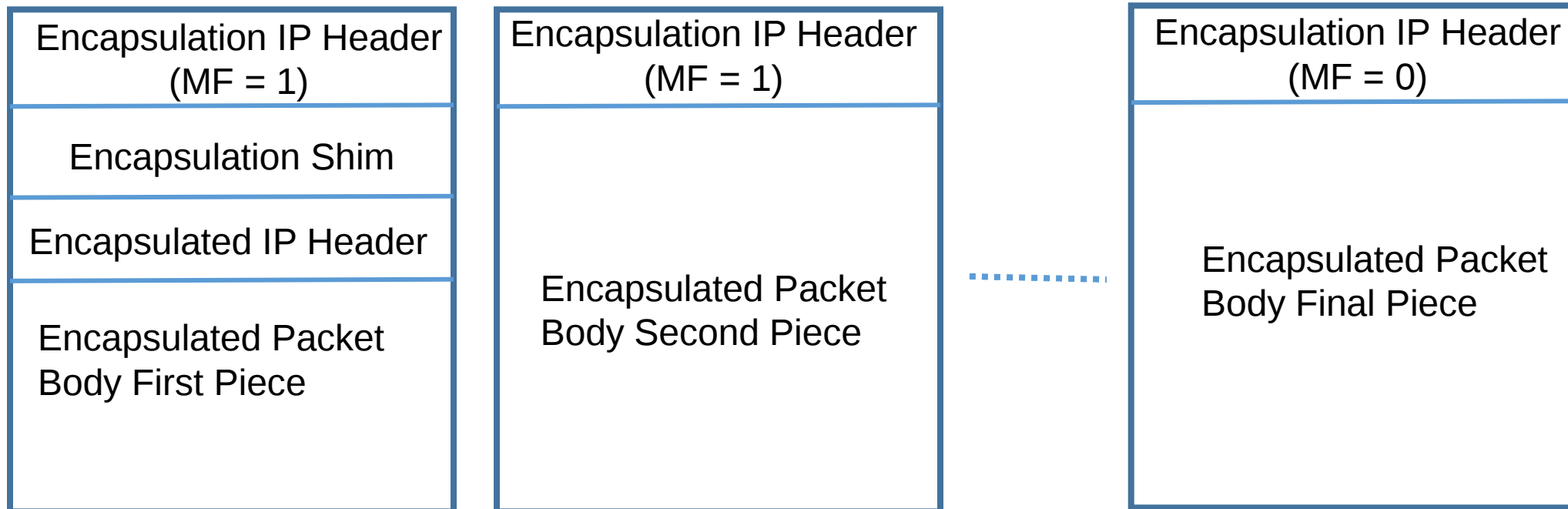https://datatracker.ietf.org/doc/draft-herbert-gue-fragmentation/

Fragmenting Tunneled Packets

- Tunneled packet consists of an encapsulation IP header, followed by an encapsulation shim, followed by an encapsulated IP packet:

Encapsulation IP Header
Encapsulation Shim
Encapsulated IP Header
Encapsulated Packet Body

- **Fragmentation sometimes unavoidable**

Fragmentation Alternative 1: Fragment Encapsulation Packet

- Break encapsulation packet into N pieces
- Append an identical IP header at the beginning of each piece
- All fragments except the final fragment have MF=1

Encapsulation IP Header (MF = 1)
Encapsulation Shim
Encapsulated IP Header
Encapsulated Packet Body First Piece

Encapsulation IP Header (MF = 1)
Encapsulated Packet Body Second Piece

....

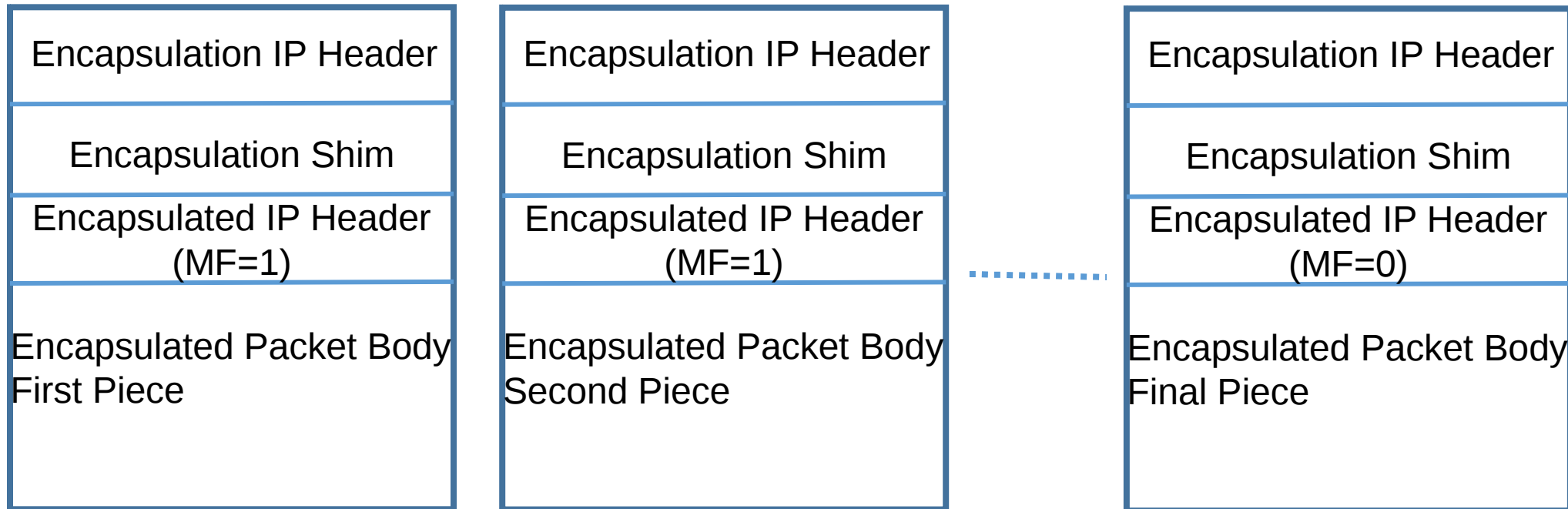| Encapsulation IP Header (MF = 0) |
| --- |
| Encapsulated Packet Body Final Piece |

Alternative 1 Issues

- IPv4 Identification field is only 16 bits – means that ID value could wrap around and cause fragment misassociations even at moderate data rates (RFC4963; RFC6864) - NAT makes IPv4 Identification misassocaitions even worse

- IPv6 fragmentation is an IPv6 extension header, and some paths unconditionally drop packets with IPv6 extension headers

- **For both IPv4 and IPv6, minimum reassembly buffer sizes are too small to support reassembly of an encapsulated packet that contains a 1500 byte payload**

Fragmentation Alternative 2: Fragment Encapsulated Packet

- Break encapsulated packet into N pieces
- Append an identical IP header at the beginning of each piece
- Encapsulate each fragment in an Encapsulation IP header plus shim
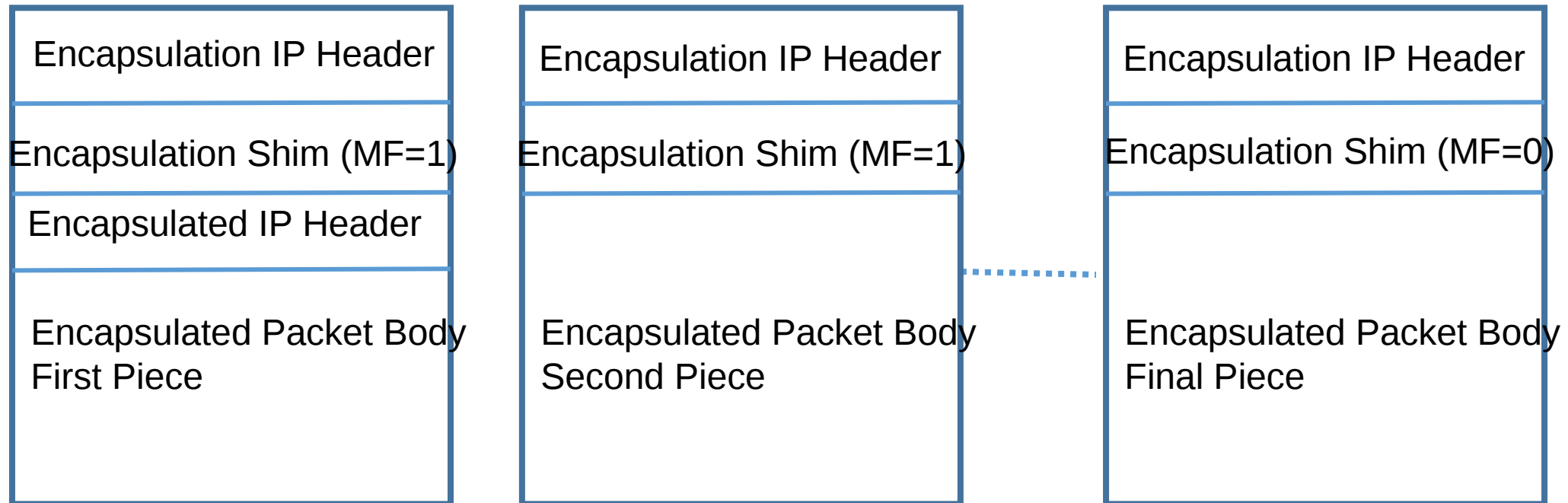
Encapsulation IP Header
Encapsulation Shim
Encapsulated IP Header (MF=1)
Encapsulated Packet Body First Piece

Encapsulation IP Header
Encapsulation Shim
Encapsulated IP Header (MF=1)
Encapsulated Packet Body Second Piece

. . . .

Encapsulation IP Header
Encapsulation Shim
Encapsulated IP Header (MF=0)
Encapsulated Packet Body Final Piece

Alternative 2 Issues

- Only available for encapsulated IPv4 packets, since IPv6 does not allow in-the-network fragmentation

Fragmentation Alternative 3: **Tunnel Fragmentation**

– Break encapsulated packet into N pieces
– Encapsulate each fragment in an Encapsulation IP header plus shim
– **Shim header has Identification, MF values**

Encapsulation IP Header	Encapsulation IP Header	Encapsulation IP Header
Encapsulation Shim (MF=1)	Encapsulation Shim (MF=1)	Encapsulation Shim (MF=0)
Encapsulated IP Header		
Encapsulated Packet Body First Piece	Encapsulated Packet Body Second Piece	Encapsulated Packet Body Final Piece

Alternative 3 Characteristics

- Avoids all issues identified for Alternatives 1 and 2
- Allows specification of a minimum reassembly buffer large enough to reassemble a 1500 byte encapsulated packet

Tunnel Fragmentation References

- First proposed in RFC2764
- Proposed Tunnel Fragmentation Extension for GRE:
  - https://datatracker.ietf.org/doc/draft-templin-intarea-grefrag/
- Proposed Tunnel Fragmentation Extension for GUE:
  - https://datatracker.ietf.org/doc/draft-herbert-gue-fragmentation/