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Path Autogeneration in BIER  
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Abstract

[I-D.ietf-bier-architecture] BIER introduces a method for multicast flow forwarding, without storing states in every node along the multicast path. This document introduces a method of establishing multicast path automatically.

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## 1. Introduction

[I-D.ietf-bier-architecture] BIER is a technology of multicast flow forwarding. [I-D.ietf-bier-mpls-encapsulation] introduces a way to use mpls in BIER forwarding. This document introduces a method of establishing multicast path automatically.

Upstream-assigned label is used in this document. Associate with the label indicated the BFIR, the two labels compose the keywords for multicast flow forwarding. Every node along the multicast path used the two labels to forward multicast flow without label changing. Obviously, the nodes along the path establish the mpls forwarding table, when they receive the packet which include the label combination and the path specification.

BFIR sends the first packet with label combination and path specification, every node along the path build the mpls forwarding table, and forward the packet to next node according to the path specification. If there is already one mpls forwarding item which has the same label combination, the node combines the next-hop in the packet to the existed forwarding item.

## 2. Packet Formats

This document introduces a new TLV that is carried by the BIER packet, and this TLV is composed by the nodes in the multicast path. There is a flag in the BIER header indicates that a path TLV is be carried. One of the reserved flag may be used to signal this.

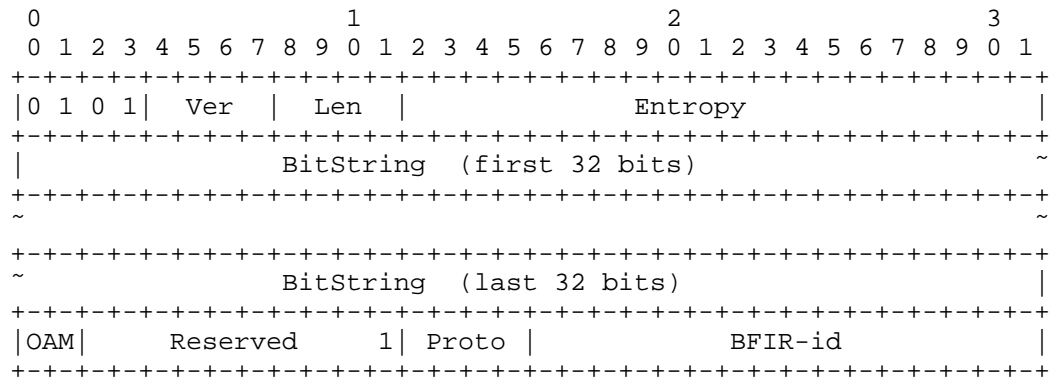


Figure 1 BIER Header

### 2.1. Node function

The path list is composed by nodes along the multicast path. The multicast path is decided by BFIR in advance through PCE or other calculations or configurations.

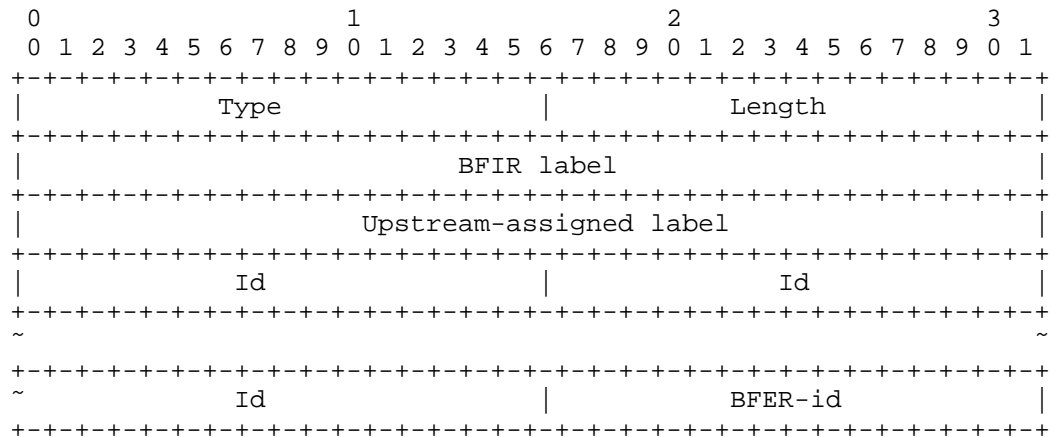


Figure 2 Path Specification

- o Type TBD, indicate that there is a path TLV.
- o Length The length of the TLV.
- o BFIR label The label of BFIR.
- o Upstream-assigned label The label that is assigned by BFIR for the specific multicast flow.

- o Id The node BFR-id or the link id along the multicast path. They are carried by the packets in order.
- o BFER-id The BFR-id of BFER.

Like the ingress replication, BFIR repeats BIER packets several times according to every BFER of the multicast flow. And then BFIR sends the BIER packets with the two labels.

The withdraw packet is the same format with the path packet. But the type should be another type, and the last node that is carried by the withdraw packet is the canceled node.

## 2.2. TE function

Also, the method of path auto-generation can be used in BIER-TE forwarding.

The format of TLV that is carried by BIER header is same as the previous section. And the difference is that the BitString is BIER-TE forwarding BitString. The packet is forwarding by the BIER-TE Forwarding Table.

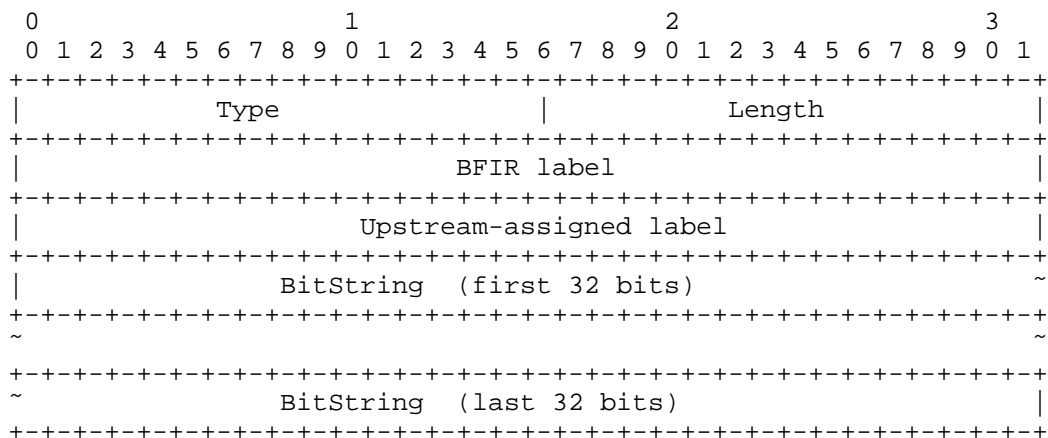


Figure 3 TE path specification

- o Type TBD, indicate that there is a TE path TLV.
- o Length The length of the TLV.
- o BFIR label The label of BFIR.
- o Upstream-assigned label The label that is assigned by BFIR for the specific multicast flow.

- o BitString The adjacency of TE path, and it is the same as the BitString in the BIER header.

When the multicast flow travels the BIER-TE path by BIER-TE forwarding, the two level labels also can be established in every BFER. If some adjacency should be withdrawn from the path, the type will be another type of TE path withdraw TLV.

### 3. Procedures

#### 3.1. Node procedure

##### 3.1.1. Sending the path packets

When BFIR gains the BFER information of a specific multicast flow, BFIR encapsulates the receiving flow with the path list, and sends to every BFER individually. Particularly, the encapsulated packet that is sent by BFIR includes the label combination.

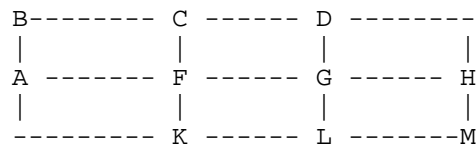


Figure4 An Example

For example, in figure 3, A is BFIR for a specific multicast flow. And D, H, M is BFER. According the PCE calculation, the multicast flow should be sent along these paths: A-F-G-D/H, A-K-L-M. So A encapsulates the flow with the two label combination and makes three copies, and then sends to D/H/M separately. In node A, there is one mpls label forwarding item which the ingress label is the two labels combination, and the next-hops are F and K with the same two labels out. A encapsulates the formal multicast flow with the two labels and forwards to next hops.

For the stability consideration, BFIR sends the path packets every once in a while. The interval may be 30 minutes. And when new BFER joined, BFIR sends the path packets to the new BFER immediately.

##### 3.1.2. Withdraw Nodes

According to the PCE calculation, some existed nodes in the path may be canceled. BFIR sends the withdraw path packet which the last node is the canceled node.

For example in figure 1, if the bandwidth in the network is changed, the multicast flow should be forwarded along these ways: A-B-C-D-H,

A-K-L-M. The specific multicast flow will not pass by the node F and G anymore. Except A sending a new path packet along the path A-B-C-D-H, A also sends two withdraw path packets to node F and G.

### 3.1.3. BFR and BFER

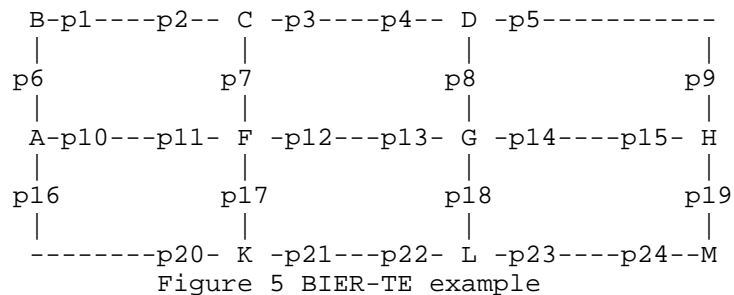
When BFR and BFER receive the path packets, they build an item in the mpls forwarding table according to the label combination that is carried by the packets. If there is an item already in the forwarding table, the nodes should add the next-hop which is the next node in the path packet.

When BFR and BFER receive the withdraw path packets which indicate that they should be canceled, the BFR and BFER delete the mpls forwarding item which line with the label combination. If the middle node finds that the next node that along the path is the canceled node, the middle node deletes the next-hop in the mpls forwarding item. If there is no next-hop in the mpls forwarding item, the node deletes the mpls item in the mpls forwarding table.

## 3.2. BIER-TE procedure

### 3.2.1. Sending the path packets

When BFIR gains the BFER information of a specific multicast flow, and BFIR knows all the adjacencies that the flow should travel, BFIR encapsulates the receiving flow with the BIER-TE adjacencies, and sends to BIER domain. If there are several SI should be encapsulated, the flow will be encapsulated by different BitString several times.



For example, in figure 4, A is BFIR for a specific multicast flow. And D, H, M is BFER. According the PCE calculation, the multicast flow should be sent along these paths: A-F-G-D/H, A-K-L-M. The BitPositions in BitString are p8, p10, p12, p14, p16, p21, p23. A encapsulates the flow with the two label combination and the BIER-TE BitString.

Like the node function, when the packet goes through the path of BIER-TE, every BFR establishes the label forwarding item.

### 3.2.2. Withdraw BIER-TE adjacencies

If some adjacencies in the existed path should be withdraw, the ingress node send the packet with withdraw type of TLV. The BitString in BIER header is previous TE path adjacency, and the BitString in the TLV is composed of withdraw adjacencies. When BFR receives the packet, BFR will withdraw the associated adjacencies itself.

## 4. Security Considerations

There should be some common security methods to guarantee the validation of path packets.

## 5. IANA considerations

IANA is requested to allocate four types in TLVs of BIER path packets. Two for node function and two for TE function.

## 6. Normative References

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