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Gap Analysis of IPv6 Multicast Source Routing (MSR6) draft-li-spring-ipv6-msr-gap-analysis-00

Abstract

This document analyses the gaps of the existing IPv6 multicast solutions under discussion in IETF based on the requirements.

Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

Status of This Memo

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Table of Contents

1. Introduction

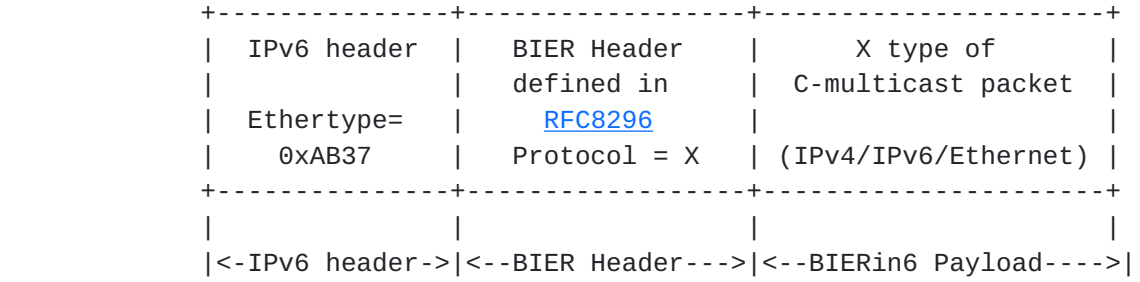
Multicast could provide efficient P2MP service without bandwidth waste. The increasing amount of live video traffic in the network bring new requirements for multicast solutions. The existing multicast solutions request multicast tree-building on control plane and maintaining end-to-end tree state per flow, which impacts router state capacity and network convergence time. There has been a lot of work in IETF to simplify service deployment, in which Source Routing is a very important technology, including SRv6, BIER, etc. Source routing is able to reduce the state of intermediate nodes and indicate multicast forwarding in the ingress nodes, which could simplify multicast deployment. Source routing requires sufficient flexibility on the forwarding plane and IPv6 has the advantage with good scalability. Therefore, it is important to simplify multicast deployment and meet high quality service requirements with IPv6 Source Routing based multicast.

Based on the design consideration defined in [I-D.cheng-spring-ipv6-msr-design-consideration], this document analyses the gaps of the existing IPv6 multicast solutions under discussion in IETF. The definition of the new IPv6 multicast source routing solution is out of the scope of this document.

2. Gap Analysis

2.1. BIERin6

ipThe solution described in [I-D.zhang-bier-bierin6] is called BIERin6. The encapsulation of BIERin6 is as follows:



BIERin6 proposes to encapsulate the IPv6 header before the BIER header in order to transit the BIER header through IPv6 nodes by adding IPv6 header between BIER forwarding nodes. The "next header" codepoint of the IPv6 header is set to the value that means that "the next header is non-MPLS BIER".

BIERin6 implements P2MP forwarding follows the BIER architecture defined in [RFC8279].

There are some issues to be considered with the classic Layered architecture of BIER used by BIERin6 in supporting IPv6 Multicast Source Routing:

1. Support non-native IPv6 scenarios : In BIERin6, IPv6 is only used as the transport tunnel to transit the IPv4 domain. In fact this method can also be used in the IPv4 to traverse the IPv4 domain. Moreover the service layer above the transport tunnel can be non-IPv6. For example, in BIERin6 MVPN could use MPLS label for VPN identification. Unlike BIERin6, IPv6 Multicast Source Routing is supposed to be a native IPv6 solution.

2. Architecture Considerations:

1) When the BIER layer is treated as an independent layer to support features mentioned in section 2, the new encapsulation for fragment, security, network slicing, DetNet, IOAM has to be defined in the BIER layer. Moreover, this will also cause redundancy and conflicts when BIER is used with IPv6 layer or MPLS layer since the encapsulations for these functionalities are also defined for the IPv6 layer and MPLS layer;

2) When the BIER encapsulation is treated as a separate layer and the rest of the functionalities are realized in the IPv6 layer, it also causes problems. For example, if encryption is supported in the IPv6 data plane, it makes the contents of the BIER layer encrypted and unprocessable; if IOAM and RH are supported in the IPv6 data plane which cause the more overhead, it would make it difficult to get information on the BIER layer and has much effect on the forwarding performance. In addition, if IOAM is engaged, this leads to information loss when IPv6 encapsulation is switched in the middle nodes and cannot be implemented end-to-end.

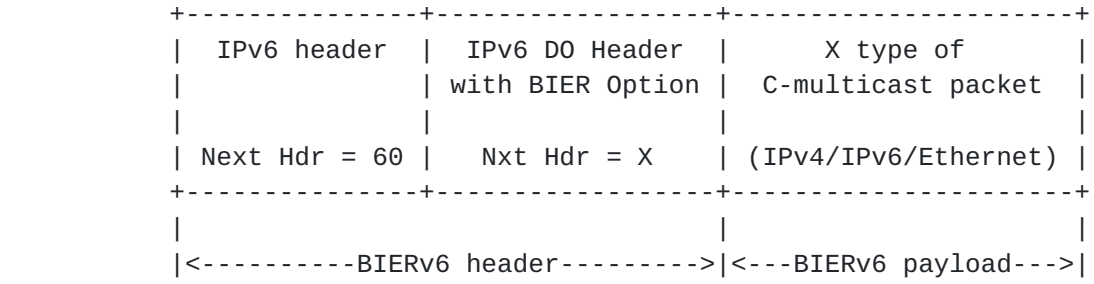
3. BIERin6 is hard to complete end-to-end service to support host initiating source routing. If BIERin6 is used in the host, the source address information can be lost in the middle nodes. Moreover, the BIER layer as an independent network layer above IPv6, just as TCP or UDP, will cause conflictions with the transport layer, and have more impact on the Internet architecture.

4. Maintenance of tunnel state: BIERin6 needs to maintain the state of the tunnel in the middle nodes when traversing IPv6 domains, which adds complexity to service deployment. When new functionalities mentioned in the sectioned such as network slicing, Detnet,IOAM,etc. are applied when traverse the IPv6 domains, it will cause more complexity in service provisioning and more network state maintenance.

5. Based on existing functionalities, MPVPN/TE/Fragmentation/ESP need be supported by BIERin6.

2.2. BIERv6

The solution described in [I-D.xie-bier-ipv6-encapsulation] is called BIERv6. The encapsulation of BIERv6 is as follows:



BIERv6 proposes to define a new type of destination options header for BIER. The destination address of the IPv6 header indicates the BIER forwarding nodes and changed to the next BIER forwarding nodes based on the result of BIER forwarding table lookup.

BIERv6 implements P2MP forwarding follows the BIER architecture defined in [RFC8279].

BIERv6 uses Native IPv6 extention header to carry BIER info. And BIERv6 could support MVPN by defining MVPN indication in source address of the outer IPv6 header, which doesn't change along the P2MP tunnel. The MVPN mechanism for BIERv6 is defined in [I-D.xie-bier-ipv6-mvpn]. BIERv6 is able to directly reuse the new functionalities supported by IPv6 and SRv6 without the problems associated with Layered Architecture. In addition, BIERv6 uses Native IPv6 and can be started directly at the Host without conflicts with the transport layer.

BIERv6 has the following challenges:

1. Non-MPLS BIER header defined in [RFC8296] is used, but the BIER header is designed as a separate layer, leaving some fields unused and redundant in IPv6.

2. BIERv6 needs to support MVPN and Traffic Engineering.

2.3. Historical Review

In the field of IPv6 unicast source routing, there has been SR over IP([RFC8663]) and SRv6. SR over IP takes the layered architecture while SRv6 adopts native IPv6 design. Both solutions has different application scenarios though there is the common functionality to traverse IPv6 domain. SR over IP controls the scope to support more new functionalities in the IPv6 data plane. SRv6 is being developed combing with the new functionalities based on the IPv6 extension.

3. Summary

MSR6 is supposed to have:

- Native IPv6 design to reduce header layers and enable unified processing

- Reuse existing IPv6 capabilities and SRv6 capabilities for multicast

- BIER is able to implement network programming at the ingress nodes in Best Effort scenarios. MSR6 needs to take advantage of the capabilities in the existing BIER mechanism

- MVPN and Traffic Engineering support are requested

The existing multicast solutions have their own limitations which constrains the deployment and development of multicast. New multicast solution is expected in IETF.

4. IANA Considerations

This document makes no request of IANA.

5. Security Considerations

TBD

6. Acknowledgements

TBD

7. Normative References

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